RTM Nagpur University

B.Tech. 6th semester Electrical Engineering
Subject: Engineering Economics and Industrial Management. (Credits: 03)
Syllabus - Theory (BTCHEE6O1T)

Examination Scheme: Internal Assessment – 30 marks, University Exam - 70marks

Course Objective:

This course is designed to familiarize the learners with important economic terminologies and key industrial concepts and to create awareness about functions of Industrial management and the concept of marketing and financial management.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concept of demand and supply and its relationship with the price
CO2	Relate various factors of production with reference to different economic sectors
CO3	Analyze the causes and effects of inflation and understand the market structure
CO4	Acquire knowledge of various functions of management and marketing management
CO5	Perceive the concept of financial management for the growth of business.

SYLLABUS - SUBJECT: ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT

UNITS	CONTENTS	NO.OF HOUR
UNIT 1	Industrial Economics: Law of demand, Demand analysis, Types of demand, Determinants of demand, Supply, Law of diminishing marginal utility, Elasticity of demand, Types of elasticity of demand.	08
UNIT 2	Factors of production, Firm and Industry, Law of return, Cost concepts, Fixed variable, Average, Marginal and Total cost, Depreciation and methods for depreciation, direct and indirect taxes	**07**
UNIT 3	Inflation, effect of inflation, Monetary and fiscal measures to control inflation, deflation, Market and market structures, Perfect competition, Monopoly, Monopolistic competition, Oligopoly, Concept & overview of share market, Effect of share market on economy, Share market terminologies.	**09**
UNIT 4	Definition, nature and scope of management, functions of management, Meaning and concepts of Marketing management, Marketing Mix, Channels of distribution, Advertising and sales promotion.	**08**
UNIT 5	Meaning, nature and scope of financial management, Brief outline of profit and loss account, balance sheet, Budgets and their importance, Types of budgets- Rigid and flexible budgets.	**08**

TEXT BOOKS:

1. Modern Economics, H. L. Ahuja, S.Chand Publishers
2. Modern Economic Theory, K. K. Dewett., S. Chand Publishers
3. Engineering Economics, D. N. Dwivedi, A. Dwivedi, Vikas Publishing House
4. Industrial Management I.K. Chopde, A.M. Sheikh
5. Business Organization and Management S.A. Sherlekar

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RTM Nagpur University – Electrical Engineering

6TH SEM B. Tech. – Computer Applications in Power System (BTCHEE602T)

Syllabus (Theory)

Sr. No.	**Course Objective** The objective of this course is -
1	This course is designed to give students the basic knowledge for the design and analysis of electrical power system , formation of Zbus and its importance are covered in this course
2	Calculation of power flow in a power system network using various techniques,
3	It is also deals with short circuit analysis and transient stability analysis.
	Course Outcomes
After successful completion of this course students will be able to	
CO1	Students will be able to determine bus Impedance & Admittance matrix by singular transformation for power system.
CO2	Determine bus Impedance & Admittance matrix by inspection and building algorithm and able to accommodate changes in Power System
CO3	Do the Short circuit calculation for symmetrical and unsymmetrical fault using bus impedance and admittance matrix.
CO4	Do the load flow analysis by N-R method and Transient stability analysis by Modified Eulers method.

SYLLABUS - **Computer Applications in Power System**	
Contents	No. of Hours
UNIT 1:- Power System Network Matrices -1 :- Definitions of Graph theory, Incidence Matrices, Primitive matrices, calculation of Network matrices by singular Transformation Methods.	7
UNIT 2:- Power System Network Matrices -2:- Derivation of addition of branch and addition of link. Formation of Z_{BUS} &Y_{Bus} by algorithms. Modification of Z_{BUS} for changes in power system.	9
UNIT 3:- **Three Phase Network Matrices:-** Three phase balance and unbalanced network elements for balance and unbalance excitation. Formation of sequence impedance matrix. **Short circuit studies:** Short circuit calculation for Balance three phase network using ZBUS (Three phase to ground fault and Line to ground fault).	10
UNIT 4:- **Load Flow Analysis:** Power system load flow equation, solution technique: Newton Raphson method in rectangular form without PV bus. **Transient stability studies:** Modelling of synchronous machine, power system network for transient stability studies. Numerical solution of swing equation by modified Euler method.	10

Books Recommended

TEXT BOOKS:

1. Computer Method in Power system Analysis by Stagg & El-Abaid, McGraw Hill
2. Computer Techniques in Power System Analysisby Dr. M. A. Pai, McGraw Hill Education(india) Pvt. Ltd.

REFERENCE BOOKS:

1. Modern power system analysis by D.P.Kothari and I.J.Nagrath , TMG
2. Power system Analysis by J.J.Grainger & W.D.Stevenson. Jr, TMH,2007.
3. Power System Analysis by Hadi Saadat – TMH Edition.

DATA BOOK:

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RTM Nagpur University – Electrical Engineering
6TH SEM, B. Tech. – SWITCHGEAR AND PROTECTION (BTCHEE603T)
Syllabus (Theory)

Sr. No.	Course Objectives The objectives of this course are-
1	To make the students to realize the importance of power system protection.
2	To introduce the students with the basic terminology of protective relaying, types of faults and different components used in power system protection.
3	To make the students to understand different types of Relays and Protective Schemes used in power system protection.
4	To demonstrate the construction, working and applications of different Circuit Breakers.

Course Outcomes	
After successful completion of this course the students will able to :	
CO1	Understand basic terminology of Protective Relaying, different types of faults and components used in Power System protection.
CO2	Apply over-current protection schemes for Medium voltage lines.
CO3	Apply various distance protection schemes for High voltage lines.
CO4	Understand differential and other protections used for Generator, Transformer and Motors
CO5	Comprehend switching phenomenon and working of various types of circuit breakers.

SYLLABUS - SWITCHGEAR AND PROTECTION

Contents	No. of Hours
UNIT I –General Philosophy of Protection: Necessity of protection, Nature and causes of faults, Types and effects of faults, Fault Statistics, Protective zones, Primary and Back up protection, Essential qualities of Protection, Basic trip circuit. Introduction of Fuses, MCB, ELCB and their comparison. Classification of relays. Introduction, working principal and comparison of Electromechanical, Static and Numerical relays.	10
UNIT II –Over-current Protection: Over current relaying, Time-Current characteristics, Current setting, Time setting, Relay coordination, Over current protection schemes for Medium voltage Lines, directional- over current relay, Protection of parallel feeders and ring mains.	8
UNIT III –Distance Protection: Distance Protection for High Voltage Lines, Working Principal and characteristics of Impedance Relay, Mho Relay, Reactance Relay, Three step distance protection scheme with contact diagrams, Effect of Power swing, arc resistance, Line length and source impedance on the operation of distance relays, Carrier aided distance Protection Schemes with contact diagrams. Carrier current protection.	8
UNIT IV – Equipment Protection: Principles of differential relaying, causes and remedies for mal operation of differential protection, protection of generator and transformers by differential relaying and other relays. Protection of Induction Motors against overloading and short circuits.	10
UNIT V –Switchgears: Arc interruption theory, recovery and Restricting voltages, RRRV, breaking of inductive and capacitive currents, different media of arc interruption, Construction and operation of Air blast, SF6 and vacuum circuit breakers.	8

Books Recommended :

Text books		
Title of book	**Name of Author/s**	**Edition & publisher**
Switchgear and protection	Sunil S. Rao	Khanna publication, 1992. New delhi
Power system protection and Switchgear	B. Ravindranath, M. Chander	New age International
Power system protection and Switchgear	B. Ram	Tata McGraw Hill
Fundamental of power system protection	Y. G. Paithankar, S. R. Bhide	Prentice hall, India, second edition, 2010
Reference books		
The art and science of protective relaying	C. Russell Mason	Willey, 1956
Protective Relaying Vol. I & II	Warrington	Springer
Switchgear Handbook	R. T. Lythall	J and P Newness Butterworth, London.

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RTMNU, Nagpur University-Electrical Engineering
6th Sem B.Tech. Semester- Open Elective-I: PLC and SCADA System-BTCHEE604T
Syllabus (Theory)

Sr. No.	Course Objective The objective of this course is to impart knowledge on the following topics-
1.	To have the basic concept, components and programming of PLC for Automation.
2.	To implement ladder logics for various applications.
3.	To understand SCADA displays and its applications.

Course Outcome	
After successful completion of this course students will be able to	
CO-1	Identify and understand components of PLCs for Automation
CO-2	Select appropriate module as per application.
CO-3	Develop PLC Programming for given application.
CO-4	Understand SCADA System.
CO-5	Develop SCADA system for various applications.

Syllabus (Open Elective-I: PLC and SCADA System)	
Content	**No. of Hours**
Unit I: **Introduction to PLC:** Need and tools of Automation, Evolution of PLC, Architecture-PLC Block diagram and working, Selection of PLC, Types of PLCs, Advantage, limitations and applications of PLCs, Networking of PLCs.	6
Unit II: **PLC Hardware:** Input and Output Modules for PLC- working, description, wiring details, specifications, interfacing; Instruction sets for given operation, Ladder Programming, Ladder logics for some applications.	8
Unit III: **PLC Programming and Applications:** Programming Languages for PLCs, PLC programming standard IEC61131, Relay type Instructions- Timer, Counter, Arithmetic operation, Data handling instructions. PLC based applications as motor control, traffic light, etc.	8
Unit IV: **Introduction to SCADA:** Application area of SCADA; Architecture-Elements, block diagram of SCADA; Types of SCADA; Features of SCADA, MTU, RTU Functions, Communications in SCADA, Applications of SCADA.	6
Unit V: **SCADA Interfacing and Applications:** Interfacing of SCADA with PLC, Creating SCADA display, Application of SCADA for ON-OFF Lamp, Traffic light control, water level control, motor control, etc.	8

Books Recommended:
Reference Books:

1. Programmable Logic controllers and Industrial Automation: Madhuchhanda Mitra, SamarjitSen Gupta, Penram International Publishing India Pvt. Ltd
2. Supervisory Control and Data Acquisition: S.A. Boyar, ISA Publication.
3. Programmable Logic controllers: V.R. Jadhav, Khanna Publications.

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RTM Nagpur University-Electrical Engineering

6th Semester B.Tech (Electrical Engineering) (CBCS)-BTCHEE604T

Course Objective:

Students will be able to study:-

- The basic Principle of Heat Transfer, Solar Tracking
- The simple modal of PV cell and PV Modules
- Balance of Solar PV Systems
- Photovoltaic system design,Distributed Generation and Smart Consumption

Subject: Solar PV System

Course Outcome:

After successful completion of this course students would be able to:

- Review Solar Tracking, tracking control and find heat radiation related queries
- Analyse the simple modal of PV cell and PV Modules
- Analyse the balance of Solar PV Systems having battery and inverter
- Demonstrate various Photovoltaic system configuration
- Apply Solar PV to Various Distributed Generation and Smart Consumption

Unit	Contents	No. of hours
Unit I: Basics of Solar Energy	basics of heat transfer, conduction, convection, radiation of heat, absorption, reflection and transmission of radiation; movement of Sun in the sky, solar tracking, types of solar tracking systems, methods and algorithms for solar tracking, tracking control	**06**
Unit II: Solar Photovoltaic Modules	Solar PV Module from solar PV cell, Mismatches in series/Parallel connection, design and structure of PV Module,PV module power output: I-V equation of PV Module, Rating of PV Module, I-V and Power curve of Module, Effect of solar Irradiation/Temperature	**09**
Unit III: Balance of Solar PV Systems:	Basic of Electrochemical cell,Factor affecting battery performance, batteries for PV system, DC-DC/DC-AC converter, Charge controller, MPPT	**08**
Unit IV: Photovoltaic system design & Application	Standalone PV system configuration, Design methodology of PV system, Hybrid PV system, grid connected PV system(configuration and working of single stage grid connected PV system) Simple payback period	**08**
Unit V : Distributed Generation and Smart Consumption:	Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid	**07**

	B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid.	

Text Book:

1. Solar Photovoltaics: Fundamentals, Technologies and Applications by Chetan Singh Solanki, Prentice Hall India, 3rd Edition. ISBN 9788120351110
2. Gilbert M. Masters: Renewable and Efficient Electric Power Systems. John Wiley & Sons, 2004
3. S. Sukhatme -Solar Energy: Principles of Thermal Collection and Storage McGraw Hill

Reference Books:

1. Roger A. Messenger & Jerry Ventre: Photovoltaic Systems Engineering. CRC Press, 2004, 2nd.

2. Trainers Textbook Solar Thermal Systems Module, Ministry of New and Renewable Energy, Government of India

3.StuartBorlase , Smart Grid: Infrastructure, Technology and Solutions, CRC Press 2012, ISBN 9781439829059.

4.Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, Smart Grid: Technology and Applications, Wiley, 2012, Print ISBN:9780470974094 |Online ISBN:9781119968696.

5.Mini S. Thomas, John D McDonald, Power System SCADA and Smart

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Grids, CRC Press, 2015, ISBN-13: 978-1482226744

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Faculty of Engineering and Technology

B.Tech Programming Programming 6th sem (Electrical)

Subject: Organizational Behaviour (BTCHEE604T)

Evaluation Scheme:(70/30)

(L-3Hrs/Week,T-1Hrs/Week);TotalCredits–3.

ExamDuration:3hrs

Objective: The objective of the course is to create awareness among learners about the various essential aspects of organizational processes and structure and motivation in organization.

Course outcomes: By the end of the course, students will be able to

1. Understand the concept and importance of organizational behaviour.
2. acquire the knowledge of interpersonal behaviour and transaction analysis
3. know different traits and theories of personality
4. analyze the importance of motivation in organization and types of leadership
5. relate personal life with professional life and their management

Unit 1. Introduction to organizational behaviour.

Concept of organization behaviour, Importance of organization behaviour, Key elements of organization behaviour, scope of organizational behaviour, authority and power

Unit 2: Introduction to interpersonal behaviour.

Nature and meaning of interpersonal behaviour, concept of transaction analysis, benefits and uses of transaction analysis, Johari window model, productivity performance and organization behaviour

Unit 3: Introduction to personality

Definition and meaning of personality, importance of personality, theories of personality, personality traits, sources of conflict

Unit 4: Introduction to Motivation and leadership.

Concept and importance of motivation, Maslow's two factor theory of motivation. Significance of motivation in organization. Types of leadership styles, difference between leaders and managers

Unit 5: Introduction to Work life balance

Importance of job satisfaction, organizational change and its significance, change management, work stress, prevention and management of work stress, work-life balance, organizational development

List of books

1. Organizational behaviour by MN Mishra, published by S.Chand.
2. The human side of organization by Michale Drafke, published by Pearson education.
3. Management and Organizational behaviour by Laurie.J. Mullins, published by Pearson education.
4. Organizational behaviour by K. Aaswathappa, Published by Himalaya publications.
5. Organizational Behaviour and Management by S.K. Srivastava, Sarup and Sons, 2005
6. Management Strategies and Organizational Behaviour, by Arvindrai N. Desai, Ashish Publishing House, 1989

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RTM Nagpur University

B.Tech. 6th semester Electrical Engineering

Subject: Numerical Mathematics and Probability Using MATLAB

(BTCHEE6O4T)

Course Objectives:

1. A primary objective is to introduce and develop advanced mathematical skills of students that are imperative for effective understanding of engineering subjects.

2. The topics covered will equip them with the techniques to understand advanced level Mathematics and its applications that would enrich logical thinking power.

Course Outcomes:

After completing the course, students will be able to

1. Learn and use MATLAB effectively in various applications as a simulation tool.

2. Find an approximate solution of algebraic and transcendental equations, system of linear equations and first order ordinary differential equations by various numerical methods and MATLAB commands.

3. Apply Z- transform to solve difference equations with constant coefficients.

4. Analyze real world scenarios to recognize when probability is appropriate, formulate problems about the scenarios; creatively model these in order to solve the problems using multiple approaches

5. Understand the impact of scientific and engineering solutions in a global and societal context.

6. Create the groundwork for post-graduate courses, specialized study, and research in mathematics.

Course Contents

Unit I: INTRODUCTION TO MATLAB (14 Hours)

Introduction, What is MATLAB?, The MATLAB system, MATLAB documentation, Starting and quitting MATLAB, MATLAB desktop matrices, array matrices and magic squares, MATLAB Expressions, Controlling command window input and output, Graphics overview of MATLAB plotting, Types of functions.

Unit II: NUMERICAL METHODS - I (14 Hours)

Error Analysis, Solution of Algebraic and Transcendental Equations: Method of False position, Newton–Raphson method and its convergence, Basic MATLAB command "fzero" to find real roots of f(x) = 0. Solution of system of simultaneous linear equations: Crout's method (LU decomposition Method), Gauss-Seidel method, MATLAB Built-in function for LU and Gauss-Seidel method.

Unit III: NUMERICAL METHODS - II (14 Hours)

Numerical solution of ordinary differential equations: Taylor's series method, Euler's modified method, Runge- Kutta 4th order method, Milne's predictor corrector method, RungeKutta method to solve simultaneous first order differential equations, Introduction of MATLAB commands for solving ordinary differential equations.

Unit IV: Z-TRANSFORM (14 Hours)

Definition, Convergence of Z-transform and properties (Statement only), Inverse Z-transform by partial fraction method, Residue method (Inversion integral method), Convolution of two sequences, Solution of difference equations with constant coefficients by Z-transform, Use of MATLAB commands ztrans(f), ztrans(f, transVar), ztrans(f, var, transVar).

Unit V: PROBABILITY (14 Hours)

Review of discrete and continuous random variables, Mathematical expectation, Variance and Standard deviation, Moments, Moment generating function, Skewness and Kurtosis, Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution, Use of MATLAB functions for numerical solution of special probability distributions.

Text/Reference Books:

(1) Applied Numerical Methods Using MATLAB (Wiley), Won Y. Yang, Wenwu Cao, Jaekwon Kim, Kyung W. Park, Ho-Hyun Park, JingonJoung, Jong-Suk Ro, Han L. Lee, Cheol-Ho Hong, Taeholm.

(2) Numerical Methods Using MATLAB (PHI), John H. Mathews, Kurtis D. Fink.

(3) Numerical Methods for Engineers and Scientists (An introduction with Applications Using MATLAB) (WILEY), Amos Gilat, Vish Subramanian.

(4) Higher Engineering Mathematics (Khanna Publications), B. S. Grewal.

(5) Advanced Engineering Mathematics (Wiley), Erwin Kreyszig.

(6) Advanced Engineering Mathematics (S. Chand), H. K. Dass. (7) Probability and Statistics (Schaum's Outline Series), Murray Spiegel, John Schiller, R. A. Srinivasan

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RTM Nagpur University - Electrical Engineering
6th sem, B.Tech.
PROFESSIONAL ELECTIVE: II (Advanced Control System)

Subject Code: BTCHEE605T

Syllabus (Theory)

S.N.	Course Objective The Objective of this course are
1	Compute the methods for State variable analysis.
2	Formulate Optimal control problem.
3	To analyze the behavior of nonlinear control systems
4	To apply concept to continuous & discrete time systems with z-transform.

Course Outcomes:-

After successful completion of this course the student will be able to:

CO1	Determine State Transition Matrix and solution of state equation for the given system.
CO2	Evaluate controllability, observability and design suitable state feedback vector for the given control system.
CO3	Evaluate Optimal Control Problem.
CO4	Describe different types of non-linearities in control system.
CO5	Solve stability problems of discrete time digital control system.

SYLLABUS :- Advanced Control System

Unit No	Contents	No. of hours
Unit 1	**State Variable Analysis:** Review of state variable representations , diagonalization of state model, Eigen value, Eigen vectors and stability , generalized Eigen vector, properties of state transition matrix (STM) , Computation of STM by Laplace transform, CayleyHamilton theorem and Canonical transformation method, Solution of state equation	08
Unit 2	**Control System Design in State Space:** Concept of Controllability & Observability, Kalman's test and Gilbert's test, Duality, Effect of Pole Zero Cancellation on Controllability and Observability. Design of State variable feedback, Pole Placement design through effect of state feedback	06
Unit 3	**Optimal Control System:** Performance Index (PI). Desirability of single P.I. Integral Square Error (ISE), Parseval'sTheorem, parameter Optimization with & without constraints.	06
Unit 4	**Non Linear Control Systems:** Types of non – linearities, jump resonance. Describing function analysis and its assumptions. Describing function of some	08

	common non- linearities, Singular points, Stability from nature of singular points. Limit cycles.	
Unit 5	**Digital Control System:** Basics of Digital Control System, Representation of Sampled Data Control System. Sample & Hold circuit. Effects of Sampling, Shannon's Sampling theorem. Z-Transform, Inverse Z- Transform & solution of Differential Equations. 'Z' & 'S' domain relationship. Stability by Bi-linear transformation &Jury's test.	08

Books Recommended:

Text Books:

1. Control System Analysis by Nagrath &Gopal, Publisher – New Age International
2. Linear Control System Analysis and Design by ConstantineH.Houpis,StuartN.Sheldon,JohnJ.D'Azzo,ConstantineH.Houpis,StuartN.Sheldon, Publisher- CRC Press
3. Digital Control by M.Gopal Publisher- TataMcGraw-Hill

Reference Books :

1 Modern Control Engineering by K.Ogata, Publisher- Prentice Hall

2 Modern control system by M. Gopal publisher – New Age International

3 Modern Control Engineering by D.Roy Choudhury publisher- PHI Learning Private Limited,

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RTMNagpurUniversity-ElectricalEngineering

6th SEM,B.Tech.- Optimization Techniques (BTCHEE6O5T)

Syllabus(Theory)

SrNo	Course Objective The objective of this course is-
1	To study classical and advanced techniques in optimization.
2	To introduce students to apply these techniques constructively to make effective decisions.
3	To apply knowledge of optimization theory to Electrical Engineering area.

Course Outcomes

Aftersuccessfulcompletionofthiscoursethestudentwillbeableto:

CO1	Formulate optimization problems as mathematical programming problems.
CO2	Select proper method to solve a given optimization problem.
CO3	Apply classical optimization techniques to solve linear optimization problems.
CO4	Apply classical optimization techniques to solve non- linear optimization problems.
CO5	Apply appropriate optimization _ techniques to solve the engineering optimization problems

Syllabus (Optimization Technique)

Content	No. of Hours
Unit I Introduction: Historical Development, Engineering applications of optimization, statement of an optimization problem, Formulation of optimization problem, classification of optimization techniques.	08
Unit II Classical optimization techniques Single and multi-variable optimization without constraints (necessary and sufficient conditions-without proof,) Multi variable optimization with equality constraints-Lagrange multiplier method, optimization with calculus-Kuhn-Tucker conditions.	08
Unit III Linear programming Graphical method, Simplex method, Revised simplex method, Duality in linear programming, Dual simplex method, Sensitivity analysis, Balanced and unbalancedtransportation problem-north west corner method, least cost method and vogel's approximation method for finding initial basic feasible solution, stepping stone method to find optimum solution	08
Unit IV Non-linear programming Unimodal function, One dimensional minimization – unrestricted search, Fibonacci search method and Golden section method, Unconstrained optimization - direct search method 69 (simplex method), Descent methods (steepest descent method and conjugate gradient method), Constrained optimization – sequential quadratic programming method.	08
Unit V Dynamic programming Multistage decision processes, concept of sub optimization and principle of optimality, linear programming as a case of dynamic programming, Application for solving unit commitment problem.	08

Books Recommended: -

Text Book

1. Engineering Optimization: Theory and Practice, S.S.Rao, New Age International Pub.2011.
2. Operations Research, H.A.Taha, Prentice Hall India Pub., 2007.
3. Operations Research-Theory and Applications, J.K. Sharma, Macmillan India Ltd., New Delhi. -2009

Reference Book

1. Introduction Operations Research, Fredrick S.Hiller Gerald J.L. Lieberman Tata McGraw Hill Pub., 2004.
2. K. Deb, "Optimization for Engineering Design – Algorithms and Examples", Prentice-Hall of India Pub., 1995.

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B.Tech. 6th semester Electrical EngineeringSubject:

Electrical Drives & Their Control (BTCHEE605T)

Syllabus - Theory

Examination Scheme: Internal Assessment – 30 marks, University Exam - 70marks

Course Objective:

This course is designed to familiarize the learners with

- Starting, speed control, braking, heating, cooling characteristics of electric motors and necessity of flywheel.
- The basics of PLC, its programming , Digital Control of Electric motors and its Application
- The motors used in Electric Traction, Electric Vehicles and its control strategies.

Course Outcomes: After completing the course, the students will be able to	
CO1	Understand the concept of Electrical characteristics like starting, speed control and braking along with numerical
CO2	Relate various factors of industries with reference to PLC, its programming and Digital Control
CO3	Analyze the causes and effects of motor control used in Electric Vehicle
CO4	Acquire knowledge of various electrical drives used in industries, AC & DC contactors and work on drives used in Industries
CO5	Perceive the concept of Electric traction and their control strategies used in practice.

SYLLABUS - SUBJECT: Electrical Drives & Their Control

UNITS	CONTENTS	NO.OF HOUR
UNIT 1	**Characteristics of Electrical Motors :** Definition, classification, speed- torque characteristics of common drive motors and their characteristics under starting, running, braking and speed control. SELECTION OF MOTOR: Power capacity for continuous and intermittent periodic duties. Flywheel Effect	08
UNIT 2	**PLC & Digital Control :** PLC, its Programming and its application in electrical drives. Brief idea about drives commonly used in industries. Digital control of electric motor. Block diagram, comparison with other methods of control	08
UNIT 3	**Basics of Electric Vehicle (EV) :** Definition of EV, Block diagram, Types of EV, Electric Motors and speed control, Motors Controllers and battery Charging.	08
UNIT 4	**AC & DC contactors and relays:** Lock out contactors, magnetic structure, operation arc interruption, contactor rating, HV contactors, control circuit for automatic starting and braking of DC motor and three phase induction motor drives. Control panel design for MCC	08
UNIT 5	**Electric Traction Drives**: Motors used in AC/DC traction, their performance and desirable characteristics, requirements and suitability of motor for traction duty. Traction motor control – control of DC traction motor. Series parallel control with numerical starting and braking of traction motor.	08

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TEXT BOOKS:

1. A course in Electrical Power , Soni, Gupta and Bhatnagar
2. Modern Electrical Traction , H. Pratap
3. Basic course in Electrical Drives, S. K. Pillai
4. Fundamentals of electrical Drives & Control, V.Singhal & B.R.Gupta
5. Advance Electrical Drives, Rik D Doncker, Andre Veltman, Ducco Wj Pulle
6. Electric Drives, R.S.Lodhi, D.P.Kothari
7. Electric Vehicle Technology, Prof. Sunil Pawar

Reference Book:-

1. Fundamentals of electrical Drives, G.K.Dubey
2. Electrical Drives, Vedam Subramanyam

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