JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA
KAKINADA – 533 003, Andhra Pradesh, India

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

COURSE STRUCTURE & SYLLABUS for

M.Tech EEE Common for CONTROL SYSTEMS (CS) & CONTROL ENGINEERING (CE) Programme

(Applicable for batches admitted from 2019-2020)

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY KAKINADA

COURSE STRUCTURE

I-Semester

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1		PC	Advanced Control Theory		3	0	0	3	100
2		PC	Advanced Digital Control Systems		3	0	0	3	100
3		PE	Elective-I i. Computer Controlled Systems ii. Control of Special Machines iii. System and Parameter Identification		3	0	0	3	100
4		PE	Elective-II i. Optimization Techniques ii. Micro Controllers& Applications iii. Stochastic Estimation and Control		3	0	0	3	100
5			Research Methodology and IPR		2	0	0	2	100
6			Control System Simulation Laboratory		0	0	4	2	100
7			Control Systems Laboratory		0	0	4	2	100
8			Audit Course – I		2	0	0	0	100
					16	0	8	18	800

II Semester

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1		PC	Non-Linear Systems Analysis		3	0	0	3	100
2		PC	Optimal Control Theory		3	0	0	3	100
3		PE	Elective-III i. Digital Signal Processing ii. Robotics and Control iii. Large scale systems		3	0	0	3	100
4		PE	Elective-IV i. Process Control and Automation ii. Decision and Estimation Theory iii. Embedded Computer Control.		3	0	0	3	100
5			Advanced Control System Simulation Laboratory		0	0	4	2	100
6			Advanced Control System Laboratory		0	0	4	2	100
7			Mini Project with Seminar		0	0	4	2	100
8			Audit Course – II		2	0	0	0	100
					14	0	12	18	800

III- Semester

S.No	Course No	Category	Course Name	P.Os	L	T	P	C	Marks
1		PE	Program Elective –V i. Adaptive Control Theory ii. Evolutionary Algorithms and Applications ii. Artificial Intelligent Techniques		3	0	0	3	100
2		OE	Open Elective i. Business Analytics ii. Industrial Safety ii. Cost Management of Engineering Projects		3	0	0	3	100
3			Dissertation Phase - I **(to be continued and evaluated next semester)**		0	0	20	10	---
					6	0	20	16	200

IV- Semester

S.No	Course No	Category	Course Name	T	P	C	Marks
1			Dissertation Phase-II **(continued from III semester)**	0	32	16	100
				0	32	16	100

Audit course 1 & 2

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.

I SEMESTER	ADVANCED CONTROL THEORY (Common to CS & CE)	category	L-T-P 3-0-0	Credits 3

Pre-requisite: Control Systems

Course Educational Objectives:

- To present state models in various forms.
- To learn the concept of controllability and Observability of LTI systems.
- To discuss and learn the design concepts for feedback controller and observers.

Unit I

Introductory matrix algebra and linear vector space, State space representation of systems.Linearization of a non - linear system.Solution of state equations. Evaluation of State Transition Matrix (STM) - Simulation of state equation using MATLAB/ SIMULINK program.

Unit II

Similarity transformation and invariance of system properties due to similarity transformations. Minimal realization of SISO, SIMO, MISO transfer functions. Discretization of a continuous time state space model.Conversion of state space model to transfer function model using Fadeeva algorithm.

Unit III

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

Unit IV

Linear Quadratic Regulator (LQR) problem and solution of algebraic Riccati equation using eigenvalue and eigen vector methods, iterative method. Controller design using output feedback.Internal stability of a system.Stability in the sense of Lyapunov, asymptotic stability of linear time invariant continuous and discrete time systems. Solution of Lyapunov type equation.

Unit V

Duality between controllability and observability - Full order Observer based controller design. Reduced order observer design. Model decomposition and decoupling by state feedback. Disturbance rejection, sensitivity and complementary sensitivity functions. Design of full order observer using Ackermann's formula - Bass Gura algorithm.

Course Outcomes:

Aftercompletion of this coursethe students will be:

- Able to apply matrix algebra to develop various forms of state models.
- Able to develop and analyze physical systems.
- Able to analyze state models.
- Able to design state feedback controller and observer.

Reference Books:

1. K. Ogata, Modern Control Engineering, Prentice Hall, India 1997
2. T. Kailath, T.,Linear Systems, Perntice Hall, Englewood Cliffs, NJ, 1980.
3. N. K. Sinha , Control Systems, New Age International, 3rd edition, 2005**.**
4. Panos J Antsaklis, and Anthony N. Michel, Linear Systems, New - age international (P) LTD. Publishers, 2009.
5. John J D'Azzo and C. H. Houpis , "Linear Control System Analysis and Design Conventional and Modern", McGraw - Hill Book Company, 1988.
6. B.N. Dutta, Numerical Methods for linear Control Systems - , Elsevier Publication, 2007.
7. C.T.Chen Linear System Theory and Design - PHI, India.
8. Richard C. Dorf and Robert H. Bishop, Modern Control Systems, 11th Edition, Pearson Edu, India, 2009.

I SEMESTER	ADVANCED DIGITAL CONTROL SYSTEMS (Common to CS & CE)	Category	L-T-P 3-0-0	Credits 3

Pre-requisite: Signals & Systems and Control Systems

Course Educational Objectives:

- To familiarize mathematical analysis of digital control systems.
- To introduce state feedback controllers and observers for digital control systems.
- To understand state estimation and state observer design methodology of single output and multi output systems.

UNIT I

Overview of modern digital control theories, Z- and inverse Z-transformation and properties, Discrete-time systems and difference equations, Sampling and reconstruction (A/D and D/A conversions), Z- and S-plane correspondence and stability test, Analysis of sampled data systems.

UNIT II

Discrete-time state equations, Sampled continuous-time systems, Canonical forms, transformation to controllable, observable and diagonal forms, Controllability and Observability.

UNIT III

State determination and control, State feedback and eigenvalue placement of single input systems, State feedback and eigenvalue placement of multi-Input systems, Quadratic optimal control, Digital tracking systems.

UNIT IV

State estimation, State observer design for single out-put systems, State observer design for multi-output systems, System Identification.

UNIT V

Digitizing analog controllers, Designing between-sample response, Digital hardware control, Actuators limitation.

Course Outcomes:

Aftercompletion ofthis coursethe students will be able to

- Analyze digital control theories using Z transform methods.
- Understand the stability criteria of discrete time systems.
- Obtain various state space models of discrete- time systems and verify controllability and observabilty.
- Design state observer for single output and multi output systems.
- Design digital hardware controller.

Reference Books:

1. Ms. Santina, A.R.Stuberud&G.H.Hostetter, Digital Control Systems Design, Oxford Univ Press, 2nd edition.
2. B.C Kuo, Digital Control Systems, 2nd Edition, Oxford Univ Press, Inc., 1992.
3. F. Franklin, J.D. Powell, and M.L. Workman, Digital control of Dynamic Systems, Addison - Wesley Longman, Inc., Menlo Park, CA , 1998.
4. Gopal, Digital Control and State Variable Methods, Tata McGraw Hill, India, 1997.
5. C. H. Houpis and G.B. Lamont, Digital Control Systems, McGraw Hill, 1985.
6. John S. Baey, Fundamentals of Linear State Space Systems, McGraw – Hill, 1st edition
7. Bernard Fried Land, Control System Design, McGraw – Hill, 1st edition
8. Dorsay, Continuous and Discrete Control Systems, McGraw - Hill.

I SEMESTER	COMPUTER CONTROLLED SYSTEMS (Common to CS & CE) (Elective-I)	CATEGORY	L-T-P 3-0-0	Credits 3

Pre-requisite: Digital Systems and computer organization

Course Educational Objectives:

- To apply H^2/H^∞ theory and robustness theory
- To construct ladder diagrams
- To develop the methodologies for programming and procedures using PLC
- To apply SCADA concepts for supervision and control
- To apply real time concepts, direct digital control and distributed control

Unit I

Multivariable control:Basic expressions for MIMO systems, Singular values, Stability norms, Calculation of system norms, Robustness, Robust stability. H^2 / H^∞ Theory: Solution for design using H^2 / H^∞, Case studies, Interaction and decoupling, Relative gain analysis, Effects of interaction, Response to disturbances, Decoupling, Introduction to batch process control.

Unit II

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

Unit IV

SCADA: Introduction, SCADA Architecture, Different Communication Protocols, Common System Components, Supervision and Control, HMI, RTU and Supervisory Stations, Trends in SCADA, Security Issues

Unit V

Real time systems- Real time specifications and design techniques- Real time kernels- Inter task communication and synchronization- Real time memory management- Supervisory control- direct digital control- Distributed control- PC based automation.

Course Outcomes: After completion of this course the students will be able

- To apply H^2/H^∞ theory and robustness theory
- To construct ladder diagrams
- To develop the methodologies for programming and procedures using PLC
- To apply SCADA concepts for supervision and control
- To apply real time concepts, direct digital control and distributed control

Reference Books:

1. Shinskey F.G., Process control systems: application, Design and Tuning, McGraw Hill International Edition ,Singapore,1988.
2. Be.langer P.R., Control Engineering: A Modern Approach, Saunders College Publishing , USA, 1995.
3. Dorf, R.C. and Bishop R. T., Modern Control Systems, Addison Wesley Longman Inc., 1999
4. Laplante P.A., Real Time Systems: An Engineer's Handbook, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
5. Stuart A. Boyer: SCADA-Supervisory Control and Data Acquisition, Instrument Society of America Publications,USA,1999
6. EfimRosenwasser, Bernhard P. Lampe, Multivariable computer-controlled systems: a transfer function approach, Springer, 2006
7. Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI
8. Programmable Logic Controllers – Programming Method and Applications by J.R.Hackworth and F.D Hackworth Jr. – Pearson, 2004.

I SEMESTER	CONTROL OF SPECIAL MACHINES (Common to CS & CE) (Elective-I)	CATEGORY	L-T-P 3-0-0	Credits 3

Pre-requisite: Electrical Machines

Course Educational Objectives:

- To apply different modes of excitation and control on open and closed loop
- To apply the control techniques of switched reluctance motors and PMSM
- To understand the different control schemes of special machines.
- To analyze the characteristics of different types of PM type Brushless DC motors and to design suitable controllers
- To apply DCLM and LIM
- To apply microprocessor for control of servomotors

Unit I

Stepper Motors:Constructional features, Principle of operation, Modes of excitation torque production in Variable Reluctance (VR) stepping motor. Dynamic characteristics, Drive systems and circuit for open loop control, closed loop control of stepping motor.

Unit II

Switched Reluctance Motors: Constructional features, Principle of operation. Torque equation, Characteristics, Control Techniques, DriveConcept. Permanent Magnet Synchronous Motors: Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self-control, Vector control, Current control Schemes.

Unit III

Permanent Magnet Brushless DC Motors: Commutation in DC motors, Difference between mechanical and electronic commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square wave permanent magnet brushless motor drives, Torque and emf equation, Torque-speed characteristics, Controllers-Microprocessors based controller.

Unit IV

Servomotors: Types, Constructional features, Principle of Operation, Characteristics, Control,– Microprocessor based applications. AC Tachometers: Schematic diagram, Operating principle, numerical problems

Unit V

Linear Motors: Linear Induction Motor (LIM) Classification, Construction, Principle of operation, Concept of Current sheet, Goodness factor, DC Linear Motor (DCLM) types, Circuit equation, DCLM control, applications.

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

- Apply different modes of excitation and control on open and closed loop
- Apply the control techniques of switched reluctance motors and PMSM
- To understand the different control schemes of special machines.
- Analyze the characteristics of different types of PM type Brushless DC motors and to design suitable controllers
- Apply DCLM and LIM
- Apply microprocessor for control of servomotors

Reference Books:

1. Miller, T.J.E. “Brushless Permanent Magnet and Reluctance Motor Drives”, Clarendon Press, Oxford, 1989.
2. Kenjo, T, “Stepping Motors and their Microprocessor control”, Clarendon Press, Oxford, 1989.
3. Naser A and Boldea I, “Linear Electric Motors: Theory, Design and Practical Application”, Prentice Hall Inc., New Jersey,1987.
4. Floyd E Saner,”Servo Motor Applications”, Pittman USA, 1993.
5. Kenjo, T and Naganori, S “Permanent Magnet and brushless DC motors”, Clarendon Press, Oxford, 1989.
6.Generalized Theory of Electrical Machines – P.S.Bimbra, Khanna publications-5th edition-1995.

I SEMESTER	SYSTEM AND PARAMETER IDENTIFICATION (Common to CS & CE) (Elective-I)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Control Systems

Course Educational Objectives:

- To apply the identification problem
- To apply impulse response identification methods
- To apply least squares, instrumental variable and recursive methods
- To develop state estimation using Kalman filters and extended Kalman filters
- To identify different mathematical models for state and parameter estimation

Unit I Introduction:

System models and model classification, Identification problem, some fields of applications.

Unit-II Classical models:

Time response and frequency response methods of transfer function evolution, Impulse response identification using cross correlation test and orthogonal series expansion, methods of convolution, model learning technique.

Unit-III Least square Method:

Least square estimates and its properties, non-recursive least square identification of dynamic system, extensions such as generalized least square repeated least square and instrumental variable method. Recurse Methods: Recursive least square, minimum variance algorithms, stochastic approximation method, maximum likelihood method.

Unit IV Identification of state variable models:

State Estimation using Kalman and extended Kalman filter, simultaneous state and parameter estimation of linear systems.

Unit V Non-Linear systems identification:

Identification of a volterra series models, identification of non-linear state models using extended Kalman filter, quasi-linearization method, invariant imbedding, gradient method, Numerical identification through model following approach.

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

- To apply the identification problem
- To apply impulse response identification methods
- To apply least squares, instrumental variable and recursive methods
- Develop state estimation using Kalman filters and extended kalman filters
- Identify different mathematical models for state and parameter estimation.

Reference Books:

1. J.M.Mendel, 'Discrete Techniques Of Parameter Estimation', Marcel Dekker, 1973.
2.F.Eykhoff, 'System Identification, Parameter and State Estimation, John Willey, 1974.
3. A.P.Sage and J.L.Melsa, 'System Identification', Academic press, 1971.

I-SEMESTER	OPTIMIZATION TECHNIQUES (Common to CS & CE) (Elective-II)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Concepts of engineering mathematics and mathematical methods.

Course Educational Objectives:

- To define an objective function and constraint functions in terms of design variables, and then state the optimization problem.
- To state single variable and multi variable optimization problems, without and with constraints.
- To explain linear programming technique to an optimization problem, define slack and surplus variables, by using Simplex method.
- To study and explain nonlinear programming techniques, unconstrained or constrained, and define exterior and interior penalty functions for optimization problems.
- To introduce evolutionary programming techniques.
- To introduce basic principles of Genetic Algorithms and Partial Swarm Optimization methods.

UNIT – I:

Introduction and Classical Optimization Techniques:

Statement of an Optimization problem – design vector – design constraints – constraint surface – objective function – objective function surfaces – classification of Optimization problems.

Single variable Optimization – multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum – multivariable Optimization with equality constraints.Solution by method of Lagrange multipliers – multivariable Optimization with inequality constraints – Kuhn – Tucker conditions.

UNIT – II:

Linear Programming

Standard form of a linear programming problem – geometry of linear programming problems – definitions and theorems – solution of a system of linear simultaneous equations – pivotal reduction of a general system of equations – motivation to the simplex method – simplex algorithm - Duality in Linear Programming – Dual Simplex method.

UNIT – III:

Nonlinear Programming:

Unconstrained cases - One – dimensional minimization methods: Classification, Fibonacci method and Quadratic interpolation method - Univariate method, Powell's method and steepest descent method.

Constrained cases - Characteristics of a constrained problem, Classification, Basic approach of Penalty Function method; Basic approaches of Interior and Exterior penalty function methods.Introduction to convex Programming Problem.

UNIT – IV:

Introduction to Evolutionary Methods:

Evolutionary programming methods - Introduction to Genetic Algorithms (GA)– Control parameters – Number of generation, population size, selection, reproduction, crossover and mutation – Operator selection criteria – Simple mapping of objective function to fitness function – constraints – Genetic algorithm steps – Stopping criteria –Simple examples.

UNIT – V:

Introduction to Swarm Intelligence Systems:

Swarm intelligence programming methods - Basic Partial Swarm Optimization – Method – Characteristic features of PSO procedure of the global version – Parameters of PSO (Simple PSO algorithm – Operators selection criteria – Fitness function constraints) – Comparison with other evolutionary techniques – Engineering applications of PSO.

Course Outcomes: After completion of this course the students will be able to

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.
- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.
- Able to apply Genetic algorithms for simple electrical problems.
- Able to solve practical problems using PSO.

Text Books

1. "Engineering optimization: Theory and practice"-by S. S.Rao, New Age International (P) Limited, 3rd edition, 1998.
2. Soft Computing with MATLAB Programming by N.P.Padhy & S.P.Simson, Oxford University Press – 2015

Reference Books:

1. **"**Optimization methods in operations Research and Systems Analysis" by K.V.Mital and C.Mohan, New Age International (P) Limited, Publishers, 3rd edition, 1996.
2. Genetic Algorithms in search, optimization, and Machine Learning by David E.Goldberg,ISBN:978-81-7758-829-3, Pearson by Dorling Kindersley (India) Pvt. Ltd.
3. "Operations Research: An Introduction" by H.A.Taha, PHI pvt. Ltd., 6th edition.
4. Linear Programming by G.Hadley, Narosa Publishers.

I SEMESTER	MICRO CONTROLLERS & APPLICATIONS (Common to CS & CE)(Elective-II)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Microprocessor

Course Educational Objectives:

- To critically compare various architectures.
- To apply interrupt concepts and communication ICs
- To apply microcontrollers to a given task
- To apply PIC microcontrollers and flash microcontrollers
- To develop interfacing circuits, and use microcontroller for measurement, automation and control

Unit-I: 8051 Microcontrollers, Addressing Modes and Instructions

Introduction to Intel 8 bit and 16 bit Microcontrollers, 8051 Architecture, Registers in 8051, 8051 Pin Description, 8051 Connections, 8051 Parallel I/O Ports, Memory Organization, 8051 Addressing Modes, 8051 Instruction Set and Simple Programs, Using Stack Pointer, 8051 Assembly Language Programming, Development Systems and Tools, Software Simulators of 8051

Unit-II: 8051 Interrupts, Timer/Counters and Serial Communication

Interrupts in 8051, Timers and Counters, Serial Communication, Atmel Microcontrollers (89CXX and 89C20XX), Architectural Overview of Atmel 89C51 and Atmel 89C2051, Pin Description of 89C51 and 89C2051, Using Flash Memory Devices Atmel 89CXX and 89C20XX

Unit-III: Applications of 8051 and Atmel 89C51 and 89C2051 Microcontrollers

Applications of 8051 and Atmel 89C51 and 89C2051 Microcontrollers- Square Wave Generation- Rectangular Waves- Pulse Generation- Pulse Width Modulation- Staircase Ramp Generation- Sine Wave Generation- Pulse Width Measurement- Frequency Counter

Unit- IV: PIC Microcontrollers

PIC Microcontrollers: Overview and Features, PIC 16C6X/7X,File Selection Register(FSR), PIC Reset Actions, PIC Oscillator Connections, PIC Memory Organizations, PIC PIC 16C6X/7X Instructions, Addressing Modes, I/O Ports, Interrupts in PIC 16C61/71, PIC 16C61/71 Timers, PIC 16C71 Analog-to-Digital Converter (ADC),

PIC 16F8XX Flash Microcontrollers :Introduction and architecture of 16F8XX, Registers, Program memory, Data Memory, DATA EEPROM and Flash Program EEPROM, Interrupts in 16F877, I/O Ports, Timers

Unit- V: Interfacing and Microcontroller Applications- Light Emitting Diodes (LEDs), Push Buttons, Relays and Latch Connections, Keyboard Interfacing, Interfacing 7-Segment Displays, LCD Interfacing, ADC AND DAC Interfacing with 89C51 Microcontrollers

Industrial Applications of Microcontrollers - Measurement Applications, Automation and Control Applications

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

- To critically compare various architectures.
- To apply interrupt concepts and communication ICs
- To apply microcontrollers to a given task
- To apply PIC microcontrollers and flash microcontrollers
- To develop interfacing circuits, and use microcontroller for measurement, automation and control

Reference Books:

1. Microcontrollers-Theory and Applications by Ajay V Deshmukh, McGraw Hills
2. Microcontrollers by Kennith J Ayala, Thomson publishers
3. Microprocessor and Microcontrollers by Prof C.R.Sarma.

I SEMESTER	STOCHASTIC ESTIMATION AND CONTROL (Common to CS & CE) (Elective-II)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Digital Control Systems

Course Educational Objectives:

- To apply the knowledge of probability theory to stochastic control problems
- To develop optimal filters for process measurements.
- To analyze optimal estimation methods for continuous linear systems.
- To formulate the deterministic or stochastic optimal control problem
- To make optimal estimation, filtering, prediction and smoothing

Unit I

Elements of the theory of stochastic processes, Gauss-Markov sequence model, Gauss- Markov process model.

Unit II

Optimal estimation for discrete linear systems, optimal prediction of discrete linear systems, optimal filtering for discrete linear systems, optimal filtering in the presence of time-correlated disturbance and measurements.

Unit III

Classification of smoothed estimates, single and double stage optimal smoothing, optimal fixed-interval smoothing, optimal fixed-point smoothing, optimal fixed-lag smoothing

Unit IV

Stochastic optimal control for discrete linear systems: Problem formulation, Deterministic problem, stochastic problem

Unit V

Optimal estimation for continuous linear systems: Problem formulation, equivalent Discrete-time problem, optimal filtering and prediction, optimal fixed-interval smoothing, optimal fixed-point smoothing, optimal fixed-lag smoothing.

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

- Apply the knowledge of probability theory to stochastic control problems
- Develop optimal filters for process measurements.
- Analyze optimal estimation methods for continuous linear systems.
- Formulate the deterministic or stochastic optimal control problem
- Make optimal estimation, filtering, prediction and smoothing

Reference Books:

1. Stochastic Optimal Linear Estimation and Control, J.S.Meditch, Tata McGraw Hill Book Company, 1969.
2. Optimal Control and Estimation, Robert F. Stengel, Dover Publications, New Yok, 1994.
3. A. Gelb, Applied Optimal Estimation, MIT Press.

I SEMESTER	RESEARCH METHODOLOGY AND IPR (COMMON TO CS & CE)	CATEGORY	L-T-P 2-0-0	CREDITS 2

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, 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-III

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-IV

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT-V

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.

REFERENCES:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.

I SEMESTER	CONTROL SYSTEM SIMULATION LABORATORY (Common to CS & CE)	CATEGORY	L-T-P 0-0-4	CREDITS 2

Pre-requisite: Control Systems

Course Educational Objectives:

- To develop programming and simulation techniques using MATLAB/SIMULINK.
- To analyze the stability of LTI systems.
- To develop controllers and compensators for linear systems.

Any 10 of the following experiments are to be conducted.

List of Experiments

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

1. Familiarization with MATLAB control system toolbox, MATLAB SIMULINK toolbox and PSPICE
2. Preliminary Transformations:
   (a) Transfer function to State space models vice- versa.
   (b) Conversion of Continuous to Discrete time systems vice- versa.
3. Verification of controllability and observablity of a given system.
4. Obtain state variables of a given physical system by writing MATLAB program
5. Simulation of Step response & impulse response for type-0, type-1 & type-2 system with unity feedback using MATLAB
6. Stability analysis of a given system using:
   (a) Root Locus.
   (b) Bode plot.
7. Implementation of PID controller and its effects on a given system.
8. Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin with additional lead compensator in forward path transfer function using MATLAB
9. Design of Lead, Lag and Lag-Lead compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.
10. Construction of Simulink model for an Induction motor.
11. Effect of P, PD, PI, PID Controller on a second order systems using MATLAB
12. Design of state observer

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

- Develop conversion models.
- Do stability analysis of LTI system using various techniques.
- Design and implement various controllers, observers and compensators using MATLAB/ SIMULINK.

I SEMESTER	CONTROL SYSTEM LABORATORY (Common to CS & CE)	CATEGORY	L-T-P 0-0-4	CREDITS 2

Pre-requisite: Control Systems

Course Educational Objectives:

• To develop programming and simulation techniques using MATLAB/SIMULINK.
• To analyze the stability of LTI systems.
• To develop controllers and compensators for linear systems.

List of experiments:

1. Position control using Synchros
2. Characteristic of Magnetic amplifier.
3. Time response specification of second order system.
4. Position control of DC motor.
5. Frequency characteristics of compensators.
6. Effect of feedback on AC servo motor.
7. Design and analysis of compensators for given applications.
8. Study of Error detectors.
9. Effect of feedback on DC motor.
10. Time response of a cascade network

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

- Develop conversion models.
- Do stability analysis of LTI system using various techniques.
- Design and implement various controllers, observers and compensators using MAT LAB/SIMULINK.

I SEMESTER	AUDIT COURSE-I (Common to CS & CE)	CATEGORY	L-T-P 2-0-0	CREDITS 0

II SEMESTER	NON-LINEAR SYSTEMS ANALYSIS (Common to CS & CE)	CATEGORY	L-T-P 3-0-0	CREDIT 3

Pre-requisite: Advanced Control Systems

Course Educational Objectives:

- To analyze nonlinear systems.
- To analyze using phase-plane method
- To analyze using describing function
- To analyze stability using different methods
- To apply sliding control and switching control laws

UNIT-I

Linear versus nonlinear systems - Fundamentals, common nonlinearities (saturation, dead - zone, on - off non - linearity, backlash, hysteresis) and their describing functions.Existence of limit cycles. Linearization: Exact linearization, input - state linearization, input - output linearization.

UNIT-II

Phase plane analysis: Phase portraits, Singular points characterization. Analysis of non - linear systems using phase plane technique, determination of limit cycles, Poincare index, Bendixon theory.

UNIT-III

Frequency domain analysis of feedback systems: Absolute stability - Circle criterion - Popov criterion. Describing function analysis of nonlinear systems.

UNIT-IV

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.

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.

Course Outcomes: Aftercompletion ofthis course, the student will be able to

- Analyze nonlinear systems.
- Analyze using phase-plane method
- Analyze using describing function
- Analyze stability using different methods
- Apply sliding control and switching control laws

Reference Books:

1. J. E. Slotine and Weiping LI, Applied Nonlinear Control, Prentice Hall,
2. Hassan K. Khalil, Nonlinear Systems, Prentice Hall, 1996.
3. Sankar Sastry, Nonlinear Systems Analysis, Stability and Control.
4. M. Vidyasagar, Nonlinear Systems Analysis, Prentice - Hall International editions, 1993

II SEMESTER	OPTIMAL CONTROL THEORY (Common to CS & CE)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Advanced Control Systems

Course Educational Objectives:

- To introduce overall performance measures with variable functions.
- To understand dynamic programming methods.
- To introduce various regulators and algorithms.

UNIT-I

Introduction: Overview of optimization problem, Performance indices, Formulation of Optimal control problem, constrained optimization, unconstrained optimization, Local optimality, Global optimality and their solutions using different techniques, convex sets, convex function, convex programming problem , Sufficient conditions for convex programming problem.

UNIT-II

Calculus of Variation: fundamental concepts, Functions and Functional, Fundamental Theorem of the calculus of Variations, Functional of a single function , Functional involving several independent functions, necessary conditions for optimal control.

UNIT-III

Linear quadratic regulator: Weighting matrices, Finite time Linear Quadratic Regulator, Solution to matrix differential Ricatti equation, Infinite time Linear Quadratic Regulator, Frequency domain Interpretation.

UNIT-IV

Dynamic programming: Principles of optimality, backward solution, forward solution, characteristics of Dynamic Programming solution, Pontryagin Minimum Principle, Hamilton-Jacobi Bellman equation.

UNIT-V

Numerical determination of optimal trajectories: Two point boundary value problem, The method of Steepest descent algorithm, variation of extremals, variation of extremal algorithm, Gradient projection algorithm.

Course Outcomes: Aftercompletion ofthis course, the student will be able to

- Develop linear quadratic regulators.
- Determine optimal trajectories.
- Understand various linear and infinite time regulators with better interpretation.

Reference Books:

1. Optimal Control Theory an Introduction, Donald E.Kirk, Prentice –Hall Network Series
2. Optimal Control systems, D.S.Naidu CRC Press
3. Optimal Control Theory, B.D.O.Anderson& Moore-PHI-1991
4. Optimum System Control –A.P.Sage
5. Introduction to optimum design, JasbirS.Arora, Elesevier, 2005.
6. D.P.Bertsekas, Dynamic Programming and optimal Control, Vol. I, 2nd edition, Athena Scientific, 2000.

II SEMESTER	ADVANCED DIGITAL SIGNAL PROCESSING (Common to CS & CE) (Elective-III)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Signals & Systems

Course Educational Objectives:

- To understand the various digital filter structures
- To design the FIR and IIR Filters
- To know the importance of FFT algorithm for computation of Discrete Fourier Transform
- To analyze the finite word length effects on various filters
- To learn the power spectrum estimation of periodic and non-periodic signals

UNIT– 1

Digital Filter Structure: Block diagram representation-Equivalent Structures-FIR and IIR digital filter Structures All pass Filters-tunable IIR Digital Filters-IIR tapped cascaded Lattice Structures-FIR cascaded Lattice structures-Parallel-Digital Sine-cosine generator-Computational complexity of digital filter structures.

UNIT– 2

Digital filter design: Preliminary considerations-Bilinear transformation method of IIR filter design-design of lowpass, 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– 3

DSP algorithm implementation: Computation of the discrete Fourier transform- number representation-arithmetic operations handling of overflow-tunable digital filters-function approximation.

UNIT– 4

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 ratio in low -order IIR filters-low-sensitivity digital filters-Reduction of Product round-off errors using error feedback-Limit cycles in IIR digital filters, Round-off errors in FFT Algorithms.

UNIT– 5

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 & torchy method.

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

- Describe structure of digital filters.
- Design digital filters with different techniques.
- Understand the implementation aspects of signal processing algorithms.
- Know the effect of finite word length in signal processing.
- Analyze different power spectrum estimation techniques.

Text Books:

1. Digital signal processing-Sanjit K. Mitra-TMH second edition, 2002.
2. Discrete Time Signal Processing – Alan V.Oppenheim, Ronald W.Shafer - PHI-1996 1st edition-9th reprint

Reference Books:

1. Digital Signal Processing and principles, algorithms and Applications – John G.Proakis -PHI –3rd edition-2002.
2. Digital Signal Processing – S.Salivahanan, A.Vallavaraj, C. Gnanapriya – TMH - 2nd reprint-2001
3. Theory and Applications of Digital Signal Proceesing-LourensR. Rebinar&Bernold.
4. Digital Filter Analysis and Design-Auntonian-TMH.

II SEMESTER	ROBOTICS AND CONTROL (Common to CS & CE) (Elective-III)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Fundamentals of Robotics and control theory

Course Educational Objectives:

- To understand the modeling of Robots with various mapping techniques.
- To understand the modeling of robots
- To understand the static and dynamic modeling
- To understand the planning and better control of manipulators with open and closed loop controls.
- To apply sensors for various robot applications and their safety measures as criteria.

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Unit I: Introduction-Robot Anatomy

Coordinate frames-mapping- mapping between rotated frames-mapping between translated frames-mapping between rotated and translated frames-description of objects in space-transformation of vectors—inverting homogeneous transform-fundamental rotation matrices

Unit-II: Symbolic Modelling of Robots –Direct and Inverse Kinematic Model

Mathematical structure and notations-description of links and joints-kinematic modeling of the manipulator- Denavit-Hatenberg notation-kinematic relationship between adjacent links- manipulator transformation matrix

Manipulator work space – Solvability of kinematic model- -Solution techniques- closed form solution-guidelines to obtain closed form solution.

Unit III:

Manipulator Differential Motion, Static and Dynamic Modelling

Linear and angular velocity of a rigid body - Relationship between transformation Matrix and angular velocity - Mapping velocity vector-Velocity propagation along links-Manipulator Jacobian - Jacobian Inverse- Jacobian Singularities- Static Analysis

Lagrangian Mechanics – Two degree of freedom Manipulator-Dynamic Model – Lagrange–Euler formulation - Newton –Euler Formulation – comparison of Lagrange–Euler & Newton –Euler Formulations – Inverse Dynamics

Unit IV: Trajectory Planning and Control of Manipulators

Definitions and planning tasks- terminology-steps in trajectory planning- Joint space techniques-Cartesian space techniques- Joint space (Vs) Cartesian space Trajectory planning.

Open and close loop control – The manipulator control problem – Linear control schemes-Characteristics of second order linear systems- Linear Second order-SISO model of a manipulator joint-Joint Actuators- partitioned PD control scheme –PID control scheme – computed torque control- force control of robotic manipulators – description of force control tasks –Force-control strategies-Hybrid position/ force control- Impedance Force/Torque control

Unit V: Robotic Sensors and Applications

Sensing- Sensors in robotics – Kinds of sensors used in robotics- -Robotic vision- Robotic vision-Industrial applications of vision controlled robotic systems- process of Imaging-Architecture of robotic vision systems- Image Acquisition- Image representation-Image processing – Industrial applications – material handling – Process applications – Assembly applications – Inspection application – Principles of Robot applications and application planning, Justification of robots- Robot safety

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

- Do modeling of Robots with various mapping techniques.
- Do model robots
- Do static and dynamic modeling
- Do planning and better control of manipulators with open and closed loop controls.
- Apply sensors for various robot applications and their safety measures as criteria.

Reference Books:

1. Robotics and control –RKMittal And I J Nagrath TMH Publishers-1st edition-2003
2. MikellP,WeissG.M.,Nagel R.N., Odrey N.G., Industrial Robotics, McGraw Hill,1986.
3. Deb.S.R- Robotics Technology and flexible automation, Tata McGraw Hill, 1994.
4. Asfahi C.R. - Robotics and manufacturing automation, John wiley,1992.
5. Klafter R.D.-Chimielewski T.A &Neign M., Robotics engineering: An integrated approach, Prentice Hall of India Pvt. Ltd., 1994.

II SEMESTER	LARGE SCALE SYSTEMS (Common to CS & CE) (Elective-III)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Advanced Control Systems

Course Educational Objectives:

- To understand the Large scale system modeling of lumped, distributed and time varying systems
- To understand thestability and control of large scale systems
- To understand themodel order reduction and control of modal analysis approach
- To understand themodel order reduction using aggregation and frequency domain methods
- To understand themodel order reduction using norms based methods

UNIT I:

Large Scale Systems Modeling

Modelingof Large Scale Systems – interactingsubsystems exchanging matter, energy, or information with the environment – Lumped – distributed – timevarying systems – Ordinary Differential Equation Modeling – DifferentialAlgebraic Equations – Linearization – determinationof Jacobian – DifferenceEquations – Basicsfor analysis of systems – SingularValues – Orderand Dimension.

UNIT II

Stability & Control

Stability & Control of Large Scale Systems – Controllability – Observability –Grammians –computation vector Lyapunov function methods, vector dissipativity theory, and decentralized control architectures– continuous-time, discrete-time, and hybrid large-scale systems. –finite-time stability and finite-time decentralized stabilization, thermodynamic modeling, maximum entropy control, and energy-based decentralized control.

UNIT III

Model Order Reduction and Control: Modal Analysis

Modal Analysis: Reduced Order Model Using Davison, Chidambara and Marshall Techniques, Suboptimal Control Using Davison and Chidambara Models, Control Law Reduction Approach Using Davison Model and Chidambara Models, Choice of Reduced Model Order.

UNIT IV

Model Order Reduction:Aggregation and Frequency Domain Methods

Aggregation Methods: Aggregation of Control Systems, Determination and Properties of Aggregated System Matrix, Error in Aggregation, Modal Aggregation, Aggregationby Continued Fraction.

Frequency Domain Methods: Moment Matching, Pade Approximation Method, Routh Approximation Technique, Continued Fraction Method.

UNIT V

Model Order Reduction: Norm Based Methods

Norm Based Methods : Norms of Vectors and Matrices, Singular Value Decomposition, Grammian Matrices and Hankel Singular Values , Matrix Inversion Formulae, Model Reduction by Balanced Truncation, Balanced Realization, Steady State Matching Reduction of Unstable Systems, Frequency-Weighted Balanced Model Reduction, Model Reduction by Impulse/Step Error Minimization.

Corse Outcomes: After completion of this course, the student will be able to do

- Model large scale systems
- Asses stability of large scale systems
- Model order reduction and control of modal analysis approach
- Model order reduction using aggregation and frequency domain methods
- Model order reduction using norms based methods

References:

1. Mohammad Jamshidi, “Large-scale systems: modelling control and fuzzy logic”, Prentice Hall, 1997.
2. Jan Lunze, “Feedback control of large scale systems” ,Prentice-Hall, 1992.
3. Jose B. Cruz, “Advances in Large Scale Systems: Theory and Applications‟, JAI Press, 1984
4. Richard Saeks,“Large-scale Dynamical Systems” Point Lobos Press, 1976
5. Andrew P. Sage, “Methodology for large-scale systems”, McGraw-Hill, 1977
6. Efficient Modeling and Control of Large-Scale Systems, edited by Javad Mohammadpour, and Karolos M., Springer, 2010.
7. M. JAMSHIDI, Large-Scale Systems - Modeling and Control, Elsevier North- Holland, New York, NY, 1983.
8. L. Fortuna, G. Nunnari and A. Gallo, “Model Order Reduction Techniques with Applications in Electrical Engineering”, Springer-Verlag London, 1992.
9. Dr. S. Janardhanan, “Model Order Reduction and Controller Design Techniques”.

II SEMESTER	PROCESS CONTROL & AUTOMATION (Common to CS & CE) (Elective-IV)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Digital Control Systems

Course Educational Objectives:

- To apply instrumentation concepts in process control, use codes and standards.
- To develop feed forward control, cascade control, ratio control, model based predictive control.
- To program the PLCs, configure, and apply.
- To configure and apply distributed control systems.
- To study the automation of various industrial operations.

Unit-I

Fundamentals of Process Control: Definition of industrial processes and control, Hierarchies in process control systems block diagram representation of process control system, Control system instrumentation, Codes and Standards, preparation of P&I diagrams.

Unit-II

Strategies for Computer-Aided Process Control: Open loop control systems, closed loop (feedback) control system, feed forward control system, cascade control system, ratio control, controller design, controller tuning, tuning of P, PI and PID controllers, Ziegler-Nichols tuning method, selection of controllers, predictive control, model based predictive control, multi-variable control system.

Unit-III

Programmable Logic Controllers (PLCs): Introduction, principles of operation, architecture of programmable logic controllers, programming the programmable controllers, software, configurations, applications.

Unit-IV

Distributed Control Systems: Introduction, functional requirements of distributed control system, system architecture, distributed control systems configuration and applications ofdistributed control systems.

Unit-V

Industrial control Applications: Automation of Thermal power plant, automation strategy, distributed system structure, automatic boiler controller, diagnostic function and protection, digital electro-hydraulic governor, automatic start-up system, thermal stress control, man-machine interface, software system, communication system, variable pressure control, combined plant control.

Course Outcomes: Aftercompletion ofthis course, the student will be able to

- Apply instrumentation concepts in process control,use codes and standards.
- Develop feed forward control, cascade control, ratio control, model based predictive control.
- Program the PLCs, configure, and apply.
- Configure and apply distributed control systems.
- Automate various industrial operations

Reference books:

1. Computer based Industrial Control, Krishna Kant, Prentice-Hall India, 2003.
2. Computer Aided Process Control, S.K.Singh, Prentice-Hall India, 2005.
3. Process Dynamics and Control, Seborg, D.E., T.F. Edgar, and D.A. Mellichamp, John Wiley, 2004.
4. Johnson D Curtis, Instrumentation Technology, Prentice-Hall India, (7^{th} Edition), 2002.

II SEMESTER	DECISION AND ESTIMATION THEORY (Common to CS & CE) (Elective-IV)	CATEGORY	L-T-P 3-0-0	CREDIT 3

Pre-requisite: Fundamentals of Linear and non-linear control systems

Course Educational Objectives

- To make decisions with respect to single and multiple observations based on digital format.
- To analyze different types of multiple decision tests in general and Gaussian case.
- To discuss different types of estimation methods tofind the objective through normal and Gaussian noise.
- To analyze estimators along with their significance properties in terms of sensitivity and error based.

Unit-I:

Binary Decisions for single and multiple observations: Maximum-Likelihood decision, Neyman-Pearson, Probability-of-error, Bayes risk and Min-Max Criteria. Vector observations, general Gaussian problem.

Unit-II:

Multiple decisions: Bayes risk, Probability of error general case and probability of error Gaussian case. Sequential Bayes tests.

Unit-III:

Fundamentals of estimation: Maximum-Likelihood, Bayes cost methods. Relationship of estimators. Linear Minimum-Variance and Least-Squares estimation.

Unit-IV:

Estimation with Gaussian noise: Linear observations, Sequential Estimation,Nonlinear Estimation and State Estimation.

Unit-V:

Properties of Estimators: Unbiased Estimators, Efficient Estimators, AsymptoticProperties, Sensitivity and error analysis.

Course Outcomes: Aftercompletion ofthis course, the student will be able to

- Digital based decisions and study their effectiveness is studied.
- Better decisions in form of single and multiple cases with better test analysis.
- Different fundamental and Gaussian state estimation methods.
- Various estimators to do the sensitivity and error analysis of different problems.

Reference Books:

1. Decision and estimation theory, J. M. Melsa and D.L. Cohen, Springer-Verlag, 1978
2. H.L. Van Trees, Detection, Estimation, and Modulation Theory, vol. I. Wiley, New York, 1968.
3. S. Kay, Fundamentals of Statistical Signal Processing: Detection Theory, Prentice Hall, 1998.
4. S. Kay, Fundamentals of Statistical Signal Processing: Estimation Theory, Prentice Hall, 1993.
5. H. V. Poor, An Introduction to Signal Detection and Estimation, 2nd Ed., Springer-Verlag, 1994.
6. L. L. Scharf, Statistical Signal Processing: Detection, Estimation and Time Series Analysis, Addison-Wesley, 1991.
7. R. Hippenstiel, Detection Theory: Applications and Digital Signal Processing, CRC Press, 2002.

II SEMESTER	EMBEDDED COMPUTER CONTROL (Common to CS & CE) (Elective-IV)	CATEGORY	L-T-P 3-0-0	CREDIT 3

Pre-requisite: Computer organization and Microprocessors

Course Educational Objectives:

- To impart the basic knowledge of embedded computer control concepts.
- To get familiarize with the basic architecture, selection, memory segments.
- To understand the concept of interfacing techniques using different controllers for fine tuning of applications.

Unit-I

Overview of design challenges and design metrics, Formalisms for system design based various technologies, Combinational logic design, Sequential logic design.

Unit-II

Basic Architecture, Programming view, Development Environment, Microprocessor selection, General-purpose processor design.

Unit-III

Timers, UART, Pulse width modulation, LCDs, Keyboards, ADCs and DACs, Memory system mechanisms, Memory hierarchy and cache Memory management units.

Unit-IV

Bus architecture, Interrupts, Direct memory access, Introduction to advanced interfacing techniques, Requirement specifications, Design alternatives

Unit-V

Open-loop and closed-loop control systems, PID controller, and Software implementation of PID controller, PID tuning and practical issues

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

- Understand the basic design concepts of digital integration techniques.
- Understand the overall architecture along with memory management units.
- Develop the operation techniques with interfacing to practical applications along with fine tuning for better output.

Reference Books:

1. Frank Vahid and Tony Givargis, Embedded System Design: A Unified Hardware/Software Introduction, John Wiley, 2002.
2. Frederick M. Cady , Microcontrollers and Microcomputers Principles of Software, and Hardware Engineering , Second Edition, Oxford University Press ,2009
3. Peter Marwedel, Embedded System Design, Springer, 2006
4. Wayne Wolf, Computers as Components, 2nd Edition, Morgan Kaufmann, 2008

II SEMESTER	ADVANCE CONTROL SYSTEM SIMULATION LABORATORY (Common to CS & CE)	CATEGORY	L-T-P 0-0-4	CREDIT 2

Course Educational Objectives:

• To design and observe the performance of control components.

• To design and observes the performance of controllers.

Any 10 of the following experiments are to be conducted.

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

List of Experiments

1. Stability analysis of a given system using Lyapunov stability criterion.
2. Implementation of Kalman Filter
3. Design of state feedback controllers for continuous time system
4. Implementation of Least Squares error method
5. To obtain the model of the Inverted pendulum and study the closed loop performance using experiments on Bytronic® Inverted Pendulum using MATLAB
6. Implementation of PID controller and its effects on a given system.
7. Evaluation of steady state error, settling time, percentage peak overshoot, gain margin, phase margin with additional lead compensator in forward path transfer function using MATLAB
8. Design of Lead, Lag and Lead-Lag compensation circuit for the given plant transfer function. Analyze step response of the system by simulation.
9. Construction of Simulink model for an Induction motor.
10. Design of reduced order state observer.
11. Solution of optimal control problem-Riccati equation.
12. Design of state feedback controllers for digital control systems

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

• Design circuits to observe the performance of components.

• Design controllers.

• Design speed control methods for motors using PLCs.

Reference Books:

1. Gene F Franklin, J David Powell, Abbas EmamiNaeini, Feedback Control of Dynamic Systems, 4th Ed, Pearson Education Asia, 2002
2. Graham C Goodwin, Stefan F Graebe, Mario E Salgado, Control System Design, Prentice Hall India, 2003.
3. John J D'Azzo, Constantine H Houpis, Stuart N. Sheldon, Linear Control System Analysis &Design with MATLAB, 5th Ed, Marcel Dekker, 2003
4. John E Gibson, Franz B. Tuteur, Control System Components, McGraw Hill, 1958 5. Users'Manual for FEEDBACK® MS150 AC Modular Servo S

II SEMESTER	ADVANCED CONTROL SYSTEM LABORATORY (Common to CS & CE)	CATEGORY	L-T-P 0-0-4	CREDIT 2

Course Educational Objectives:

- To design and observe the performance of control components.
- To design and observes the performance of controllers.

List of Experiments:

1. PLCs for static applications
2. Effect of P,PI, PID controller for closed loop system.
3. Temperature control using PID.
4. Tuning of P, PI and PID controller for first order plant with dead time using Z-N method.
5. Applications and analysis of compensators for the given plant transfer function.
6. Study of position control using servo motor.
7. Speed control of stepper motor.
8. Speed control of DC motor using PLC
9. Speed control of AC motor using PLC
10. Process control using PLC.

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

- Design circuits to observe the performance of components.
- Design controllers.
- Design speed control methods for motors using PLCs.

Reference Books:

1. Gene F Franklin, J David Powell, Abbas Emami Naeini, Feedback Control of Dynamic Systems, 4th Ed, Pearson Education Asia, 2002
2. Graham C Goodwin, Stefan F Graebe, Mario E Salgado, Control System Design, Prentice Hall India, 2003.
3. John J D'Azzo, Constantine H Houpis, Stuart N. Sheldon, Linear Control System Analysis & Design with MATLAB, 5th Ed, Marcel Dekker, 2003
4. John E Gibson, Franz B. Tuteur, Control System Components, McGrawHill, 1958
5. Users' Manual for FEEDBACK® MS150 AC Modular Servo System
6. Users' Manual for 8085n Microprocessor kit, ©ViMicroSystems.
7. www.mathworks.com
8. Users' Manual for Bytronic® Inverted Pendulum.
9. Users' Manual for Level Process Station, ©Vi McroSystems

II SEMESTER	MINI PROJECT WITH SEMINAR (Common to CS & CE)	CATEGORY	L-T-P 0-0-4	CREDIT 2

Note:
It is recommended that a Supervisor/advisor should be allotted to each student at the end of the semester-I or allot at the start of the semester-II

Syllabus content:

A Student has to select one paper published in any of the IEEE Transactions and simulate the same. The student has to present the progress of the work at the middle of the semester. At the end of the semester, the student has to present the results by explaining the idea of the topic, methodology, finding of the simulations. A Student should also submit a report of the entire work carried out under this course. The end semester presentation must be video recorded and preserved.

II SEMESTER	AUDIT COURSE-II (Common to CS & CE)	CATEGORY	L-T-P 2-0-0	CREDIT 0

III SEMESTER	ADAPTIVE CONTROL THEORY (Common to CS & CE) (Elective-V)	CATEGORY	L-T-P 3-0-0	CREDIT 3

Pre-requisite: Advanced Control Systems

Course Educational Objectives:

- To understand theknowledge of norms and non-autonomous systems
- To study the basic approaches of adaptive control and types of adaptive control
- To the identification problem of linear time invariant systems
- To understand thedirect and indirect adaptive control
- To analyze the methods of adaptive control

Unit-I

Preliminaries

Norms and Lp spaces, positive definite matrices, input and output, Lp stability, small gain theorem, Positive real functions and stability – Analysis of Dynamical Systems, Analysis of solutions to differential equations, equilibria and stability, invariant sets, Lyapunov stability theory and performance analysis, Non-autonomous systems, LaSalle Extensions, Barbalat Lemma.

Unit-II

Introduction to Adaptive Control

Basic approaches to adaptive control, Applications of adaptive control. Introduction to types of Adaptive Control, Model Reference-Variable Structure-Sliding Mode- Neuro-Fuzzy-Learning Control-Intelligent Control using schematic diagrams and literature survey.

Unit-III

Identification

Identification problem – Identification of linear time-invariant systems, adaptive observers. Sufficient richness conditions for parameter convergence. Equation error and output error methods

Gradient and least-squares algorithms: Linear error equation. Gradient and normalized gradient algorithms. Least squares algorithms (batch, recursive, recursive with forgetting factor). Convergence properties.Identification for Control.

Frequency-domain analysis and averaging approximations: Averaging of signals. Averaging theory for one-time scale and two-time scale systems.Applications to adaptive systems.

Unit-IV

Model Reference Adaptive Control

Indirect adaptive control: Pole placement adaptive control, Model reference adaptive control, Predictive control, Singularity regions and methods to avoid them.

Direct adaptive control: Strictly positive real transfer functions and Kalman-Yacubovitch-Popov lemma. Lyapunov redesign, Passivity theory, Direct model reference adaptive control, One case study of MRAC and computer based design.

Unit-V

Methods in Adaptive Control:

Adaptive Back-stepping, Adaptive Output Feedback Control, Adaptive Neuro Control., Examples of Adaptive Control.One case study and computer simulation.

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

- Analyze dynamic systems
- Critically compare types of adaptive control
- Apply different identification methods
- Apply direct and indirect MRAC approaches
- Apply different adaptive control strategies

References:

1. K.J. Astrom and B. Wittenmark, „Adaptive Control", Addison-Wesley, 2nd edition, 1995.
2. P.A. Ioannou& J. Sun, „Robust Adaptive Control", Prentice Hall, Upper Saddle River, NJ, 1996..
3. I.D. Landau, R. Lozano, and M. M'Saad, „Adaptive Control", Springer Verlag, London, 1998.
4. K.S. Narendra and A.M. Annaswamy, „Stable Adaptive Systems", Prentice-Hall, 1989.
5. S. Sastry and M. Bodson, „Adaptive Control: Stability, Convergence, and Robustness", PrenticeHall, 19

III SEMESTER	EVOLUTIONARY ALGORITHMS AND APPLICATIONS (Common to CS & CE) (Elective-V)	CATEGORY	L-T-P 3-0-0	CREDIT 3

Pre-requisite: i) Optimization Techniques ii) Power System Operation

Course Educational Objectives:

- To distinguish between conventional optimization algorithms and evolutionary optimization algorithms.
- To apply genetic algorithm and particle swarm optimization algorithm to power system optimization problems.
- To analyze and apply Ant colony optimization algorithm and artificial Bee colony algorithm to optimize the control parameters./power system optimization problems.
- To apply shuffled frog leaping algorithm and bat optimization algorithm to power system optimization problem.
- To apply multi-objective optimization algorithm to power system multi-objective problems.

UNIT– I

Fundamentals of Soft Computing Techniques

Definition-Classification of optimization problems- Unconstrained and Constrained optimization Optimality conditions- Introduction to intelligent systems- Soft computing techniques- Conventional Computing versus Swarm Computing - Classification of meta-heuristic techniques - Single solution based and population based algorithms – Exploitation and exploration in population based algorithms - Properties of Swarm intelligent Systems - Application domain - Discrete and continuous problems - Single objective and multi-objective problems.

UNIT– II

Genetic Algorithm and Particle Swarm Optimization

Genetic algorithms- Genetic Algorithm versus Conventional Optimization Techniques - Genetic representations and selection mechanisms; Genetic operators- different types of crossover and mutation operators -Bird flocking and Fish Schooling – anatomy of a particle- equations based on velocity and positions -PSO topologies - control parameters – GA and PSO algorithms for solving ELD problem without loss, Selective Harmonic Elimination in inverters and PI controller tuning.

UNIT– III

Ant Colony Optimization and Artificial Bee Colony Algorithms

Biological ant colony system - Artificial ants and assumptions - Stigmergic communications - Pheromone updating- local-global - Pheromone evaporation - ant colony system- ACO models-Touring ant colony system-max min ant system - Concept of Elitist Ants-Task partitioning in honey bees - Balancing foragers and receivers - Artificial bee colony (ABC) algorithms-binary ABC algorithms – ACO and ABC algorithms for solving Economic Dispatch without loss and PI controller tuning.

UNIT– IV

Shuffled Frog-Leaping Algorithm and Bat Optimization Algorithm

Bat Algorithm- Echolocation of bats- Behavior of microbats- Acoustics of Echolocation- Movement of Virtual Bats- Loudness and Pulse Emission- Shuffled frog algorithm-virtual population of frogscomparison of memes and genes -memeplex formation- memeplexupdation- BA and SFLA algorithms for solving ELD without loss and PI controller tuning.

UNIT– V

Multi Objective Optimization

Multi-Objective optimization Introduction- Concept of Pareto optimality - Non-dominant sorting technique-Pareto fronts-best compromise solution-min-max method-NSGA-II algorithm and application to general two objective optimization problems.

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

- State and formulate the optimization problem, without and with constraints, by using design variables from an engineering design problem.
- Apply classical optimization techniques to minimize or maximize a multi-variable objective function, without or with constraints, and arrive at an optimal solution.

- Formulate a mathematical model and apply linear programming technique by using Simplex method. Also extend the concept of dual Simplex method for optimal solutions.
- Apply gradient and non-gradient methods to nonlinear optimization problems and use interior or exterior penalty functions for the constraints to derive the optimal solutions.
- Apply Genetic algorithms for simple electrical problems and able to solve practical problems using PSO.

Text Books

1. Xin-She Yang, "Recent Advances in Swarm Intelligence and Evolutionary Computation", Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb "Multi-Objective Optimization using Evolutionary Algorithms", John Wiley & Sons, 2001.
3. James Kennedy and Russel E Eberheart, "Swarm Intelligence", The Morgan Kaufmann Series in Evolutionary Computation, 2001.

Reference Books:

1. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, "Swarm Intelligence-From natural to Artificial Systems", Oxford university Press, 1999.
2. David Goldberg, „Genetic Algorithms in Search, Optimization and Machine Learning", Pearson Education, 2007.
3. Konstantinos E. Parsopoulos and Michael N. Vrahatis, "Particle Swarm Optimization and Intelligence: Advances and Applications", Informat IonscIence reference, IGI Global, , 2010.
4. N P Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.

Reference Papers:

1. "Shuffled frog-leaping algorithm: a memetic meta-heuristic for discrete optimization" by Muzaffareusuff, Kevin lansey and Fayzul pasha, Engineering Optimization, Taylor & Francis, Vol. 38, No. pp.129–154, March 2006.
2. "A New Metaheuristic Bat-Inspired Algorithm" by Xin-She Yang, Nature Inspired Cooperative Strategies for Optimization (NISCO 2010) (Eds. J. R. Gonzalez et al.), Studies in Computational Intelligence, Springer Berlin, 284, Springer, 65-74 (2010).
3. "Firefly Algorithms for Multimodal Optimization" Xin-She Yang, O. Watanabe and T. Zeugmann (Eds.), Springer-Verlag Berlin Heidelberg, pp. 169–178, 2009.

III SEMESTER	ARTIFICIAL INTELLIGENT TECHNIQUES (Common to CS & CE) (Elective-V)	CATEGORY	L-T-P 3-0-0	CREDIT 3

Pre –requisite: Fundamentals of Neural networks and Fuzzy Logic

Course Educational Objectives:

- To have knowledge on concept of neural network.
- To know different types of neural networks and training algorithms.
- To understand the concept of genetic algorithm and its application in optimization.
- To have the knowledge on fuzzy logic and design of fuzzy logic controllers.
- To know the applications of AI Techniques in electrical engineering.

UNIT– 1

Introduction

Artificial Neural Networks (ANN) – definition and fundamental concepts – Biological neural networks – Artificial neuron – activation functions – setting of weights – typical architectures – biases and thresholds – learning/training laws and algorithms. Perceptron – architectures, ADALINE and MADLINE – linear separability- XOR function.

UNIT– 2

ANN Paradigms

ADALINE – feed forward networks – Back Propagation algorithm- number of hidden layers – gradient decent algorithm – Radial Basis Function (RBF) network. Kohonen's self organizing map (SOM), Learning Vector Quantization (LVQ) and its types – Functional Link Networks (FLN) – Bidirectional Associative Memory (BAM) – Hopfield Neural Network.

UNIT– 3

Classical and Fuzzy Sets

Introduction to classical sets- properties, Operations and relations; Fuzzy sets, Membership, Operations, Properties, Fuzzy relations, Cardinalities, Membership functions.

UNIT– 4

FUZZY LOGIC CONTROLLER (FLC)

Fuzzy logic system components: Fuzzification, Inference engine (development of rule base and decision making system), Defuzzification to crisp sets- Defuzzification methods.

UNIT– 5

Application of AI Techniques

Speed control of DC motors using fuzzy logic –load flow studies using back propagation algorithm, single area and two area load frequency control using fuzzy logic.

Course Outcomes: At the end of the course, student will be able to

- Differentiate between Algorithmic based methods and knowledge based methods.
- Use appropriate AI framework for solving power system problems.
- To design fuzzy logic controllers for power engineering applications.

Text Books:

1. Introduction to Artificial Neural Systems - Jacek M. Zurada, Jaico Publishing House, 1997.
2. Fuzzy logic with Fuzzy Applications – T.J Ross – McGraw Hill Inc, 1997.

Reference Books:

1. Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications by S.Rajasekaran andG.A.VijayalakshmiPai – PHI Publication.
2. Modern power Electronics and AC Drives – B.K.Bose -Prentice Hall, 2002
3. Genetic Algorithms- David E Goldberg. Pearson publications.
4. Introduction to Neural Networks using MATLAB 6.0 by S N Sivanandam, S Sumathi, S N Deepa TMGH
5. Introduction to Fuzzy Logic using MATLAB by S N Sivanandam, S Sumathi, S N Deepa Springer, 2007.

III SEMESTER	BUSINESS ANALYTICS (Common to CS & CE) (Open Elective)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre–requisite: Mathematics and Probability & Statistics

Course Educational objective:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- To become familiar with processes needed to develop, report, and analyze business data.
- Mange business process using analytical and management tools.

Unit I:

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit II:

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression.Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

Unit III:

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive
analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

Unit IV:

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation UsingAnalytic Solver Platform, New-Product Development Model, NewsvendorModel, Overbooking Model, Cash Budget Model.

Unit V:

Decision Analysis: Formulating Decision Problems, Decision Strategies withthe without Outcome Probabilities, Decision Trees, the Value ofInformation, Utility and Decision Making.

Recent Trends in: Embedded and collaborative business intelligence, Visualdata recovery, Data Storytelling and Data journalism.

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

- Demonstrate knowledge of data analytics.
- Demonstrate the ability of think critically in making decisions based on dataand deep analytics.
- Demonstrate the ability to use technical skills in predicative and prescriptivemodeling to support business decision-making.
- Demonstrate the ability to translate data into clear, actionable insights.

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

III SEMESTER	INDUSTRIAL SAFETY (Common to CS & CE) (Open Elective)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: Engineering Fundamentals

Course Educational Objectives:

- To learn safety aspects of any industrial area
- To learn fundamentals and types of maintenance engineering
- To learn causes and effects of wear and Corrosion and their prevention
- To learn identification of faults and their repair
- To learn preventive maintenance- periodic an preventive-maintenance of industrial systems

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

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

- Understand the general industrial requirements like lighting, cleanliness prevention from hazards and accidents.
- Analyze maintenance requirements of the industry and cost associated.
- Analyze wear and corrosion aspects of the industry and their prevention.
- Identifying the faults prone areas and their repair and periodic maintenance.

Reference Books:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

III SEMESTER	COST MANAGEMENT OF ENGINEERING PROJECTS (Common to CS & CE) (Open Elective)	CATEGORY	L-T-P 3-0-0	CREDITS 3

Pre-requisite: MEFA & Management Science

Course Educational Objectives:

- To learn cost concepts in decision making
- To learn different stages and aspects of a project and execution
- To learn resources planning, quality management.
- To learn application of techniques such as linear programming, PERT/CPM
- To learn profit planning and budgeting

Unit I: Introduction and Overview of the Strategic Cost Management Process

Unit II: Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Unit III: Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities.Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts.Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Unit IV: Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems.Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector.Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints.Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis.Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurement of Divisional profitability pricing decisions including transfer pricing.

Unit V: Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Course Outcomes: After completion of this course, the studentwill be able to

- Understand the cost management process and various costs involved in a project
- Analyze various aspects of a project like project site, project team, contracts, execution and commissioning
- Perform various costing and cost management and cost management, profit planning
- Apply linear programming PERT/CPM to cost management

Reference Books:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

III SEMESTER	DISSERTATION PHASE-I	CATEGORY	L-T-P 0-0-20	CREDIT 10

IV SEMESTER	DISSERTATION PHASE-II	CATEGORY	L-T-P 0-0-32	CREDIT 16

AUDIT 1 and 2: ENGLISH FOR RESEARCH PAPER WRITING

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

Syllabus

Units	CONTENTS	Hours
1	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	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,	4
5	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	4
6	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Suggested Studies:

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'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: DISASTER MANAGEMENT

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

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	**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.	4
3	**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	4
4	**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.	4
5	**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.	4
6	**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.	4

Suggested Readings:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.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.

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

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

Syllabus

Unit	Content	Hours
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8
3	• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

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.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood

Being a logical language will help to develop logic in

AUDIT 1 and 2: SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

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

Syllabus

Unit	Content	Hours
1	• Alphabets in Sanskrit, • Past/Present/Future Tense, • Simple Sentences	8
2	• Order • Introduction of roots • Technical information about Sanskrit Literature	8
3	• Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

4. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
5. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
6. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2: VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	Content	Hours
1	• 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	4
2	• 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	6
3	• Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. • Punctuality, Love and Kindness. • 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	6
4	• 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	6

Suggested reading

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

Course outcomes

Students will be able to 1.Knowledge of self-development

2.Learn the importance of Human values 3.Developing the overall personality

AUDIT 1 and 2: CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. 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.
3. 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.

Syllabus

Units	Content	Hours
1	• **History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	• **Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	**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.	4
4	**Organs of Governance:** Parliament Composition Qualifications and Disqualifications Powers and Functions • Executive President Governor Council of Ministers Judiciary, Appointment and Transfer of Judges, Qualifications Powers and Functions	4

5	**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	O 4
6	**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.	4

Suggested reading

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.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. 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.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

Syllabus

Units	Content	Hours
1	**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.	4
2	• Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. • Curriculum, Teacher education.	2
3	• Evidence on the effectiveness of pedagogical practices • Methodology for the in depth 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.	4
4	• 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	4
5	**Research gaps and future directions** Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	2

Suggested reading

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.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	Content	Hours
1	• Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	• Asan and Pranayam 1. Various yog poses and their benefits for mind & body 2. Regularization of breathing techniques and its effects-Types of pranayam	8

Suggested reading

1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also

2. Improve efficiency

AUDIT 1 and 2: PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
1	Neetisatakam-Holistic development of personality • Verses- 19,20,21,22 (wisdom) • Verses- 29,31,32 (pride & heroism) • Verses- 26,28,63,65 (virtue) • Verses- 52,53,59 (dont's) • Verses- 71,73,75,78 (do's)	8
2	• 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.	8
3	• 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: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, • Chapter 4-Verses 18, 38,39 • Chapter18 – Verses 37,38,63	8

Suggested reading

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.

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. 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