19MB4111: BUSINESS ECONOMICS AND FINANCIAL ANALYSIS

B. Tech IV Year I Semester

L	T	P	C
3	-	-	3

Course Objective:

- To understand the concepts of business economics, objectives, scope, role & responsibilities of a manager of a business undertaking.
- To analyse the market dynamics namely demand, elasticity of demand, demand forecasting and supply.
- To Gain the knowledge on the production theories and cost analysis while dealing with the production.
- To explain the process & principles of accounting and to maintain Journal, Ledger, Trial Balance.
- To acquire the basics of how to analyze and interpret the financial statements through ratio analysis.

Course Outcome: At the end of this course, students will demonstrates the ability to

- Determine the objectives, role & responsibilities of a manager of a business undertaking.
- Understand the demand for a product of a company, to analyze various factors influencing demand elasticity and forecast & compute the future sales level of a product.
- Examine optimum production & cost functions with the help of mathematical equations, Assess the cost behaviour, costs useful for managerial decision making.
- Apply the Principle of double entry to the maintenance of books of records and explain the significance and objectives of trial balance and final accounts.
- Analyze, interpret & comment on the financial statements of a business enterprise by using ratios analysis

UNIT – I

Introduction to Business and Economics:

Business: Structure of Business Firm, Theory of Firm, Types of Business Entities, Sources of Capital for a Company, Non-Conventional Sources of Finance.

Economics: Significance of Economics, Micro and Macro Economic Concepts, Concepts and Importance of National Income, Inflation, Money Supply in Inflation, Business Cycle, Features and Phases of Business Cycle. Nature and Scope of Business Economics, Role of Business Economist, Multidisciplinary nature of Business Economics.

UNIT – II

Demand and Supply Analysis:

Elasticity of Demand: Elasticity, Types of Elasticity, Law of Demand, Measurement and Significance of Elasticity of Demand, Factors affecting Elasticity of Demand, Elasticity of Demand in decision making, Demand Forecasting: Characteristics of Good Demand Forecasting, Steps in Demand Forecasting, Methods of Demand Forecasting.

Supply Analysis: Determinants of Supply, Supply Function & Law of Supply.

UNIT- III

Production, Cost, Market Structures & Pricing:

Production Analysis: Factors of Production, Production Function, Production Function with one variable input, two variable inputs, Returns to Scale, Different Types of Production Functions.

Cost analysis: Types of Costs, Short run and Long run Cost Functions.
Market Structures: Nature of Competition, Features of Perfect competition, Monopoly, and Monopolistic Competition.
Pricing: Types of Pricing, Product Life Cycle based Pricing, Break Even Analysis, and Cost Volume Profit Analysis (simple problems).

UNIT - IV

Financial Accounting: Accounting concepts and Conventions, Accounting Equation, Double-Entry system of Accounting, Rules for maintaining Books of Accounts, Journal, Posting to Ledger, Preparation of Trial Balance, Elements of Financial Statements, and Preparation of Final Accounts.

UNIT - V

Financial Analysis through Ratios: Concept of Ratio Analysis, Liquidity Ratios, Turnover Ratios, Profitability Ratios, Proprietary Ratios, Solvency, Leverage Ratios (simple problems).

TEXT BOOKS:

1. D. D. Chaturvedi, S. L. Gupta, "Business Economics - Theory and Applications", International Book House Pvt. Ltd. 2013.
2. Dhanesh K Khatri, "Financial Accounting", Tata McGraw Hill, 2011.
3. Geethika Ghosh, Piyali Gosh, Purba Roy Choudhury, "Managerial Economics", 2e, Tata McGraw Hill Education Pvt. Ltd. 2012.

REFERENCES:

1. Paresh Shah, "Financial Accounting for Management" 2e, Oxford Press, 2015.
2. S. N. Maheshwari, Sunil K Maheshwari, Sharad K Maheshwari, "Financial Accounting", 5e, Vikas Publications, 2013.

19EE4112: POWER SYSTEM OPERATION AND CONTROL

B. Tech IV Year I Semester

L	T	P	C
3	-	-	3

Prerequisite: Power Systems - I & Power Systems - II

Course Objectives:

- To understand optimal operation of generators.
- To understand optimal scheduling of hydro thermal generators.
- To develop model for turbine and generators.
- To know about load frequency control.
- To understand computer Control of Electrical Power Systems.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Analyze the optimal operation of generators.
- Analyze the optimal scheduling of power plants.
- Model the given turbine and generator.
- Discuss about load frequency control.
- .Analyze the power systems automation using SCADA.

UNIT-I: OPTIMAL OPERATION OF GENERATORS

Optimal operation of Generators in Thermal Power Stations – heat rate Curve – Cost Curve – Incremental fuel and Production costs, input-output characteristics, Optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses – Loss Coefficients, General transmission line loss formula.

UNIT – II: HYDROTHERMAL SCHEDULING

Optimal scheduling of Hydrothermal System: Hydroelectric power plant models, scheduling problems-short term hydrothermal scheduling problem.

UNIT – III: MODELLING OF TURBINE, GENERATOR AND AUTOMATIC CONTROLLERS

Modelling of Turbine: First order Turbine model, Block Diagram representation of Steam Turbines and Approximate Linear Models.

Modelling of Generator (Steady State and Transient Models): Description of Simplified Network, Model of a Synchronous Machine (Classical Model), Description of Swing Equation (No Derivation) and State-Space II-Order Mathematical Model of Synchronous Machine.

Modelling of Governor: Mathematical Modelling of Speed Governing System – Derivation of small signal transfer function.

Modelling of Excitation System: Fundamental Characteristics of an Excitation system, Transfer function and Block diagram representation of IEEE Type-1 Model.

UNIT-IV: LOAD FREQUENCY CONTROL

Necessity of keeping frequency constant - Definitions of Control area – Single area control – Block diagram representation of an isolated power system – Steady state analysis – Dynamic response – Uncontrolled case.

Two-Area Load Frequency Control: Load frequency control of 2-area system – uncontrolled case and controlled case, tie-line bias control - Load Frequency Controllers - Proportional plus Integral control of single area and its block diagram representation - steady state response – Load Frequency Control and Economic dispatch control.

UNIT-V: SCADA FUNCTIONS

Introduction to SCADA: Grid Operation & Control - Difficulties in operating the large power systems manually - need for going to SCADA operation - advantages of SCADA operation.

Remote Terminal Unit (RTU) & Communication Practices: Major Components - Types of Communications - Power Line Carrier Communications – Microwave - Optical fibre - VSAT Communication.

TEXTBOOKS:

1. C. L. Wadhwa, "Electrical Power Systems", New age International, 6th Edition, 2018.
2. I. J. Nagrath & D. P. Kothari, "Modern Power System Analysis", Tata McGraw – Hill Publishing Company Ltd, 3rd edition, 2009.
3. Michael John Howard Sterling, "Power System Control", Volume 6 of IEE control engineering series, Published by the Institution of Electrical Engineers, 1978.

REFERENCE BOOKS:

1. J. Duncan Glover and M. S. Sarma, "Power System Analysis and Design", Thompson 6th Edition, 2019.
2. O. I. Elgerd, "Electric Energy systems Theory", Tata McGraw-hill Publishing Company Ltd., Second Edition., 1982.
3. Grainger and Stevenson, "Power System Analysis", Tata McGraw Hill, Indian edition, 1994.
4. Hadi Saadat, "Power System Analysis", TMH Edition, 1999.
5. S. Bennett and D.A. Linkens (Editors): "Real–Time Computer Control", IEE Control engineering series (24), Peter Peregrinus Ltd., 1984.

19EE4171: UTILIZATION OF ELECTRICAL ENERGY
(Professional Elective-III)

B. Tech IV Year I Semester

L	T	P	C
3	-	-	3

Prerequisite: Electrical Machines-I & Electrical Machines-II

Course Objectives:

- To understand the concepts of electric drives and their application to electrical Traction systems.
- To understand the methods of electric heating and welding.
- To understand the fundamentals of illumination and good lighting practices.
- To acquire knowledge about the mechanics of train movement.
- To learn about tractive effort and its calculations.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Discuss electrical drive characteristics and their applications in industries.
- Discuss the various methods of electric heating and welding.
- Design a lighting scheme for residential and commercial premises.
- Discuss the various types of electric traction, types of motors used, and the mechanics of train movement.
- Calculate tractive effort, power, specific energy consumption, and coefficient of adhesion.

UNIT-I: ELECTRIC DRIVES

Type of electric drives, choice of motor, starting and running characteristics, speed control, temperature rise, particular applications of electric drives, types of industrial loads, continuous, intermittent and variable loads, load equalization.

UNIT-II: ELECTRIC HEATING AND ELECTRIC WELDING

Electric Heating: Introduction**,** Advantages and methods of electric heating, resistance heating induction heating and dielectric heating.

Electric Welding: Electric welding, Advantages; Types- resistance and arc welding, electric welding equipment, comparison between A.C. and D.C. Welding; applications.

UNIT-III: ILLUMINATION

Introduction, terms used in illumination, laws of illumination, polar curves, photometry, integrating sphere, sources of light.

Various Illumination Methods: Discharge lamps, MV and SV lamps – comparison between tungsten filament lamps and fluorescent tubes, Basic principles of light control, Types and design of lighting and flood lighting.

UNIT-IV: ELECTRIC TRACTION – I

System of electric traction and track electrification. Review of existing electric traction systems in India. Special features of traction motor, methods of electric braking-plugging rheostat braking and regenerative braking. Mechanics of train movement. Speed-time curves for different services – trapezoidal and quadrilateral speed time curves.

UNIT-V: ELECTRIC TRACTION – II

Calculations of tractive effort, power, specific energy consumption for given run, effect of varying acceleration and braking retardation, adhesive weight and coefficient of adhesion.

TEXT BOOKS

1. E. Openshaw Taylor, "Utilisation of Electric Energy", University Press, 1961.
2. Partab, H., "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Sons, New Delhi, 2017.

REFERENCE BOOKS

1. N. V. Suryanarayana, "Utilization of Electrical Power including Electric drives and Electric traction", NewAge International (P) Limited, Publishers, 2017.
2. C. L. Wadhwa, "Generation, Distribution and Utilization of electrical Energy", New Age International (P) Limited, Publishers, 2015.
3. Tripathy, S.C., "Electric Energy Utilisation and Conservation", Tata McGraw Hill Publishing Company Ltd. New Delhi, 1991.

19EE4172: ELECTRICAL ENERGY CONSERVATION AND AUDITING
(Professional Elective-III)

B. Tech IV Year I Semester

L	T	P	C
3	-	-	3

Prerequisite: Power Systems-I

Course Objectives:

- To familiarize various forms and conservation of energy.
- To know the necessity of energy management and energy auditing techniques.
- To analyze the energy economic efficiency.
- To apply energy conservation techniques in electrical utilities.
- To know the energy efficiency in thermal system.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Describe the fundamental concepts of conservation of energy.
- Demonstrate energy management and energy auditing.
- Analyze the energy efficiency techniques.
- Implement energy conservation techniques in electrical utilities.
- Explain the energy efficiency techniques in thermal system.

UNIT I: ENERGY SCENARIO

Energy sources-Primary and Secondary, Commercial and Non-commercial, Energy scenario in India and Global scenario, Energy Security, Energy and GDP, Energy Intensity, Energy conservation and its importance, Energy Conservation Act 2001 and related policies, Role of Non- conventional and renewable energy.

UNIT II: ENERGY MANAGEMENT AND ENERGY AUDIT

Definition and Objectives of Energy management, Energy management strategy, Key elements, Responsibilities and duties of Energy Manager, Energy efficiency Programs, Energy Monitoring System, Importance of SCADA, Definition, need of energy Audit, Types of Energy Audit, Energy Audit instruments and metering, thermography, SMART metering

UNIT III: FINANCIAL ANALYSIS AND MANAGEMENT

Investment need, Financial analysis techniques, Calculation of Simple Pay-back period, return on investment, cash flows, risk and sensitivity analysis, Time value of money, Net Present value, Breakeven analysis, Cost optimization, Cost and Price of Energy services, Cost of Energy generated through Distributed Generation

UNIT IV: ENERGY EFFICIENCY IN ELECTRICAL UTILITIES

Electrical billing, power factor management, distribution and transformer losses, losses due to unbalance and due to harmonics, Demand Side Management, Demand-Response, Role of tariff in DSM and in Energy management, TOU tariff, Power factor tariff, Integrated Resource Planning and Energy Management Energy conservation in Lighting systems, HVAC, Electric Motors, Pump and Pumping systems

UNIT V: ENERGY EFFICIENCY IN THERMAL SYSTEMS

Fuels and combustion, properties of Fuel Oil, coal and gas, storage and handling of fuels, principles of combustion, combustion of oil, coal, gas. Energy efficiency in Boilers, Steam systems, Furnaces, Insulation and Refractors.

TEXT BOOKS:

1. Tripathy, S.C., "Electric Energy Utilisation and Conservation", Tata McGraw Hill Publishing Company Ltd. New Delhi, 1991.
2. Paul o' Callaghan, "Energy management", McGraw Hill Book Company, 1st edition, 1998.
3. Eastop T.D and Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific &Technical, 1990.

REFERENCE BOOKS:

1. Anthony J. Pansini, Kenneth D. Smalling, "Guide to Electric Load Management. Pennwell Publishers(1998)
2. W.R. Murphy and G. McKay Butter worth, "Energy management", Heinemann publications, 1982.
3. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilization", Hemisphere Publication, Washington, 1988.

19EE4173: POWER SEMICONDUCTOR DRIVES
(Professional Elective-III)

	L	T	P	C
B. Tech IV Year I Semester	**3**	**-**	**-**	**3**

Prerequisite: Electrical Machines – I, Electrical Machines – II and Power Electronics

Course Objectives:

- To acquire knowledge about the drive system and operating modes of drive.
- To study and Understand characteristics of Chopper fed DC drives.
- To study and understand the speed control of induction motor from stator side.
- To study and understand the speed control of induction motor from rotor side.
- To study and understand the control of synchronous motor using various methods.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Differentiate phase-controlled DC drives speed-torque characteristics, merits and demerits. Also, identify the drawbacks of speed control of motor by conventional methods.
- Differentiate chopper-controlled DC drives speed-torque characteristics, merits and demerits. Also, identify the drawbacks of speed control of motor by conventional methods.
- Discuss the speed–torque characteristics of an induction motor drive using different control strategies from stator side and their merits and demerits.
- Discuss the speed–torque characteristics of an induction motor drive using different control strategies from rotor side and their merits and demerits.
- Analyze the synchronous motor drive speed–torque characteristics using different control strategies and its merits and demerits.

UNIT – I: CONVERTER FED DC DRIVES

Introduction to Thyristor controlled Drives, Single-phase semi and fully controlled converters connected to DC separately excited and DC series motors – continuous current operation – output voltage and current waveforms, Speed- Torque Characteristics- Problems on Converter fed DC motors. Three-phase semi and fully controlled converters connected to DC separately excited and DC series motors – continuous current operation – output voltage and current waveforms, Speed- Torque Characteristics- Problems on Converter fed DC motors.

UNIT – II: CHOPPER FED DC DRIVES

Single quadrant, and two quadrant chopper fed DC separately excited and series motors – Continuous current operation – Output voltage and current wave forms – speed-torque characteristics – Problems on chopper fed D.C Motors – Closed Loop operation (Block Diagram Only).

Four Quadrant Operations of DC Drives: Introduction to Four quadrant operation – Motoring operations, Electric Braking – Plugging, Dynamic, and Regenerative Braking operations. Four quadrant operation of D.C motors by single-phase and three-phase dual converters – Closed loop operation of DC motor (Block Diagram Only)

UNIT-III: STATOR SIDE CONTROL OF INDUCTION MOTOR

Variable voltage characteristics-Control of induction motor by AC Voltage Controllers – Waveforms – speed-torque characteristics. Variable frequency characteristics-Variable frequency control of induction motor by Voltage source and current source inverter and cyclo converters- PWM control – Comparison of VSI and CSI operations – Speed-torque

characteristics – numerical problems on induction motor drives – Closed loop operation of induction motor drives (Block Diagram Only)

UNIT – IV: ROTOR SIDE CONTROL OF INDUCTION MOTOR

Rotor resistance control – conventional methods, static rotor resistance control, Slip power recovery schemes – Static Scherbius drive – Static Kramer Drive – their performance and speed-torque characteristics – advantages, applications, and numerical problems.

UNIT –V: CONTROL OF SYNCHRONOUS MOTORS

Control of synchronous motors – Operation of self-controlled synchronous motors by VSI, CSI and Cycloconverters. Load commutated CSI fed Synchronous Motor – Operation – Waveforms – speed torque characteristics – Applications – Advantages and Numerical Problems – Closed Loop control operation of synchronous motor drives (Block Diagram Only), variable frequency control –Cyclo converter, PWM based VSI & CSI.

TEXT BOOKS

1. Gopal K. Dubey, "Fundamentals of Electrical Drives", Narosa Publications, 2nd edition, 2004.
2. R. Krishnan, "Electric Motor Drives - Modeling, Analysis and Control", Pearson Education India, 2015.
3. Bimal K.Bose, "Modern Power Electronics and AC Drives", Pearson Prentice Hall, 2002.
4. Vedam Subramanyam, "Thyristor Control of Electric Drives", Tata McGraw Hill Publications, 1987.

REFERENCE BOOKS

1. S K Pillai, "A First course on Electrical Drives", New Age International (P) Ltd. 2nd Edition, 2012.
2. P. C. Sen, "Thyristor DC Drives", Wiley-Blackwell, 1981.

19EE4174: HVDC TRANSMISSION
(Professional Elective-IV)

B. Tech IV Year I Semester

L	T	P	C
3	-	-	3

Prerequisite: Power Systems-I, Power System-II, Power System Protection and Power Electronics

Course Objectives:

- To study the concepts of HVDC systems and Graetz circuit.
- To study HVDC systems control with various methods.
- To study and understand the power flow analysis in AC/DC systems.
- To study and understand various protection methods for HVDC systems.
- To acquire knowledge about Harmonics and filters.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Compare AC and HVDC system and to describe various types of DC links and Analyze Graetz circuit for rectifier and inverter mode of operation.
- Describe various methods for the control of HVDC systems.
- Perform power flow analysis in AC/DC systems.
- Describe various protection methods for HVDC systems.
- Classify Harmonics and design different types of filters.

UNIT- I: BASIC CONCEPTS

Necessity of HVDC systems, Economics and Terminal equipment of HVDC transmission systems, Types of HVDC Links, Apparatus required for HVDC Systems, Comparison of AC and DC Transmission, Application of DC Transmission System, Planning and Modern trends in D.C. Transmission. Analysis of HVDC Converters: Choice of Converter Configuration, Analysis of Graetz circuit, Characteristics of 6 Pulse and 12 Pulse converters, Cases of two 3 phase converters in Y/Y mode – their performance.

UNIT- II: CONVERTER AND HVDC SYSTEM CONTROL

Principle of DC Link Control, Converters Control Characteristics, Firing angle control, Current and extinction angle control, Effect of source inductance on the system, Starting and stopping of DC link, Power Control. Reactive Power Control in HVDC: Introduction, Reactive Power Requirements in steady state, sources of reactive power- Static VAR Compensators, Reactive power control during transients.

UNIT- III: POWER FLOW ANALYSIS IN AC/DC SYSTEMS

Modelling of DC Links, DC Network, DC Converter, Controller Equations, Solution of DC load flow, P.U. System for DC quantities, solution of AC-DC Power flow-Simultaneous method-Sequential method.

UNIT- IV: CONVERTER FAULTS AND PROTECTION

Converter faults, protection against over current and over voltage in converter station, surge arresters, smoothing reactors, DC breakers, Audible noise, space charge field, corona effects on DC lines, Radio interference.

UNIT-V: HARMONICS

Generation of Harmonics, Characteristics harmonics, calculation of AC Harmonics, Non Characteristics harmonics, adverse effects of harmonics, Calculation of voltage and Current harmonics, Effect of Pulse number on harmonics. Filters: Types of AC filters, Design of Single tuned filters –Design of High pass filters.

TEXT BOOKS:

1. K. R. Padiyar, "HVDC Power Transmission Systems", Third edition, New Age International (P) Limited, Publishers, 2015.
2. S K Kamakshaiah, and V Kamaraju, "HVDC Transmission", TMH Publishers, 2011.

REFERENCE BOOKS:

1. S. Rao, "EHVAC and HVDC Transmission and Distribution Engineering", 3rd Edition, Khanna publishers, 1999.
2. Jos Arrillaga, "HVDC Transmission", the institution of electrical engineers, IEE power & energy series 29, 2nd edition, 1998.
3. E. W. Kimbark, "Direct Current Transmission", John Wiley and Sons, Volume 1, 1971.
4. E. Uhlmann, "Power Transmission by Direct Current", B. S. Publications, 2009.

19EE4175: ELECTRIC AND HYBRID VEHICLES
(Professional Elective-IV)

	L	T	P	C
B. Tech IV Year I Semester	**3**	**-**	**-**	**3**

Prerequisite: Electrical Machines-I, Electrical Machines-II and Power Electronics

Course Objectives:

- To understand the fundamental concepts of conventional vehicles.
- To understand the fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
- To understand the performance of electrical propulsion units with different motor drives.
- To understand electrical energy storage using batteries, fuel cells and super capacitors.
- To understand various energy management strategies in electric vehicles.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Analyze mechanical design of conventional vehicles.
- Describe hybrid vehicles and their performance.
- Analyze various motor drives used in hybrid electrical vehicles.
- Understand different possible ways of energy storage.
- Understand the different strategies related to energy storage systems.

UNIT-I: INTRODUCTION

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, mathematical models to describe vehicle performance.

UNIT-II: HYBRID ELECTRIC VEHICLES

History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies.

UNITIII: ELECTRIC TRAINS

Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies.

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives.

UNIT-IV: ENERGY STORAGE

Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage, battery management system, Fuel Cell based energy storage, Super Capacitor based energy storage, Flywheel-based energy storage, Hybridization of different energy storage devices.

UNIT-V: ENERGY MANAGEMENTS TRATEGIES

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies. Review of various Energy management strategies.

TEXTBOOKS:

1. C. Mi, M. A. Masrurand D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L.Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.

REFERENCES:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.
3. Aishwarya Panday, Hari Om Bansal, "A Review of Optimal Energy Management Strategiesfor Hybrid Electric Vehicle", International Journal of Vehicular Technology, vol. 2014, Article ID 160510, 19 pages, 2014.

19EE4176: ELECTRICAL MACHINE DESIGN
(Professional Elective-IV)

	L	T	P	C
B. Tech IV Year I Semester	**3**	**-**	**-**	**3**

Prerequisite: Electrical Machines-I and Electrical Machines-II

Course Objectives:

- To know the various factors which influence the design electrical machines.
- To understand the design of transformers.
- To study the design of induction motors.
- To know the design of synchronous machines.
- To understand the CAD design concepts.

Course Outcomes: At the end of this course, students will demonstrate the ability to

- Discuss the various factors which influence the design of electrical machines.
- Design single and three-phase transformers.
- Design of induction motors.
- Design of synchronous machines.
- Analyze design concepts of various ac machines using CAD.

UNIT – I: INTRODUCTION

Major considerations in electrical machine design, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings, thermal considerations, heat flow, temperature rise, rating of machines.

UNIT – II: TRANSFORMERS

Sizing of a transformer, main dimensions, kVA output for single and three-phase transformers, window space factor, overall dimensions, operating characteristics, regulation, no load current, temperature rise in transformers, design of cooling tank, methods for cooling of transformers.

UNIT – III: INDUCTION MOTORS

Sizing of an induction motor, main dimensions, length of air gap, rules for selecting rotor slots of squirrel cage machines, design of rotor bars & slots, design of end rings, design of wound rotor, magnetic leakage calculations, leakage reactance of poly-phase machines, magnetizing current, short circuit current, circle diagram, operating characteristics.

UNIT – IV: SYNCHRONOUS MACHINES

Sizing of a synchronous machine, main dimensions, design of salient pole machines, short circuit ratio, shape of pole face, armature design, armature parameters, estimation of airgap length, design of rotor, design of damper winding, determination of full load field m.m.f, design of field winding, design of turbo alternators, rotor design.

UNIT – V: COMPUTER AIDED DESIGN (CAD)

Limitations (assumptions) of traditional designs, need for CAD analysis, synthesis and hybrid methods, design optimization methods, variables, constraints and objective function, problem formulation. Introduction to FEM based machine design. Introduction to complex structures of modern machines. PMSMs, BLDCs, SRM and claw-pole machines.

TEXT BOOKS:

1. A. K. Sawhney, "A Course in Electrical Machine Design", Dhanpat Rai and Sons, 1970.
2. M.G. Say, "Theory & Performance & Design of A.C. Machines", ELBS London.

REFERENCE BOOKS:

1. S. K. Sen, "Principles of Electrical Machine Design with computer programmes", Oxford and IBH Publishing, 2006.
2. K. L. Narang, "A Text Book of Electrical Engineering Drawings", Satya Prakashan, 1969.
3. A. Shanmugasundaram, G. Gangadharan and R. Palani, "Electrical Machine Design Data Book", New Age International, 1979.
4. M. V. Murthy, "Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
5. "Electrical machines and equipment design exercise examples" using Ansoft's Maxwell 2D machine design package.

19EE4151: ELECTRICAL AND ELECTRONICS DESIGN LAB

	L	T	P	C
B. Tech IV Year I Semester	**-**	**-**	**2**	**1**

Prerequisite: Basic Electrical Engineering

Course Objectives:

- To enhance practical knowledge related to different subjects.
- To learn fabrication of various electrical and electronics elements.
- To give an exposure to troubleshoot various components.
- To learn how to design a filter circuit for given application.
- To prepare students for working on different hard ware projects.

Course Outcomes: At the end of this course students will demonstrate the ability to

- Discuss the concepts related to electrical and electronics engineering practically.
- Fabricate basic electrical and electronics circuit elements/networks.
- Troubleshoot the circuits.
- Design filter circuit for application.
- Show hard ware skills such as wiring and soldering.

List of Experiments

Note: Any 10 experiments are required to be conducted from the following list

1. Design and fabrication of electromagnet for different inductance values.
2. Design and fabrication of single phase Induction/three phase induction motor stator.
3. Start delta starter wiring for automatic and manual operation.
4. Wiring of distribution box with MCB, ELCB, RCCB and MCCB.
5. Wiring of 40W tube, T-5 LED and Metal Halide lamp.
6. Assembly of various types of contactors with wiring.
7. Assembly of DOL and 3point starter with NVC connections and over load operation.
8. Design and development of 5V regulated power supply.
9. Design and development of precision rectifier.
10. Design and development of first order/second order low pass/high pass filters
11. Peak detector using op-amplifiers.
12. Zero crossing detector using op-amplifiers.

19EE4152: POWER SYSTEMS SIMULATION LAB

	L	T	P	C
B. Tech IV Year I Semester	**-**	**-**	**2**	**1**

Prerequisites: Power System-I, Power System-II and Power system analysis

Course Objectives

- To understand the distribution of voltage across the insulator string.
- To analyze the transmission line parameters of different configurations of transmission network
- To understand the formation of Y_{BUS} and $Z_{BUS.}$
- To analyze the different types of load flow methods.
- To analyze the fault currents for symmetrical and unsymmetrical faults.

Course Outcomes: At the end of this course students will demonstrate the ability to

- Determine the distribution of voltage across the insulator string.
- Analyze the transmission line parameters of different configurations of transmission network.
- Acquire knowledge on formation of Bus Admittance and Impedance Matrices and Solution of Networks.
- Analyze the different types of load flow methods
- Analyze the fault currents for symmetrical and unsymmetrical fault.

List of Experiments

Note: Any 10 experiments are required to be conducted from the following list

1. Voltage Distribution Across Insulator String
2. Estimation of Tariff Based on Load Curve
3. Calculation of R, L, C, Zs of 3-Phase Transmission Line
4. Modelling of Transmission lines
5. Time response of R-L,R-C and R-L-C circuit
6. Calculation of Fault Currents of Transmission Line
7. Formation of Y_{BUS}
8. Formation of Z_{BUS}.
9. Load Flow Analysis using Gauss Seidal (GS) Method.
10. Single Area Load Frequency control
11. Load Flow Analysis using Fast Decoupled (FD) Method.
12. Optimum Loading of Generators neglecting transmission losses

19EE4181: MAJOR PROJECT PHASE – I

B.Tech IV Year I Semester

L	T	P	C
-	-	6	3

19EE4182: MINI PROJECT

B.Tech IV Year I Semester

L	T	P	C
-	-	-	2

19MB4211: MANAGEMENT SCIENCE

	L	T	P	C
B. Tech IV Year II Semester	**3**	**-**	**-**	**3**

Prerequisites: Business Economics and Financial analysis

Course Objectives:

- To acquire knowledge about management and organisation.
- To understand operations and marketing management.
- To understand human resource management.
- To know about project management through some methods.
- To know strategies for business.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Plan an organisational structure for a given context in the organisation.
- Carry out production operations through Work study, to understand the markets, customers and competition better and price the given products appropriately.
- Ensure quality for a given product or service plan and control the HR function better.
- Plan, schedule and control projects through PERT and CPM.
- Evolve a strategy for a business or service organisation.

UNIT -I: INTRODUCTION TO MANAGEMENT AND ORGANISATION

Concepts of Management and organization- nature, importance and Functions of Management, Systems Approach to Management - Taylor's Scientific Management Theory– Fayal's Principles of Management – Maslow's theory of Hierarchy of Human Needs – Douglas McGregor's Theory X and Theory Y – Hertzberg Two Factor Theory of Motivation - Leadership Styles, Social responsibilities of Management.

Designing Organisational Structures: Basic concepts related to Organisation - Departmentation and Decentralisation, Types and Evaluation of mechanistic and organic structures of organisation and suitability.

UNIT -II: OPERATIONS AND MARKETING MANAGEMENT

Plant location and Plant Layout-Methods of production (Job, Batch and Mass Production), Work Study -Basic procedure involved in Method Study and Work Measurement – Business Process Reengineering (BPR)

Statistical Quality Control: Control charts for Variables and Attributes (simple Problems) and Acceptance Sampling, TQM, Six Sigma, Objectives of Inventory control, EOQ, ABC Analysis, Purchase Procedure, Stores Management and Stores Records – JIT System, Supply Chain Management, Functions of Marketing, Marketing Mix, and Product Life Cycle, Channels of distribution.

UNIT -III: HUMAN RESOURCES MANAGEMENT (HRM)

Concepts of HRM, HRD and Personnel Management and Industrial Relations (PMIR), HRM vs PMIR

Basic functions of HR Manager: Manpower planning, Recruitment, Selection, Training and Development, Placement, Wage and Salary Administration, Promotion, Transfer, Separation, Performance Appraisal, Grievance Handling, Job Evaluation and Merit Rating.

UNIT -IV: PROJECT MANAGEMENT (PERT/CPM)
Network Analysis, Programme Evaluation and Review Technique (PERT), Critical Path Method (CPM), identifying critical path, Probability of Completing the project within given time, Project Cost Analysis, Project Crashing (simple problems).

UNIT -V:STRATEGIC MANAGEMENT AND CONTEMPORARY STRATEGIC ISSUES: Mission, Goals, Objectives, Policy, Strategy, Programmes, Elements of Corporate Planning Process, Environmental Scanning, Value Chain Analysis, SWOT Analysis, Steps in Strategy Formulation and Implementation, Generic Strategy alternatives. Bench Marking and Balanced Score Card as Contemporary Business Strategies.

TEXT BOOKS:

1. Stoner, Freeman, Gilbert, "Management", 6th Ed, Pearson Education, New Delhi, 2004.
2. P. Vijaya Kumar, N. Appa Rao and Ashima B. Chhalill, "Management Science", Cengage India Pvt Ltd, 2012.

REFERENCE BOOKS:

1. Kotler Philip and Keller Kevin Lane: "Marketing Management", Pearson, 2012.
2. Koontz and Weihrich: "Essentials of Management", McGraw Hill, 2012.
3. Thomas N.Duening and John M.Ivancevich "Management—Principles and Guidelines", Biztantra, 2012.
4. Kanishka Bedi, "Production and Operations Management", Oxford University Press, 2012.
5. Samuel C.Certo: "Modern Management", 2012.
6. Schermerhorn, Capling, Poole and Wiesner: "Management", Wiley, 2012.
7. Parnell: "Strategic Management", Cengage, 2012.
8. Lawrence R Jauch, R. Guptaand William F.Glueck:"Business Policy and Strategic Management", Frank Bros. 2012.
9. Aryasri: "Management Science", McGraw Hill, 2012

19EE4271: DIGITAL SIGNAL PROCESSING
(Professional Elective-V)

B. Tech IV Year II Semester

L	T	P	C
3	-	-	3

Prerequisites: Mathematics-III, Control Systems and Signals and Systems

Course Objectives:

- To familiarize the relationships between continuous-time and discrete time signals and systems.
- To study fundamentals of time, frequency and Z-plane analysis and to discuss the inter-relationships of these analytic method.
- To study the designs and structures of IIR digital filters from analysis to synthesis for a given specifications.
- To study the designs and structures of FIR digital filters from analysis to synthesis for a given specifications.
- To acquaint in FFT algorithms, Multi rate signal processing techniques and finite word length effects.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Perform time, frequency, and Z-transform analysis on signals and systems.
- Discuss the inter-relationship between DFT and various transforms.
- Discuss the significance of various filter structures and effects of round off errors.
- Design a digital filter for a given specification.
- Determine the tradeoffs between normal and multi rate DSP techniques and finite length word effects.

UNIT-I: INTRODUCTION

Introduction to Digital Signal Processing: Discrete Time Signals &Sequences, conversion of continuous to discrete signal, Normalized Frequency Linear Shift Invariant Systems, Stability, and Causality, linear differential equation to difference equation Linear Constant Coefficient Difference Equations, Frequency Domain Representation of Discrete Time Signals and Systems

Realization of Digital Filters: Applications of Z–Transforms, Solution of Difference Equations of Digital Filters, System Function, Stability Criterion, Frequency Response of Stable Systems,

UNIT-II: DISCRETE FOURIER TRANSFORMS

Properties of DFT, Linear Convolution of Sequences using DFT, Computation of DFT: Over-Lap Add Method, Over-Lap Save Method, Relation between DTFT, DFS, DFT and Z-Transform. Fast Fourier Transforms: Fast Fourier Transforms (FFT)-Radix-2 Decimation-in-Time and Decimation-in-Frequency FFT Algorithms, Inverse FFT, and FFT with General Radix-N.

UNIT-III: IIR DIGITAL FILTERS

Analog filter approximations–Butter worth and Chebyshev, Design of IIR Digital Filters from Analog Filters, Step and Impulse Invariant Techniques, Bilinear Transformation Method, Spectral Transformations, Realization of Digital Filters–Direct, Canonic, Cascade and Parallel Forms

UNIT-IV: FIR DIGITAL FILTERS

Characteristics of FIR Digital Filters, Frequency Response, and Design of FIR Filters: Fourier Method, Digital Filters using Window Techniques, Frequency Sampling Technique, Comparison of IIR&FIR filters.

UNIT-V: MULTI-RATE DIGITAL SIGNAL PROCESSING

Introduction, Down Sampling, Decimation, Upsampling, Interpolation, Sampling Rate Conversion, Conversion of Band Pass Signals, Concept of Resampling, Applications of Multi Rate Signal Processing.

Finite Word Length Effects: Limit cycles, Over flow Oscillations, Round-off Noise in IIR Digital Filters, Computational Output Round off Noise, Methods to Prevent Over flow, Trade off between Round Off and Overflow Noise, Applications of multi stage signal processing, Dead Band Effects.

TEXTBOOKS:

1. John G. Proakis, Dimitris G. Manolakis "Digital Signal Processing, Principles, Algorithms, and Applications", Pearson Education, PHI, 2007.
2. A. V. Oppenheim and R. W. Schaffer "Discrete Time Signal Processing", PHI, 2009

REFERENCES:

1. Loney Ludeman "Fundamentals of Digital Signal Processing", John Wiley, 2009
2. LiTan "Digital Signal Processing–Fundamentals and Applications", Elsevier, 2008
3. Robert J. Schilling, Sandra L. Harris "Fundamentals of Digital Signal Processing using MATLAB", Thomson, 2007
4. Emmanuel C. Ifeachor and Barrie W. Jervis "Digital Signal Processing - A Practical approach", 2nd Edition, Pearson Education, 2009

19EE4272: POWER QUALITY AND FACTS
(Professional Elective-V)

B. Tech IV Year II Semester

L	T	P	C
3	-	-	3

Prerequisite: Power Systems – II, Power Electronics and Power system Protection and Switch Gear

Course Objectives:

- To know the basic concepts of power quality problems.
- To understand the fundamentals of FACTS Controllers, Importance of controllable parameters.
- To acquire knowledge about Shunt compensation.
- To acquire knowledge about Series compensation.
- To acquire knowledge about combined shunt and Series compensation.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Describe the severity of power quality problems in distribution system.
- Illustrate Transmission Lines and Series/Shunt Reactive Power Compensation.
- Analyze different types of static shunt compensators.
- Analyze different types of static series compensators.
- Analyze the power quality improvement by using combined shunt and Series compensators.

UNIT – I: POWER QUALITY PROBLEMS IN DISTRIBUTION SYSTEMS

Power Quality problems in distribution systems: Transient and Steady state variations in voltage and frequency. Unbalance, Sags, Swells, Interruptions, Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations. Flicker and its measurement.

UNIT- II: TRANSMISSION LINES AND SERIES/SHUNT REACTIVE POWER COMPENSATION

Basics of AC Transmission. Analysis of uncompensated AC transmission lines. Passive Reactive Power Compensation. Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

UNIT- III: STATIC SHUNT COMPENSATORS

Objectives of shunt compensation, Methods of controllable VAR generation, Static Var Compensator, its characteristics, TCR, TSC, FC-TCR configurations, STATCOM, basic operating principle, control approaches and characteristics

UNIT- IV: STATIC SERIES COMPENSATORS

Objectives of series compensator, variable impedance type of series compensators, TCSC, TSSC-operating principles and control schemes, SSSC, Power Angle characteristics, Control range and VAR rating, Capability to provide reactive power compensation, external control

UNIT-V: COMBINED COMPENSATORS

Introduction to Unified Power Flow Controller, Basic operating principles, Conventional control capabilities, independent control of real and reactive power.

TEXT BOOKS:

1. C.Sankaran "Power Quality", CRC Press
2. Math H. J. Bollen "Understanding power quality problems", IEEE press.
3. Narain G. Honorani, Laszlo Gyugyi "Understanding FACTS –Concepts and Technology of Flexible AC Transmission Systems"

REFERENCE BOOKS:

1. Dugan Roger C, Santoso Surya, Mc Granaghan, Marks F. Beaty and H. Wayre "Electrical Power Systems Quality", McGraw Hill
2. J. Arillaga, N.R. Watson, S.Clon "Power Systems Quality Assessment", John Wiley.

19EE4273: ELECTRICAL DISTRIBUTION SYSTEMS
(Professional Elective-V)

B. Tech IV Year II Semester

L	T	P	C
3	-	-	3

Prerequisites: Power System – I and Power System – II.

Course Objectives:

- To acquire knowledge about distribution systems.
- To study design considerations of feeders.
- To compute voltage drop and power loss in feeders.
- To study protection of distribution systems.
- To examine the power factor improvement and voltage control.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Discuss basic concepts of distribution systems.
- Design distribution feeders.
- Compute power loss and voltage drop of the feeders.
- Design protection system for distribution systems.
- Discuss the importance of voltage control and power factor improvement.

UNIT – I: INTRODUCTION TO DISTRIBUTION SYSTEMS

Introduction: Distribution system planning, Factors affecting the Distribution system planning, Load modelling and characteristics. Coincidence factor – contribution factor - Loss factor - Relationship between the load factor and loss factor. Load growth, Classification of loads (Residential, commercial, Agricultural and Industrial) and their characteristics.

UNIT – II: DISTRIBUTION FEEDERS

Design Considerations of Distribution Feeders: Radial, loop and network types of primary feeders, Introduction to low voltage distribution systems (LVDS) and High voltage distribution systems (HVDS), voltage levels, Factors effecting the feeder voltage level, feeder loading.

Substations: Locations of substations, rating of distribution substation, service area within primary feeders. Benefits derived through optimal location of substations (Perpendicular bisector rule and X, Y co-ordinate method).

UNIT - III: DISTRIBUTION SYSTEM ANALYSIS

Voltage drop and Power-loss calculations: Derivation for voltage drop and power loss in lines, manual methods of solution for radial networks, three phase balanced primary lines, analysis of non-three phase systems, method to analyze the distribution feeder cost.

UNIT -IV: PROTECTIVE DEVICES & CO ORDINATION

Objectives of distribution system protection, types of common faults and procedure for fault calculations.

Protective Devices: Principle of operation of Fuses, Auto Circuit Reclosers, and line sectionalizes, and circuit breakers.

Coordination: Coordination of Protective Devices: Objectives of protection co-ordination, General coordination procedure, Types of protection coordination: Fuse to Fuse, Autorecloser to Fuse, Circuit breaker to Fuse, Circuit breaker to Autorecloser.

UNIT – V: COMPENSATION FOR POWER FACTOR IMPROVEMENT

Capacitive compensation for power-factor control -Different types of power capacitors, Calculation of Power factor correction, and capacitor allocation - Economic justification of capacitors - Procedure to determine the best capacitor location.

Voltage Control: Importance of voltage control, methods of voltage control, Equipment for voltage control, effect of shunt capacitors, effect of series capacitors, effect of AVB/AVR on voltage control, line drop compensation, voltage fluctuations.

TEXT BOOKS:

1. Turan Gonen, "Electric Power Distribution System Engineering", CRC Press, 3rd Edition 2014.
2. V. Kamaraju, "Electrical Power Distribution Systems", Tata McGraw Hill Publishing Company, 2nd edition, 2010.

REFERENCE BOOKS:

1. G. Ram Murthy, "Electrical Power Distribution hand book", 2nd edition, University press 2004.
2. A.S. Pabla, "Electric Power Distribution", Tata McGraw Hill Publishing company, 6th edition, 2013.

19EE4274: ADVANCED POWER ELECTRONICS
(Professional Elective-VI)

B. Tech IV Year II Semester

L	T	P	C
3	-	-	3

Prerequisite: Power Electronics

Course Objectives:

- To acquire knowledge about switching regulators.
- To study and understand resonant pulse inverters.
- To study and understand multilevel inverters.
- To acquire knowledge about power supplies.
- To know applications of power electronics.

Course Outcomes: At the end of this course, students will demonstrate the ability to:

- Evaluate different dc-dc voltage regulators.
- Simulate and analyze resonant converters.
- Select appropriate phase shifting converter for a multi-pulse converter.
- Discuss about power supplies.
- Analyze the applications of power electronics.

UNIT-I: SWITCHING VOLTAGE REGULATORS

Introduction: Linear power supply (voltage regulators); Switching voltage regulators- Flyback converter, Forward converter, half bridge, Full bridge configurations, Push-pull converter, Cuk converter, SEPIC Converter; Design criteria for SMPS; Multi output switch mode regulator Averaging Models of Converters, State–Space Analysis of Regulators, Design Considerations for Input Filter and Converters, Drive IC for Converters.

UNIT-II: RESONANT PULSE INVERTERS

Introduction: Series Resonant Inverters, Parallel Resonant Inverters, Voltage Controlled Resonant Inverters, Class E Resonant Inverter, Class E Resonant Rectifier, Zero–Current Switching (ZCS) Resonant Converters, Zero Voltage Switching Resonant Converters (ZVS), Comparison between ZCS and ZVS Resonant Converters, Two Quadrant ZVS Resonant Converters, Resonant DC – Link Inverters.

UNIT-III: MULTILEVEL INVERTERS

Introduction: Multilevel Concept, Types of Multilevel Inverters, Diode – Clamped Multilevel Inverter, Flying - Capacitors Multilevel Inverter. Cascaded Multilevel Inverter, Applications, Features of Multilevel Inverters, Comparison of Multilevel Converters.

UNIT-IV: D.C & A.C POWER SUPPLIES

Introduction: DC Power Supplies-classification, switched mode dc power supplies, AC Power Supplies-classification, switched mode ac power supplies, Resonant AC power supplies – bidirectional ac power supplies, Multistage Conversions, Control Circuits.

UNIT-V: RESIDENTIAL AND INDUSTRIAL APPLICATIONS

High Voltage DC Transmission, Static VAR Compensators, Interconnection of Renewable Energy Sources and Energy Storage systems to the Utility Grid, Active Filters. Power line disturbances – power conditioners – Uninterruptible Power supplies – applications.

TEXT BOOKS

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics Circuits, Devices and Applications", Prentice Hall of India, 3rd edition, 2009.
3. Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc., 2006.

REFERENCE BOOKS

1. Derek A. Paice, "Power Electronic Converter Harmonics Multipulse Methods for Clean Power", IEEE Press, 1996.
2. Muhammad H. Rashid, "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
3. P.C.Sen, "Modern Power Electronics", S. Chand and Co. Ltd., New Delhi, 2000.
4. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009.

19EE4275: MODERN CONTROL SYSTEMS
(Professional Elective-VI)

B. Tech IV Year II Semester

L	T	P	C
3	-	-	3

Prerequisite: Control Systems

Course Objectives:

- To learn the designing of state variable feedback systems.
- To acquire knowledge of state space and state feedback in modern control systems.
- To know the design of feedback control systems.
- To acquire knowledge about optimal control systems.
- To know about digital time systems.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Analyze mathematical modelling and analysis of different canonical forms.
- Discuss state space and state feedback in modern control systems, pole placement, design of state observers and output feedback controllers.
- Analyze and design different feedback control systems using different control design techniques.
- Perform the stability analysis nonlinear systems by Lyapunov method develop design skills in optimal control problems.
- Derive discrete-time mathematical models in both time domain (difference equations, state equations) and z domain (transfer function using z-transform).

UNIT-1: DESIGN OF STATE VARIABLE FEEDBACK SYSTEMS

Introduction, State space representation of physical systems, State space models of some common systems like R-L-C networks, DC motor, etc., Controllable Canonical Form, Observable Canonical Form, Diagonal Canonical Form, State transition matrix, Solution of state equations, Controllability and Observability, Full-State Feedback Control Design; Observer Design; Integrated Full-State Feedback and Observer;

UNIT-2: STATE SPACE REPRESENTATION

Discrete- Time State Space Equations, Solution of Discrete- Time State Space Equations, Z-Transfer from State Space Equations, Similarity Transformation, Stability of State Space Realizations, Controllability and Observability State Feedback Control: On State and Output Feedback, Pole Placement, Principles of Observer, State Feedback and Pole Assignment Using Transfer Functions.

UNIT-3: DESIGN OF FEEDBACK CONTROL SYSTEMS

Introduction; Approaches to System Design; Cascade Compensation Networks; Phase-Lead Design Using the Bode Diagram; Phase-Lead Design Using the Root Locus; System Design Using Integration Networks; Phase-Lag Design Using the Root Locus; Phase-Lag, phase lead Design Using the Bode Diagram; Design on the Bode Diagram.

UNIT-4: INTRODUCTION TO ROBUST CONTROL AND OPTIMAL CONTROL

Robust control system and system sensitivities to parameter perturbations, analysis of

robustness, systems with uncertain parameters, considerations in design of robust control system, robust PID controller. Lyapunov's stability Lyapunav stability criteria.

UNIT-5: DISCRETE –TIME SYSTEMS

The Structure of a Digital Control System, Analog Systems with Piecewise Constant Inputs, Difference Equations, The Z- Transform, Z- Transform Solution of Difference Equation, The Time Response of a Discrete- Time System, Frequency Response of Discrete- Time Systems. Stability of Digital Control Systems: Definitions of Stability, Stable Z- Domain Pole Locations, Stability Conditions, Stability Determination, and Jury Test.

TEXT BOOKS:

1. B.C.Kuo, "Digital control systems", Oxford University Press, 2007.
2. M. Gopal, "Control Systems, Principles and Design", McGraw Hill, 2012.
3. Ogata, K. "Discrete-time Control Systems", Pearson Education, 2015.

REFERENCE BOOKS:

1. M. Sami Fadali, Antonio Visioli, "Digital Control Engineering: Analysis and Design", Academic Press; 1st edition, 2009.
2. Bandyopadhyay, M.N. "Control Engineering: Theory and Practice", Prentice-Hall of India Private Limited, 2003.

19EE4276: OPTIMIZATION TECHNIQUES
(Professional Elective-VI)

B. Tech IV Year II Semester

L	T	P	C
3	-	-	3

Prerequisite: Mathematics–I and Mathematics–II

Course Objectives:

- To study and understand the various optimization techniques.
- To acquire knowledge about linear programming.
- To acquire knowledge about unconstrained nonlinear programming.
- To know about constrained nonlinear programming.
- To study and understand dynamic programming.

Course Outcomes: At the end of this course, students will demonstrates the ability to

- Explain the need of optimization of engineering systems.
- Apply linear programming method to solve engineering problems.
- Apply unconstrained non linear programming technique to solve engineering problems.
- Apply constrained non-linear programming to solve engineering problems.
- Apply dynamic programming technique to solve engineering problems.

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.

Classical Optimization Techniques: Single variable Optimization–multi variable Optimization without constraints – necessary and sufficient conditions for minimum/maximum–multi variable Optimization with equality constraints. Solution by method of Lagrange multipliers–Multi variable 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.

Transportation Problem: Finding initial basic feasible solution by north–west corner rule, least cost method and Vogel's approximation method–testing for optimality of balanced transportation problems.

UNIT-III: UNCONSTRAINED NONLINEAR PROGRAMMING

One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method

Unconstrained Optimization Techniques: Uni-variant method, Powell's method and steepest descent method.

UNIT-IV: CONSTRAINED NON-LINEARPROGRAMMING

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-V: DYNAMIC PROGRAMMING

Dynamic programming multistage decision processes–types–concept of sub optimization and the principle of optimality–computational procedure in dynamic programming–examples illustrating the calculus method of solution-examples illustrating the tabular method of solution.

TEXTBOOKS:

1. Singiresu S. Rao, "Engineering Optimization: Theory and Practice", John Wiley and Sons, 4th edition, 2009.
2. H. S. Kaseneand K. D. Kumar, "Introductory Operations Research", Springer (India), Pvt. Ltd., 2004.

REFERENCES:

1. George Bernard Dantzig, Mukund Narain Thapa, "Linear programming", Springer series in operations research 3rdedition, 2003.
2. H. A. Taha, "Operations Research: An Introduction", 10thEdition, Pearson/Prentice Hall, 2016.
3. Kalyanmoy Deb, "Optimization for Engineering Design–Algorithms and Example", PHI Learning Pvt. Ltd, New Delhi, 2012.

19EE4281: MAJOR PROJECT-PHASE II

B.Tech IV Year II Semester

L	T	P	C
-	-	14	7