



**ACE**  
**ENGINEERING COLLEGE**  
 Ankushapur, Ghatkesar-501301

**B. Tech. in ELECTRICAL AND ELECTRONICS ENGINEERING**  
**COURSE STRUCTURE & SYLLABUS (ACER22 Regulations)**

**IV YEAR II SEMESTER**

<b>S. No.</b>	<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1		Open Elective-III	3	0	0	3
2		Professional Elective-V	3	0	0	3
3		Professional Elective-VI	3	0	0	3
4	EE801PC	Project Stage-II including Seminar	0	0	22	11
		<b>Total Credits</b>	<b>9</b>	<b>0</b>	<b>22</b>	<b>20</b>

**EE831OE: CHARGING INFRASTRUCTURE FOR ELECTRIC VEHICLES****(Open Elective - III.1)****IV Year B.Tech. EEE II-Sem****L T P C****3 0 0 3****Prerequisite:** None, Interest in Electric Vehicles.**Course Objectives:**

- Gain understanding of the various components involved in an electric vehicle charging system.
- Comprehend the different types of electric vehicle chargers, along with the applicable standards governing their design and operation.
- Interpret the diverse communication protocols utilized in electric vehicle charging systems and stay familiar with the latest trends in this evolving field.

**Course Outcomes:** At the end of this course, students will be able to:

- Understand the various components of Electric vehicle charging system
- Comprehend the different types of Electric vehicle chargers and their standards
- Interpret the various communication protocols and recent trends in Electric vehicle charging

**UNIT-I:****Introduction to EV charging:**

Electric Vehicle Charging; Charging Modes; Electric Vehicle Supply Equipment (EVSE): Types, Components of EV Battery Chargers; Challenges in Electric Vehicle Charging.

**UNIT-II:****Charger sizing and standards:**

Charger Classification; Slow Charging and Fast Charging; DC Charging and AC Charging; Selection and Sizing of Chargers: Charger Connectors and Cables; Charging Standards: Connectors, Supply Equipment; EMI/EMC; Testing Methods for Chargers and EVSE

**UNIT-III:****EV charger communications protocols:**

Open Charge Point Protocol (OCPP); Open System Interconnection Layer Model (OSI); Adapted PWM Signal based Low-level Communication; PLC based High-level Communication; CAN Communication; Billing and Authentication

**UNIT-IV:****Public charging infrastructure:**

Location, Planning and Implementation of Public Charging Stations; Components; Selection and Sizing

- HT/LT Equipment & Cables; Protection; Safety Standards: Policy and Regulatory Aspects; EV Charging Station and their Business Models;

Economic Aspects; Major Challenges

**UNIT-V:**

**Future frontiers in EV charging:**

Bulk Charging; Battery Swapping; Wireless Charging; EVs as Distributed Storage  
Resources: Grid to Vehicle (G2V) and Vehicle to Grid (V2G), V2X Concept,  
Integration of Charging Station with Renewable Sources and its Impact on the Grid

**TEXT BOOKS:**

1. Iqbal Husain, “Electric and Hybrid Vehicles: Design Fundamentals”, 3rd Edition, CRC Press, 2021
2. Code of Practice for Electric Vehicle Charging Equipment Installation, 4th Edition, IET, 2020.

**REFERENCE BOOKS:**

1. Sheldon S. Williamson, “Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles”, 1st Edition, Springer, 2013.
  3. Tom Denton, “Automotive Electrical and Electronic Systems”, 5th Edition, Routledge, 2018.
  4. Wolfhard Lawrenz, “CAN System Engineering: From Theory to Practical Applications”, Springer, 2nd Edition, 2013.
- Weblink: <https://www.udemy.com/course/charging-infrastructure-for-electric-vehicles/>

**EE832OE: RELIABILITY ENGINEERING****(Open Elective - III.2)****IV Year B.Tech. EEE II-Sem****L T P C****3 0 0 3**

**Prerequisite:** Mathematics-III (Laplace Transforms, Numerical Methods and Complex variables)

**Course Objectives:**

- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems

**Course Outcomes:** At the end of this course, students will be able to:

- model various systems applying reliability networks and evaluation of the same
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irreparable systems

**UNIT-I:**

**Basic Probability Theory:** Elements of probability, probability distributions, Random variables, Density and Distribution functions- Mathematical expected – variance and standard deviation – **BINOMIAL DISTRIBUTION:** Concepts, properties, engineering applications.

**UNIT-II:**

**Network Modeling And Evaluation Of Simple Systems:** Basic concepts- Evaluation of network Reliability / Unreliability - Series systems, Parallel systems - Series-Parallel systems- Partially redundant systems- Examples.

**Network Modeling And Evaluation Of Complex Systems:** Conditional probability method- tie set, Cut-set approach- Event tree and reduced event tree methods- Relationships between tie and cut-sets-Examples.

**UNIT-III:**

**Probability Distributions In Reliability Evaluation:** Distribution concepts, Terminology of distributions, General reliability functions, Evaluation of the reliability functions, shape of reliability functions –Poisson distribution – normal distribution, exponential distribution, Weibull distribution.

**Network Reliability Evaluation Using Probability Distributions:** Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

**UNIT-IV:**

**Discrete Markov Chains:** Basic concepts- Stochastic transitional probability matrix- time dependent probability evaluation- Limiting State Probability evaluation- Absorbing states – Application.

**Continuous Markov Processes:** Modeling concepts- State space diagrams- Unreliability evaluation of single and two component repairable systems

**UNIT-V:**

**Frequency And Duration Techniques:** Frequency and duration concepts, application to multi state problems, Frequency balance approach.

**Approximate System Reliability Evaluation:** Series systems – Parallel systems- Network reduction techniques- Cut set approach- Common mode failures modeling and evaluation techniques- Examples.

**TEXT BOOKS:**

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited

**REFERENCE BOOKS:**

1. Reliability Engineering: Theory and Practice by Alessandro Birolini, Springer Publications.
2. An Introduction to Reliability and Maintainability Engineering by Charles Ebeling, TMH Publications.
3. Reliability Engineering by Elsayed A. Elsayed, Prentice Hall Publications.

**EE851PE: POWER QUALITY & FACTS**  
(Professional Elective-V.1)

**IV Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Prerequisite:** Power Electronics, Power System Operation and Control, HVDC Transmission

**Course Objectives:**

- Define power quality and explore various terms associated with it. Study voltage-related powerquality issues, focusing on short and long interruptions.
- Conduct a detailed study on characterizing voltage sags, with a specific emphasis on magnitude and three-phase unbalanced voltage sags. Understand how power quality issues affect the behaviour of power electronics loads and rotating machinery.
- Gain an understanding of FACTS controllers, their controllable parameters, and types. Explore the importance of shunt and series compensation, focusing on the control and comparison of STATCOM and SVC, and the functioning and regulation of other FACTS devices like GCSC, TSSC, and TCSC.

**Course Outcomes:** At the end of this course, students will be able to:

- Develop an awareness of the severity of power quality issues in distribution systems, focusing on their impact and challenges.
- Understand the concept of transforming voltage sags from upstream (higher voltages) to downstream (lower voltage) in the distribution system.
- Demonstrate competence in selecting controllers based on specific applications and system requirements. Thoroughly understand various systems and their requirements, including the control circuits of shunt controllers (SVC & STATCOM) and series controllers (GCSC, TSSC, and TCSC) for enhancing transient stability, preventing voltage instability, and damping power oscillations.

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

**REFERENCE BOOKS:**

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

**EE852PE: SOLAR POWER BATTERIES**  
(Professional Elective-V.2)

**IV Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Prerequisite:** Renewable Energy Sources, Energy Storage Systems

**Course Objectives:**

- To understand the PV systems and the solar power batteries operation
- To analyze the solar PV system storage with batteries.
- To understand Grid Tie vs. Off-Grid Solar Battery System

**Course Outcomes:** At the end of this course, students will be able to:

- Know operating principles of different types of solar power batteries
- Use the batteries for effective storage of solar PV.
- Gain the knowledge on environmental impacts of solar power batteries.

**UNIT-I:**

Introduction to solar PV systems, basics of Storage for solar PV systems, Storage for solar PV systems: the batteries, Introduction to Solar Power Batteries, terminology associated, understanding Solar Battery Specifications, working principle, Series Vs. Parallel, Charging parameters, cycle life, Temperature effects, Battery Design and Construction, Important components in battery construction.

**UNIT-II:**

Primary and Secondary batteries, Classification of Secondary batteries, i.e Lead-Acid, Lead-Antimony, Lead-Calcium, Lead-Acid Battery Chemistry, Nickel-Cadmium Batteries and their types.

**UNIT-III:**

AC Coupled Storage vs. DC Coupled Storage, working of Solar Batteries with a Solar Power System and Hybrid Inverter, Main Degradation mechanisms of Solar Batteries, Battery Strengths and Weaknesses, Battery System Design and Selection Criteria, Life Expectancy, Battery standards, Safety precautions,

**UNIT-IV:**

Solar Battery Costs, Declining Cost, factors contribute to the performance of solar battery, selection of suitable batteries based on the application, Grid Tie vs. Off-Grid Solar Battery System, Benefits and disadvantages of using solar batteries,

**UNIT-V:**

The environmental impacts of batteries: Introduction, Service life of the

components, Energy requirements for production and transport of the PV-battery system components, Contributing components, Influence of different user conditions, Uncertainties, Future research, Energy return factor, The overall battery efficiency, Different efficiency measures and battery design, The Future of Solar Battery Storage.

**TEXT BOOKS:**

1. S. Sumathi and L. Ashok Kumar, Solar PV and Wind Energy Conversion Systems: An Introduction to Theory, Modeling with MATLAB/SIMULINK, and the Role of Soft Computing Techniques, Springer 2011
2. H.A. Kiehne, "Battery Technology Handbook" by *Publisher*: CRC Press 2003
3. <https://core.ac.uk/download/pdf/30044842.pdf>
4. Handbook on Battery Energy Storage System
5. <https://www.adb.org/sites/default/files/publication/479891/handbook-battery-energy-storage-system.pdf>

**REFERENCE BOOKS:**

1. Cristina Archer and S. Lovejoy, Battery Technology for Electric Vehicles: Public Science and Private Innovation, Springer 2015
2. Soteris A. Kalogirou, "Solar Energy Engineering: Processes and Systems" by, Academic Press, Year: 2009
3. [https://files.bregroup.com/bre-co-uk-file-library-copy/filelibrary/nsc/Documents%20Library/NSC%20Publications/88031-BRE\\_Solar-Consumer-Guide-A4-12pp.pdf](https://files.bregroup.com/bre-co-uk-file-library-copy/filelibrary/nsc/Documents%20Library/NSC%20Publications/88031-BRE_Solar-Consumer-Guide-A4-12pp.pdf)
4. <https://www.sunwize.com/tech-notes/solar-battery-basics/>
5. <https://palmetto.com/learning-center/blog/how-does-a-solar-battery-work>
6. <https://www.letsgosolar.com/faq/what-is-a-solar-battery/>
7. <https://www.purevolt.ie/domestic-solar/equipment/solar-storage-batteries.php>

**EE853PE: AI TECHNIQUES IN ELECTRICAL ENGINEERING**  
**(Professional Elective-V.3)**

**IV Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Pre-requisites:** Power Systems Operation and Control

**Course Objectives:**

- To locate soft commanding methodologies, such as artificial neural networks, Fuzzy logic and genetic Algorithms.
- To observe the concepts of FFN and concept of fuzziness involved in various systems and comprehensive knowledge of fuzzy logic control and to design the fuzzy control
- To analyze genetic algorithm, genetic operations and genetic mutations.

**Course Outcomes:** At the end of this course, students will be able to:

- Understand feed forward neural networks, feedback neural networks and learning techniques.
- Understand fuzziness involved in various systems and fuzzy set theory.
- Develop fuzzy logic control and genetic algorithm for applications in electrical engineering.

**UNIT-I:**

**Artificial Neural Networks:** Introduction, Models of Neuron Network-Architectures –Knowledge representation, Artificial Intelligence and Neural networks–Learning process-Error correction learning, Hebbian learning – Competitive learning-Boltzmann learning, supervised learning-Unsupervised learning–Reinforcement Learning-Learning tasks.

**UNIT-II:**

**ANN Paradigms:** Multi-layer perceptron using Back propagation Algorithm (BPA), Self –Organizing Map (SOM), Radial Basis Function Network-Functional Link Network (FLN), Hopfield Network.

**UNIT-III:**

**Fuzzy Logic:** Introduction –Fuzzy versus crisp, Fuzzy Sets-Membership function – Basic Fuzzy set operations, Properties of Fuzzy sets –Fuzzy Cartesian Product, Operations on Fuzzy relations –Fuzzy logic–Fuzzy Quantifiers, Fuzzy Inference-Fuzzy Rule based system, Defuzzification methods.

**UNIT-IV:**

**Genetic Algorithms:** Introduction-Encoding –Fitness Function-Reproduction operators, Genetic Modeling –Genetic Operators-Cross over-Single site cross over, two points cross over –Multi point cross over Uniform cross over, Matrix cross

over-Cross over Rate-Inversion & Deletion, Mutation operator –Mutation – Mutation Rate-Bit-wise operators, Generational cycle-convergence of Genetic Algorithm.

**UNIT-V:**

**Applications Of AI Techniques:** Load forecasting, Load flow studies, Economic load dispatch, Load frequency control, Single area system and two area system, Reactive power control, Speed control of DC and AC Motors.

**TEXT BOOKS:**

1. S. Rajasekaran and G.A.V.Pai Neural Networks, Fuzzy Logic & Genetic Algorithms, PHI, New Delhi, 2003.
2. Rober J. Schalkoff, Artificial Neural Networks, Tata McGraw Hill Edition, 2011.

**REFERENCE BOOKS:**

1. P. D. Wasserman; Neural Computing Theory & Practice, Van Nostrand Reinhold, New York, 1989.
2. Bart Kosko; Neural Network & Fuzzy System, Prentice Hall, 1992
3. D. E. Goldberg, Genetic Algorithms, Addison-Wesley 1999.

**EE861PE: SMART GRID TECHNOLOGIES**  
**(Professional Elective-VI.1)**

**IV Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Pre-requisites:** None

**Course Objectives:**

- To defend smart grid design to meet the needs of a utility
- To select issues and challenges that remain to be solved
- To analyze basics of electricity, electricity generation, economics of supply and demand, and the various aspects of electricity market operations in both regulated and deregulated environment.

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

- Understand the features of smart grid in the context of Indian grid.
- Understand the role of automation in transmission and distribution.
- Apply evolutionary algorithms for smart grid and understand operation, maintenance of PMUs, PDCs, WAMs, and voltage and frequency control in micro grid

**UNIT-I:**

**Introduction To Smart Grid:** What is Smart Grid? Working definitions of Smart Grid and Associated Concepts –Smart grid Functions-Traditional Power Grid and Smart Grid –New Technologies for Smart Grid – Advantages –Indian Smart Grid –Key Challenges for Smart Grid.

**UNIT- II:**

**Smart Grid Architecture:** Components and Architecture of Smart Grid Design –Review of the proposed architectures for Smart Grid. The fundamental components of Smart Grid designs — Transmission Automation – Distribution Automation –Renewable Integration

**UNIT- III:**

**Tools And Techniques For Smart Grid:** Computational Techniques –Static and Dynamic Optimization Techniques –Computational Intelligence Techniques – Evolutionary Algorithms –Artificial Intelligence techniques.

**UNIT-IV:**

**Distribution Generation Technologies:** Introduction to Renewable Energy Technologies – Micro grids

–Storage Technologies –Electric Vehicles and plug –in hybrids –Environmental impact and ClimateChange –Economic Issues.

**Communication Technologies And Smart Grid:** Introduction to

Communication Technology –Synchro-Phasor Measurement Units (PMUs) –Wide Area Measurement Systems (WAMS).

**UNIT-V:**

**Control Of Smart Power Grid System**

Load Frequency Control (LFC) in Micro Grid System –Voltage Control in Micro Grid System – ReactivePower Control in Smart Grid. Case Studies and Test beds for the Smart Grids.

**TEXT BOOKS:**

1. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 2013
2. Gil Masters, Renewable and Efficient Electric Power System, Wiley-IEEE Press, 2004.

**REFERENCE BOOKS:**

1. A.G. Phadke and J.S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer Edition, 2010.
2. T. Ackermann, Wind Power in Power Systems, Hoboken, NJ, USA, John Wiley, 2005.

## **EE862PE: ELECTRICAL DISTRIBUTION SYSTEMS**

**(Professional Elective-VI.2)**

**IV Year B.Tech. EEE II-Sem**

**L T P C**  
**3 0 0 3**

**Prerequisites:** Power System – I, Power System - II

**Course Objectives:**

- To understand design considerations of feeders
- To compute voltage, drop and power loss in feeders
- To understand protection, PF improvement and voltage control

**Course Outcomes:** At the end of this course, students will be able to:

- design the feeders and compute power loss and voltage drop of the feeders
- design protection of distribution systems
- understand the importance of voltage control and power factor improvement

**UNIT-I:**

**General Concepts**

Introduction to distribution system, Distribution system planning, Factors effecting 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.

**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, Application of general circuit constants (A, B, C, D) to radial feeders, basic design practice of the secondary distribution system, secondary banking, secondary network types, secondary mains.

**UNIT-II:**

**Substations:** Location of Substations: Rating of distribution substation, service area with 'n' primary feeders. Benefits derived through optimal location of substations. Optimal location of Substations (Perpendicular bisector rule and X, Y co-ordinate method).

**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-III:**

**Protection:** Objectives of distribution system protection, types of common faults and procedure for fault calculations, over current Protective Devices: Principle of operation of Fuses, Auto-Circuit Recloser - and Auto-line sectionalizers, and circuit breakers.

**Coordination:** Coordination of Protective Devices: Objectives of protection coordination, general coordination procedure, Types of protection coordination: Fuse to Fuse, Auto-Recloser to Fuse, Circuit breaker to Fuse, Circuit breaker to Auto-Recloser.

**UNIT-IV:**

**Compensation For Power Factor Improvement:** Capacitive compensation for power-factor control - Different types of power capacitors, shunt and series capacitors, effect of shunt capacitors (Fixed and switched), effect of series capacitors, difference between shunt and series capacitors, Calculation of Power factor correction, capacitor allocation - Economic justification of capacitors - Procedure to determine the best capacitor location.

**UNIT-V:**

**Voltage Control:** 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, 3<sup>rd</sup> Edition 2014.
2. V. Kamaraju, Electrical Power Distribution Systems, Tata Mc Graw Hill Publishing Company, 2<sup>nd</sup> edition, 2010.

**REFERENCE BOOKS:**

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

**EE863PE: MACHINE LEARNING APPLICATIONS TO ELECTRICAL  
ENGINEERING**

**(Professional Elective-VI.3)**

**IV Year B.Tech. EEE II-Sem**

**L T P C  
3 0 0 3**

**Prerequisites:** Mathematics, Python

**Course Objectives:**

- To develop a foundational understanding of machine learning principles and techniques.
- To explore and understand how machine learning can be integrated into various electrical engineering applications.
- To gain hands-on experience in implementing machine learning algorithms to solve real-world electrical engineering problems.

**Course Outcomes:** At the end of this course, students will be able to:

- Demonstrate proficiency in applying machine learning algorithms to solve real-world problems in electrical engineering
- Integrate machine learning principles effectively into electrical engineering applications,
- Enhance problem-solving skills by successfully addressing complex issues in electrical engineering through machine learning.

**UNIT-I:**

**Introduction to Machine Learning:**

Definition and types of machine learning, Historical perspective, Basic concepts: supervised learning, unsupervised learning, reinforcement learning

**UNIT-II:**

**Fundamentals of Electrical Engineering Relevant to ML:**

Overview of electrical circuits and systems, Signal processing basics, Introduction to control systems

**UNIT-III:**

**Data Preprocessing and Feature Engineering:**

Data cleaning and handling missing values, Feature scaling and normalization, Feature extraction and selection

**UNIT-IV:**

**Machine Learning Algorithms for Electrical Engineering Applications**

Regression and classification algorithms, Decision trees and ensemble methods, Neural networks and deep learning, Support vector machines, Clustering algorithms for pattern recognition

**UNIT-V:****Case Studies and Applications in Electrical Engineering**

Power system optimization using ML, Fault detection and diagnostics in electrical systems, Smart grid applications, Signal processing with ML, Control system optimization and adaptive control using ML

**TEXT BOOKS:**

1. C. Aldrin Renold and Sumathi S., Pattern Recognition and Machine Learning, Wiley India, 2015.
2. S. Rajasekaran and G. Aghila, Machine Learning: An Algorithmic Perspective, Chapman and Hall/CRC, 2018
3. Chandra Shekhar Yadav, S. Ramakrishnan, and U. Rajendra Acharya, Machine Learning: Concepts, Methodologies, Tools and Applications, Springer 2018.

**REFERENCE BOOKS:**

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press 2010
2. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
3. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press 2012.