VIDYA JYOTHI
INSTITUTE OF TECHNOLOGY
AN AUTONOMOUS INSTITUTION

Accredited by NAAC & NBA, Approved By A.I.C.T.E., New Delhi, Permanently Affiliated to JNTUH, Hyderabad
Aziz Nagar, C.B.Post, Hyderabad -500075

Board of Studies Meeting
of
Department of Electrical and Electronics Engineering
held on 22.12.2025

Department of Electrical and Electronics Engineering

VJIT / BOS / EEE / 2025 / 3 Date: 19.12.2025

BOARD OF STUDIES MEETING NOTICE

The Board of Studies meeting of Electrical and Electronics Engineering department is scheduled to be held on 22.12.2025 at 11:30 AM (in online mode). You are requested to make it convenient to attend the same.

Items on Agenda:

1. To discuss and decide the course structure of II Year B.Tech Electrical and Electronics Engineering and syllabi of courses offered by Department of Electrical and Electronics Engineering for II Year B.Tech Electrical and Electronics Engineering students admitted from the AY 2025-2026 (R25 Regulation).
2. To ratify the course structure and syllabi of Minor Course "Electric Vehicles" offered by Department of Electrical and Electronics Engineering for other branch students admitted from the AY 2025-26 (R25 Regulation).
3. Any other matter with the permission of the Chair.

C.N. Sai

Chairman
BOS of EEE

Department of Electrical and Electronics Engineering

Minutes of the Board of Studies of Department of Electrical and Electronics Engineering meeting held on 22-12-2025 at 11:30AM.

The following members were present in the meeting.

S. No	Name of the Member	Designation	Signature
1	Dr. C. N. Ravi, Professor & HOD, Dept. of EEE, VJIT	Chairman	CN Ravi
2	Dr. S. Tara Kalyani, Senior Professor, EEE, JNTUH UCESTH	JNTUH Nominee	S. Tara Kalyani 22/12/25
3	Dr. A. Srujana, Principal & Professor, VJIT	Internal Member	Srujana
4	Dr. P. Chow Reddy, Managing Director, Interleaved Multidisciplinary Research Centre	Industry Member	[signature]
5	Dr. T. Anil Kumar, Professor and HOD, EEE, Anurag University	External Member	Anil
6	Dr. G. Suresh Babu, Professor, EEE, CBIT	External Member	[signature]
7	Dr. P. Krishna Murthy, Director, Jayaprakash Narayanan College of Engineering	External Member	[signature]
8	Dr. N. Bhupesh Kumar, Professor, Dept. of EEE, VJIT	Internal Member	[signature]
9	Dr. D. Chandra Sekhar , Associate Professor, Dept. of EEE, VJIT	Internal Member	[signature]
10	Mr. T. Parameshwar, Associate Professor, Dept. of EEE, VJIT	Internal Member	[signature]
11	Mr. P. Nageshwara Rao, Associate Professor, Dept. of EEE, VJIT	Internal Member	[signature]
12	Mr. B. Rajesh, Assistant Professor, Dept. of EEE, VJIT	Internal Member	B Rajesh 22/12/25

Resolutions

Item No.1: To discuss and decide the course structure of II Year B.Tech Electrical and Electronics Engineering and syllabi of courses offered by Department of Electrical and Electronics Engineering for II Year B.Tech Electrical and Electronics Engineering students admitted from the AY 2025-2026 (R25 Regulation). Annexure - I

The Chairman presented the course structure of II Year B.Tech EEE admitted from AY 2025-26 and courses offered by EEE Department for the same as per Annexure-I.

After discussing various aspects of the Course Structure and syllabi the committee passed the following resolution.

Resolution (1): The members after thorough discussion approved the course structure and syllabi of II Year B. Tech. in Electrical and Electronics Engineering for R25 Regulation as per **Annexure-I**

Noted and Approved.

Item No.2: To discuss and decide the course structure and syllabi of Minor Course "Electric Vehicles" offered by Department of Electrical and Electronics Engineering for other branch students admitted from the AY 2025-26 (R25 Regulation). Annexure - II

The Chairman presented the proposed course structure and syllabi of Minor Course in **"Electric Vehicles"** offered by Department of Electrical and Electronics Engineering for other branch students admitted from the AY 2025-26 (R25 Regulation).

Resolution (2): The members after thorough discussion approved the course structure and syllabi of Minor Course "Electric Vehicles" offered by Department of Electrical and Electronics Engineering for other branch students admitted from the AY 2025-26 (R25 Regulation) as per **Annexure-II**.

Noted and Approved.

1. C.N.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Annexure – I

Annexure-I

B.Tech. in ELECTRICAL AND ELECTRONICS ENGINEERING

II Year COURSE STRUCTURE & SYLLABUS (R25 Regulations)

Applicable from AY 2025-26 Batch

II YEAR I SEMESTER (25 Hours)

S. No.	Course Category	Course Title	L	T	P	Credits
1.	PC	Electromagnetic fields	3	0	0	3
2.	PC	Electrical Machines – I	3	0	0	3
3.	PC	Electronic Devices and Circuits	3	0	0	3
4.	PC	Power Systems – I	3	0	0	3
5.	PC	Electrical Measurements and Sensors	2	0	0	2
6.	MS	Innovation and Entrepreneurship	2	0	0	2
7.	PC	Electrical Machines - I Lab	0	0	2	1
8.	PC	Electrical Measurements and Sensors Lab	0	0	2	1
9.	PC	Electronic Devices and Circuits Lab	0	0	2	1
10.	SE	Design of Electrical Systems using AutoCAD	0	0	2	1
11.	ES	Environmental Science	1	0	0	1
		Total Credits	**17**	**0**	**8**	**21**

II YEAR II SEMESTER (25 Hours)

S. No.	Course Category	Course Title	L	T	P	Credits
1.	BS	Numerical Methods and Complex Variables	3	0	0	3
2.	PC	Electrical Machines – II	3	0	0	3
3.	PC	Power Systems – II	3	0	0	3
4.	PC	Digital Electronics	3	0	0	3
5.	PC	Control Systems	3	0	0	3
6.	PC	Computational Mathematics Lab	0	0	2	1
7.	PC	Electrical Machines - II Lab	0	0	2	1
8.	PC	Control Systems Lab	0	0	2	1
9.	PC	Digital Electronics Lab	0	0	2	1
10.	SE	PCB Design	0	0	2	1
		Total Credits	**15**	**0**	**10**	**20**

1. C.H.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

ELECTROMAGNETIC FIELDS

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Mathematics & Physics

Course Objectives:

- To introduce the concepts of electric field and magnetic field.
- To know Applications of electric and magnetic fields in the development of the theory for power transmission lines and electrical machines.
- To know about electromagnetic waves.

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

CO1. Explain static electric field concepts including charge distributions, Gauss's law, electric potential, electric dipole, and electrostatic energy for different field configurations.

CO2. Apply field equations and boundary conditions to analyze conductors, dielectrics, and capacitance using Poisson's and Laplace's equations.

CO3. Analyze static magnetic fields produced by current-carrying conductors using Biot–Savart law, Ampere's circuital law, and magnetic potential formulations.

CO4. Evaluate magnetic force interactions, inductive effects, and magnetic circuits by examining forces on charges and current elements, and self and mutual inductances.

CO5. Formulate electromagnetic field relationships using Maxwell's equations to interpret time-varying fields, electromagnetic induction, and wave propagation.

UNIT-I:

Static Electric Field: Review of conversion of a vector from one coordinate system to another coordinate system, Coulomb's law, Electricfield intensity, Electrical field due to point charges. Line, Surface and Volume charge distributions. Gauss law and itsapplications. Absolute Electric potential, potential difference, Calculation of potential differences for different configurations. Electric dipole, Electrostatic Energy and Energy density.

UNIT-II:

Conductors, Dielectrics and Capacitance: Current and current density, Ohms Law in Point form, Continuity equation, Boundary conditions of conductors and dielectric materials. Capacitance, Capacitance of a two-wire line, Poisson's equation, Laplace's equation.

UNIT-III:

Static Magnetic Fields: Biot-Savart Law, Ampere Circuital Law, Magnetic flux and magnetic flux density, Scalar and Vector Magnetic potentials. Steady magnetic fields produced by current carrying conductors.

UNIT-IV:

Magnetic Forces

Force on a moving charge, Force on a differential current element, Force between differential current elements, Magnetic boundary conditions, Magnetic circuits, Self-inductances and mutual inductances.

UNIT-V:

Time Varying Fields and Maxwell's Equations: Faraday's laws of Electromagnetic induction, Displacement current, Point form of Maxwell's equation, Integral form of Maxwell's equations, Motional Electromotive forces.

Introduction to Electromagnetic Waves

TEXT BOOKS:

1. M. N. O. Sadiku, "Elements of Electromagnetics", Oxford University Publication, 2014.
2. W. Hayt, "Engineering Electromagnetics", McGraw Hill Education, 2012.

REFERENCE BOOKS:

1. A. Pramanik, "Electromagnetism-Problems with solution", Prentice Hall India, 2012.
2. G. W. Carter, "The electromagnetic field in its engineering aspects", Longmans, 1954.
3. W. J. Duffin, "Electricity and Magnetism", McGraw Hill Publication, 1980.

Online Recourses:

1. https://nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/115/101/115101005/
3. https://nptel.ac.in/courses/108/106/108106023/

ELECTRICAL MACHINES - I

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Prerequisites: Electrical Circuits -I & II

Course Objectives:

- To study and understand different types of DC machines and their performance evaluation through various testing methods.
- To understand the operation of single-phase and Three-phase Transformers
- To analyze the performance of transformers through various testing methods.

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

CO1. Explain the construction, operating principles, armature reaction, commutation, excitation methods, and performance characteristics of DC generators.

CO2. Apply DC motor principles to determine torque, speed control, losses, efficiency, and to conduct standard performance tests of DC machines.

CO3. Analyze the operation, equivalent circuit, losses, efficiency, and regulation of single-phase transformers under no-load and load conditions.

CO4. Evaluate transformer performance by interpreting results of open-circuit, short-circuit, and Sumpner's tests for loss separation and efficiency prediction.

CO5. Design transformer configurations for parallel operation and poly-phase applications by selecting appropriate connections and transformer types.

UNIT -I:

D.C. Generators: Principle of operation – Action of commutator – constructional features – armature windings – lap and wave windings – simplex and multiplex windings (elementary treatment only) – EMF Equation. Concept of Armature reaction and commutation – Cross magnetizing and de-magnetizing AT/pole. Methods of Excitation – separately excited and self-excited generators – build-up of EMF - critical field resistance and critical speed. Performance Characteristics of shunt, series and compound generators and applications.

UNIT -II:

DC Motors: Principle of operation – Back EMF. - Torque equation – characteristics and application of shunt, series and compound motors.

3-point starter, Speed control of DC shunt and series motors - Armature voltage and field flux control methods. Losses — Constant & Variable losses –calculation of efficiency — condition for maximum efficiency.

Testing of DC Machines: Methods of Testing – Direct, Indirect, and Regenerative Testing – Brake Test – Swinburne's Test – Hopkinson's Test.

UNIT -III:

Single Phase Transformers: Types - constructional details-minimization of hysteresis and eddy current losses- EMF equation - operation on no-load and on load - phasor diagrams and Applications.
Equivalent circuit - losses and efficiency — regulation - All day efficiency - effect of variations of frequency & supply voltage on iron losses.

UNIT -IV:

Testing of Transformers: Open Circuit and Short Circuit tests - Sumpner's Test - predetermination of efficiency and regulation-separation of losses test.

UNIT -V:

Parallel operation with equal and unequal voltage ratios - auto transformers-equivalent circuit - comparison with two winding transformers.

Poly-phase transformers – Poly-phase connections - Y/Y, Y/Δ, Δ/Y, Δ/Δ and open Δ, Scott connection and Applications.

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, Revised Edition, 2021.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

Online Recourses:

1. https://nptel.ac.in/courses/108/105/108105155/
2. https://nptel.ac.in/courses/108/105/108105017/
3. https://nptel.ac.in/courses/108/106/108106071/

POWER SYSTEM – I

B.Tech. II Year I Sem.

L	T	P	C
3	0	0	3

Prerequisite: Electrical Circuits-I &II

Course Objectives:

- To understand the power generation through conventional and non-conventional sources
- To illustrate the economic aspects of power generation and tariff methods
- To know about substations and distribution systems

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

CO1. Explain the operation, layout, components, site selection, advantages, and limitations of conventional and renewable electric power generation plants.

CO2. Apply economic principles of power generation to evaluate load characteristics, plant capacity, and energy tariffs.

CO3. Analyze the layout and bus-bar arrangements of air-insulated substations and GIS to assess their suitability for power system applications.

CO4. Evaluate DC distribution systems by performing voltage drop calculations for various distributor configurations and comparing distribution alternatives.

CO5. Design AC distribution systems by selecting appropriate configurations and computing voltage drops under different loading and power factor conditions.

UNIT - I

Generation of Electric Power: Operation of Hydel, Thermal, Nuclear and Gas Power plant with layouts - Description of components-Choice of site - advantages and disadvantages, Introduction and description of components- renewable energy sources and plants (solar and wind).

UNIT - II:

Economics of Power Generation: Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load curve, Load duration curve, number and size of generator units.

Base load and peak load plants.

Cost of electrical energy-fixed cost, running cost, Tariffs.

UNIT - III:

Air Insulated Substations (AIS): Indoor & Outdoor substations: Substations layout showing the location of all the substation equipment. Bus bar arrangements in the Sub-Stations: Simple arrangements like single bus bar, sectionalized single bus bar, main and transfer bus bar system with relevant diagrams.

GIS - Single line diagram, Advantages.

UNIT – IV:

DC Distribution: Classification of Distribution Systems. - Comparison of DC vs. AC and Under-Ground vs. Over- Head Distribution Systems. - Requirements and Design features of Distribution Systems. -Voltage Drop Calculations (Numerical Problems) in D.C Distributors for the following cases: Radial D.C Distributor fed one end and at the both the ends (equal/unequal Voltages) and Ring Main Distributor.

UNIT - V:

AC Distribution: Introduction, AC distribution, Single phase, 3-phase 3 wire, 3-phase 4 wire system, bus bar arrangement, Selection of site for substation. Voltage Drop Calculations (Numerical Problems) in AC Distributors for the following cases: Power Factors referred to receiving end voltage and with respect to respective load voltages.

TEXT BOOKS:

1. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", 2nd Edition, New Age International, 2009.
2. A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, "A Text book on Power System Engineering", Dhanpat Rai Publishing Company (P) Ltd, 2008.

REFERENCE BOOKS:

1. J. B. Gupta, A Course in Power Systems" Katson Books, 11th Edition, 2016.
2. C.L. Wadhwa, "Electrical Power Systems", 5th Edition, New Age International, 2009.
3. W. D. Stevenson, "Elements of Power System Analysis", 4th Edition, McGraw Hill, 1984.

Online Recourses:

1. https://nptel.ac.in/courses/108/102/108102047/
2. https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-2(TB)(ET) ((EE)NPTEL).pdf
3. https://onlinecourses.nptel.ac.in/noc20_ee67/preview

ELECTRICAL MEASUREMENTS AND SENSORS

B.Tech. II Year I Sem

L	T	P	C
2	0	0	2

Prerequisites: Electrical Circuits-I &II, Analog Electronics and Electromagnetic Fields.

Course Objectives:

- To introduce the basic principles of all measuring instruments.
- To deal with the measurement of voltage, current, Power factor, power, energy and magnetic measurements.
- To understand the basic concepts of smart and digital metering.

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

CO1. Explain the principles, construction, operating torques, errors, and range extension methods of analog measuring instruments including PMMC, moving iron, and electrostatic voltmeters.

CO2. Apply DC and AC potentiometers and instrument transformers for accurate measurement of electrical quantities and qualitative analysis of ratio and phase angle errors.

CO3. Analyze the measurement of power and energy in single-phase and three-phase systems using dynamometer wattmeters and induction energy meters, including error sources and compensation techniques.

CO4. Evaluate DC and AC bridge measurement techniques for resistance, inductance, and capacitance, considering sensitivity, accuracy, and suitability for different measurement ranges.

CO5. Design measurement solutions using sensors and smart instruments by integrating appropriate transducers, signal conditioning, communication technologies, and intelligent features for modern metering applications.

UNIT - I:

Introduction to Measuring Instruments: Classification — deflecting, control and damping torques — Ammeters and Voltmeters – PMMC, moving iron type instruments – expression for the deflecting torque and control torque – Errors and compensations, extension of rangeusing shunts and series resistance. Electrostatic Voltmeters-electrometer type and attracted disc type – extension of range of Electrostatic Voltmeters.

UNIT - II:

Potentiometers & Instrument Transformers: Principle and operation of DC Crompton's potentiometer – standardization – Measurement of unknown resistance, current, voltage. AC Potentiometers: polar and coordinate type's standardization – applications. CT and PT – Ratio and phase angle errors (Qualitative approach).

UNIT - III:

Measurement of Power & Energy: Single phase dynamometer wattmeter, LPF and UPF, Double element and three element dynamometer wattmeter, expression for deflecting and control torques – Extension of range of wattmeter using instrument transformers — Measurement of active and reactive powers in balanced and unbalanced systems.

Single phase induction type energy meter – driving and braking torques – errors and compensations – testing by phantom loading using RSS meter. Three phase energy meter – trivector meter, maximum demand meters (Qualitative approach).

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

UNIT - IV:

DC & AC Bridges: Method of measuring low, medium and high resistance — sensitivity of Wheat-stone's bridge – Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method.

Measurement of inductance- Maxwell's bridge, Hay's bridge, Anderson's bridge. Measurement of capacitance and loss angle –De Sauty's Bridge - Wien's bridge – Schering Bridge. (Qualitative approach)

UNIT - V:

Sensors- Classification of transducers- Temperature sensors- Proximity sensor- Pressure sensor- IR sensors- Motion detection sensors- Ultrasonic sensors- Rotor Position Sensors, Operation of Strain Gauge- Thermocouples, construction and working of LVDT, Piezo electric transducers, photovoltaic, photo conductive cells, and photo diodes-Applications.

Smart instruments: Intelligent transducer, self-diagnosis and remote calibration features, HART communication, MEMS, non-linearity compensation; smart energy meter components, working principle; Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI) environments.

TEXTBOOKS:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications,2005.
2. Dr. Rajendra Prasad, "Electrical Measurements & Measuring Instruments", Khanna Publishers 1989.

REFERENCE BOOKS:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd.,2007.
3. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.

Online Recourses:

1.https://nptel.ac.in/courses/108/105/108105153/

2.https://www.cdac.in/index.aspx?id=pe_pe_PEG_SMARTENERGY

1. C.N. [signature] 2. [signature] 3. [signature] 4. [signature]
5. [signature] 6. [signature] 7. [signature] 8. [signature]
9. [signature] 10. [signature] 11. [signature] 12. [signature]

ELECTRICAL MACHINES - I LAB

B.Tech. II Year I Sem.

L	T	P	C
0	0	2	1

Prerequisites: Electrical machines - I

Course Objectives:

- To uncover the students to the operation of DC Generators.
- To know the operation of various types of DC Motors.
- To examine the performance of Single and Three Phase Transformers.

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

CO1. Set up and conduct standard tests on DC generators, DC motors, and single-phase transformers by following correct laboratory procedures and safety practices.

CO2. Measure electrical and mechanical parameters such as voltage, current, power, speed, torque, and losses during load and no-load tests on DC machines and transformers.

CO3. Plot and interpret characteristic curves and performance graphs of DC generators, DC motors, and transformers from experimentally obtained data.

CO4. Analyze test results to determine efficiency, regulation, speed control characteristics, critical field resistance, and critical speed of electrical machines.

CO5. Demonstrate proficiency in evaluating the performance and operational behavior of DC machines and single-phase transformers for practical electrical engineering applications.

Any 10 out of the following experiments required to be conducted:

1. Magnetization characteristics of DC shunt generator (Determination of critical field resistance and critical speed)
2. Load test on DC shunt generator (Determination of characteristics)
3. Load test on DC series generator (Determination of characteristics)
4. Hopkinson's test on DC shunt machines (Predetermination of efficiency)
5. Swinburne's test (Predetermination of efficiency)
6. Brake test on DC compound motor (Determination of performance curves)
7. OC and SC Test on Single Phase Transformer
8. Brake Test on DC shunt motor (Determination of performance curves)
9. Load Test on DC compound generator (Determination of characteristics).
10. Measurement of Voltage, Current and Real Power in primary and Secondary Circuits of a Single-Phase Transformer
11. Load Test on Single Phase Transformer (Calculate Efficiency and Regulation)
12. Speed control of DC shunt motor

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

ELECTRICAL MEASUREMENTS AND SENSORS LAB

B.Tech. II Year I Sem.	**L**	**T**	**P**	**C**
	0	**0**	**2**	**1**

Prerequisites: Electrical Circuits –I & II

Course Objectives:

- To calibrate Watt, Energy and PF Meter and determination of three phase active & reactive powers.
- To determine unknown inductance, resistance, capacitance by performing experiments on DC Bridges & AC Bridges.
- To determine the ratio and phase angle errors of Instrument transformers.

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

CO1. Set up standard measurement and calibration circuits for electrical instruments such as energy meters, power factor meters, and PMMC instruments following laboratory safety practices.

CO2. Calibrate electrical measuring instruments including energy meters, dynamometer meters, potentiometers, and bridges by accurately adjusting, connecting, and recording experimental parameters.

CO3. Measure electrical quantities such as power, reactive power, resistance, displacement, strain, and transformer turns ratio using bridges, wattmeters, LVDT, and strain gauges with improved accuracy.

CO4. Analyze experimental results by computing errors, tolerance, and calibration characteristics and correlating observed behavior with theoretical expectations.

CO5. Demonstrate proficiency in selecting, integrating, and testing sensors and high-voltage equipment to perform reliable measurements and interpret results for practical engineering applications.

Any ten of the following experiments are to be conducted:

1. Calibration and testing of single-phase energy Meter.
2. Calibration of dynamometer power factor meter.
3. Crompton DC Potentiometer – Calibration of PMMC ammeter and PMMC voltmeter.
4. Kelvin's double Bridge – Measurement of resistance – Determination of Tolerance.
5. Dielectric testing of oil using HT Testing Kit.
6. Schering Bridge & Anderson Bridge.
7. Measurement of 3 - Phase reactive power with single-phase wattmeter.
8. Measurement of displacement with the help of LVDT.
9. Measurement of 3-phase power with single watt meter and two CTs.
10. Resistance strain gauge – strain measurements and Calibration.
11. Transformer turns ratio measurement using AC bridges.
12. Demonstration of different sensors using trainer kit

TEXT BOOKS:

1. A. K. Sawhney, "Electrical & Electronic Measurement & Instruments", Dhanpat Rai & Co. Publications,2005.
2. Dr. Rajendra Prasad, "Electrical Measurements & Measuring Instruments", Khanna Publishers 1989.

REFERENCE BOOKS:

1. G. K. Banerjee, "Electrical and Electronic Measurements", PHI Learning Pvt. Ltd., 2nd Edition, 2016.
2. R. K. Rajput, "Electrical & Electronic Measurement & Instrumentation", S. Chand and Company Ltd.,2007.
3. S. C. Bhargava, "Electrical Measuring Instruments and Measurements", BS Publications, 2012.

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.

DESIGN OF ELECTRICAL SYSTEMS USING AUTOCAD

B.Tech. II Year I Sem. **L T P C**
0 0 2 1

Prerequisite:

Course Objectives:

1. To provide hands-on training in using AutoCAD for electrical design and drafting.
2. To understand the principles of preparing electrical wiring diagrams and panel layouts.
3. To enable students to design residential, commercial, and industrial electrical systems.
4. To introduce students to symbols, standards, and practices in electrical CAD.

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

- **CO1.** Apply AutoCAD tools to create electrical schematics and layouts.
- **CO2.** Design residential and commercial wiring systems as per standards.
- **CO3.** Develop and document substation and panel wiring drawings.
- **CO4.** Interpret electrical diagrams and create professional CAD documentation.
- **CO5.** Work on real-time electrical design problems using CAD tools.

Module I: Introduction to AutoCAD for Electrical Design Overview of AutoCAD interface and tools

- Layers, blocks, and annotation in AutoCAD
- Electrical symbols: IEC/ANSI/IS standards
- Drawing and modifying basic electrical elements

Lab Experiments:

- Creating simple electrical circuit diagrams using AutoCAD
- Use of layers and blocks for electrical layouts

Module II: House Wiring and Lighting System Design

- Design of single-line diagrams (SLDs)
- Layout of internal wiring for residential buildings
- Load calculation and cable selection
- Earthing and protection system basics

Lab Experiments:

- Preparation of residential wiring layout
- Switchboard and lighting plan for 1BHK/2BHK house

Module III: Commercial and Industrial Electrical Layouts

- Design of power circuits and lighting for commercial buildings
- Distribution board design and component placement
- Panel board and busbar layout

Lab Experiments:

- Design and drafting of distribution system for a small commercial building
- Electrical room layout with control panels

Module IV: Substation and Control Circuit Design

- Single-line diagram of substations
- Control circuit schematics
- Relay control and contactor wiring diagrams
- Cable routing and tray layout

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

Lab Experiments:

- Drawing of 11kV/440V substation SLD
- Panel wiring diagram for DOL/Star-Delta motor starter

Module V: Mini Project and Professional Practice

- Project planning, drawing standards, title block, and BOM
- Design and documentation of a small-scale electrical system
- Printing, plotting, and exporting drawings

Lab Activity:

- Mini-project: Design and documentation of electrical system for a small apartment, lab, or factory setup

Software Requirements:

- AutoCAD Electrical (Student or Institutional License)
- Optional: E-Plan, DraftSight, or similar tools for advanced users

TEXT BOOKS:

1. K.B. Raina and S.K. Bhattacharya "Electrical Design Estimating and Costing" New Age International.
2. Prof. Sham Tickoo "AutoCAD Electrical 2023 for Electrical Control Designers" CADCIM Technologies.

REFERENCE BOOKS:

1. Frederic P. Hartwell and Herbert P. Richter "Practical Electrical Wiring" Park Publishing.
2. James A. Leach and Shawna Lockhart "AutoCAD 2023 Instructor" SDC Publications.
3. Ray C. Mullin and Phil Simmons "Electrical Wiring Residential" Cengage Learning.

Online Resources:

1. **Autodesk Knowledge Network**: https://knowledge.autodesk.com.
2. **NPTEL**: Basic Electrical Drawing and CAD-related modules (search under "Electrical Engineering").

ELECTRICAL MACHINES - II

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisites: Electrical Circuits-I &II and Electrical Machines -I

Course Objectives:

- To deal with the detailed analysis of three phase induction motors & Alternators.
- To understand operation, construction and types of single-phase motors and their applications.
- To introduce the concept of parallel operation of alternators.

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

CO1. Explain the construction, operating principles, and torque–slip characteristics of three-phase induction machines including rotor behavior and power flow relations.

CO2. Apply equivalent circuits and testing methods to determine the performance, starting characteristics, and speed control of induction machines and induction generators.

CO3. Analyze the construction, winding schemes, EMF generation, harmonics, armature reaction, and load characteristics of synchronous generators.

CO4. Evaluate the voltage regulation and parallel operation of synchronous generators using standard methods and phasor relationships under varying excitation and load conditions.

CO5. Assess synchronous motor and single-phase machine applications by analyzing their operating principles, performance characteristics, and starting methods for practical engineering use.

UNIT - I:

Three Phase Induction Machines: Constructional details of cage and wound rotor machines-production of a rotating magnetic field - principle of operation - rotor EMF and rotor frequency - rotor reactance, rotor current and Power factor at standstill and during operation. Rotor power input, rotor copper loss and mechanical power developed and their inter relation. Torque equation-expressions for maximum torque and starting torque — torque-slip characteristics.

UNIT - II:

Characteristics of Induction Machines: Equivalent circuit - phasor diagram - crawling and cogging. No-load Test and Blocked rotor test –Predetermination of performance-Methods of starting and starting current and Torque calculations, Applications.

Speed Control Methods: Change of voltage, change of frequency, voltage/frequency, injection of an EMF intorotor circuit (qualitative treatment only)-induction generator-principle of operation.

UNIT - III:

Synchronous Generator (Alternator): Constructional Features of round rotor and salient pole machines – Armature windings – Integral slot and fractional slot windings; Distributed and concentrated windings – distribution, pitch and winding factors – EMF Equation. Harmonics in generated EMF — suppression of harmonics – armature reaction - leakage reactance – synchronous reactance and impedance – phasor diagram – load characteristics.

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

UNIT - IV:

Regulation of Synchronous Generator: Synchronous impedance method, MMF method and ZPF method– two reaction theory– Determination of X_d and X_q (Slip test) Phasor diagrams — Regulation of salient pole alternators.

Parallel Operation of Synchronous Generator: Synchronizing Alternators with infinite bus bars — synchronizing power torque — parallel operation and load sharing - Effect of change of excitation and mechanical power input.

UNIT - V:

Synchronous Motors: Theory of operation – phasor diagram – Variation of current and power factor with excitation — synchronous condenser — Mathematical analysis for power developed. Hunting and its suppression – Methods of starting.

Single Phase Machines: Single phase induction motor – Constructional Features-Double revolving field theory – split-phase motors – Universal Motor - BLDC Motor – principle of operation, PMSM principle of operation and reluctance motor principle of operation and their applications.

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

Online Recourses:

1. https://nptel.ac.in/courses/108/105/108105131/
2. https://nptel.ac.in/courses/108/106/108106072/

POWER SYSTEM – II

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisite: Electrical Circuits - I & II and Power Systems – I

Course Objectives:

- To study the performance of transmission lines and travelling waves.
- To understand the concept of voltage control, compensation methods and per unit representation of power systems.
- To know the Symmetrical components and fault calculation analysis

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

CO1. Explain the constructional features and electrical characteristics of overhead transmission lines, including inductance, capacitance, and the effects of earth, skin, and proximity.

CO2. Apply transmission line models to evaluate the performance of short, medium, and long lines using appropriate equivalent circuits and ABCD constants.

CO3. Analyze the performance of overhead line insulators and transmission systems by examining sag–tension relations, corona effects, voltage control, and power factor improvement methods.

CO4. Evaluate power system behavior using per-unit representation and travelling wave theory to interpret system response under switching and transient conditions.

CO5. Investigate power system fault scenarios using symmetrical components to compute fault currents, sequence networks, and short-circuit capacity.

UNIT - I

Overhead Transmission Lines: Line conductors, Composite conductors transposition, bundled conductors, Inductance and capacitance of single phase and three phase lines with symmetrical spacing, and effect of earth on capacitance, skin and proximity effects.

UNIT - II:

Performance of Lines: Representation of lines, short transmission lines, medium length lines, nominal T and PI- representations, long transmission lines. The equivalent circuit representation of a long Line, A, B, C, and D constants, Ferranti Effect.

UNIT - III:

Overhead Line Insulators: Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential, testing of insulators, Sag and Tension calculations.

Corona: Introduction, disruptive critical voltage, corona loss, Factors affecting corona loss and methods of reducing corona loss, Advantages and Disadvantages of corona, interference between power and Communication lines.

Voltage Control & Power Factor Improvement: Introduction – methods of voltage control, shunt and series capacitors / Inductors, tap changing transformers, synchronous phase modifiers, power factor improvement methods.

UNIT IV:

Per Unit Representation of Power Systems: The one-line diagram, impedance and reactance diagrams, per unit quantities, changing the base of per unit quantities, advantages of per unit system.

Travelling Waves on Transmission Lines: Production of travelling waves, open circuited line, short-circuited line, line terminated through a resistance, line connected to a cable, Reflection and Refraction coefficients.

UNIT - V

Symmetrical Components and Fault Calculations: Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks, fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase fault, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus.

TEXT BOOKS:

1. C. L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International, 2009.
2. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis", Tata Mc Graw Hill Pub. Co., New Delhi, Fourth edition, 2011.

REFERENCE BOOKS:

1. A. Chakrabarti, M.L. Soni, P.V. Gupta, U.S. Bhatnagar, "A Text book on Power System Engineering", Dhanpat Rai Publishing Company (P) Ltd, 2008.
2. W. D. Stevenson, "Elements of Power System Analysis", 4th Edition, McGraw Hill, 1984.
3. John J. Grainger & W.D. Stevenson, "Power System Analysis", Mc Graw Hill International,1994.

Online Recourses:

1. https://nptel.ac.in/courses/108/102/108102047/
2. https://nptel.ac.in/courses/108/107/108107112/

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

CONTROL SYSTEMS

B.Tech. II Year II Sem.

L	T	P	C
3	0	0	3

Prerequisite: Electrical Circuits-I & II and Electrical Machines-I

Course objectives:

- Understand the mathematical modelling of physical systems.
- Comprehend the representation of dynamical systems through input-output models, including transfer functions and state-space models.
- Understand the design of controllers and compensators to enhance the performance and stability of dynamical systems

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

CO1. Explain the mathematical modeling of physical systems and feedback control concepts using transfer functions, block diagrams, signal flow graphs, and controller components.

CO2. Examine the time-domain response and stability of linear time-invariant systems using standard test signals, Routh–Hurwitz criterion, and root-locus technique.

CO3. Analyze system behavior in the frequency domain using Bode plots, polar plots, and Nyquist stability criterion to assess stability.

CO4. Apply classical control strategies by designing and tuning P, PI, PD, PID controllers and lead, lag, and lead–lag compensators.

CO5. Evaluate dynamic system performance using state-space models by analyzing state equations, system response, controllability, and observability.

UNIT - I:

Mathematical modelling of physical systems: Open — loop and Closed loop Systems, Concept of Feedback Control, Benefits of Feedback and Effects of feedback, Linear, Non-Linear, Time Variant and Time Invariant systems, Mechanical and Electrical Systems, Transfer function, Block-Diagram Techniques, Signal flow graph, Controller Components: DC Servo motors, AC Servomotors, Synchro's.

UNIT - II:

Time-Domain Analysis with Input-Output Models: Standard Test signals, Time response of first and second order systems for step input, Time Domain Specifications, Types of System, Steady state response, Error Analysis for Linear time Invariant Systems.

Concept of Stability: Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique: Construction of Root-loci.

UNIT - III:

Frequency Domain Analysis: Introduction to frequency response, Relationship between time and frequency response, Concept of Bode plots and construction. Polar plots, Nyquist stability criterion. Relative stability using Nyquist criterion — gain and phase margin

1. C.N. [signature] 2. [signature] 3. [signature] 4. [signature]
5. [signature] 6. [signature] 7. [signature] 8. [signature]
9. [signature] 10. [signature] 11. [signature] 12. [signature]

UNIT - IV:

Classical Controllers and Compensators: Proportional, Integral and Derivative Controllers- PI, PD and PID controllers, Lead, Lag and Lead-Lag compensators (elementary treatment only).

UNT - V:

State Variable Analysis: Concept of State, State variables and State model. State Representation, Transformation of State variables, Solution of state equations and Complete response of the Systems. Concept of controllability and observability.

TEXT BOOKS:

1. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

REFERENCE BOOKS:

1. Norman S Nise, "Control Systems Engineering", Wiley, 2019 8th Edition
2. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
3. K. R. Varmah, "Control Systems", McGraw Hill Education, 2010.

Online Recourses:

1.https://www.controleng.com
2.https://www.mathworks.com
3.https://nptel.ac.in/courses/108/102/108102043

1. C.N. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

ELECTRICAL MACHINES - II LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Prerequisites: Electrical Machines – I

Course Objectives:

- To understand the operation of Induction, Synchronous Machines and Transformers.
- To study the performance analysis of Induction and Synchronous Machines through various Testing methods.
- To analyze the performance of single and three-phase transformers.

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

CO1. Set up and conduct standard no-load, blocked-rotor, Sumpner's, and brake tests on electrical machines and transformers by following correct experimental and safety procedures.

CO2. Measure machine and transformer parameters such as regulation, losses, reactance, and sequence impedances using appropriate test methods and instrumentation.

CO3. Plot and interpret characteristic curves and equivalent circuits of induction motors, synchronous machines, alternators, and transformers from experimental observations.

CO4. Analyze test results to determine performance indices including efficiency, voltage regulation, power losses, and operating characteristics under different conditions.

CO5. Demonstrate proficiency in configuring advanced transformer and machine operations such as parallel operation, Scott connection, and salient-pole parameter determination for practical power system applications.

Any 10 experiments are required to be conducted:

1. Sumpner's test on a pair of single-phase transformers
2. No-load & Blocked rotor tests on three phase Induction motor
3. Regulation of a three –phase alternator by synchronous impedance & MMF methods
4. 'V' and 'Inverted V' curves of a three—phase synchronous motor.
5. Equivalent Circuit of a single-phase induction motor
6. Determination of Xd and Xq of a salient pole synchronous machine
7. Brake Test on three phase Induction Motor
8. Regulation of three-phase alternator by ZPF method
9. Separation of core losses of a single-phase transformer
10. Parallel operation of Single-phase Transformers
11. Measurement of sequence impedance of a three-phase alternator.
12. Scott Connection of transformer

TEXT BOOKS:

1. P. S. Bimbhra, "Electrical Machinery", Khanna Publishers, 2011.
2. I.J. Nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.

REFERENCE BOOKS:

1. Prithwiraj Purkait, Indrayudh Bandyopadhyay, "Electrical Machines", Oxford, 2017.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.

1. C.N. [illegible] 2. [illegible] 3. [illegible] 4. [illegible]
5. [illegible] 6. [illegible] 7. [illegible] 8. [illegible]
9. [illegible] 10. [illegible] 11. [illegible] 12. [illegible] 21

CONTROL SYSTEMS LAB

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives:

- Understand system representations like transfer function and state space, and assess system dynamic response.
- Evaluate system performance using both time and frequency domain analyses, identifying methods to enhance performance.
- Study controllers and compensators to improve system performance based on the assessments from time and frequency domain analyses.

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

CO1. Obtain the time response and transfer function models of second-order systems, DC motors, and DC generators using experimental and simulation tools.

CO2. Analyse the characteristics of synchros, AC servo motors, and the effect of feedback on DC servo motor performance through controlled laboratory experiments.

CO3. Evaluate the stability characteristics of Linear Time Invariant (LTI) systems using Bode plots, Root Locus, and Nyquist criteria with suitable simulation software.

CO4. Asses the performance of P, PI, PD, and PID controllers on second-order systems by conducting time-domain, steady-state error, and dynamic response analysis using simulation tools.

CO5. Validate lead, lag, and lead-lag compensators to meet given system specifications by developing state-space and transfer-function-based models using appropriate software platforms.

Any 10 experiments are required to be conducted:

1. Time response of Second order system
2. Characteristics of Synchro's
3. Effect of feedback on DC servo motor
4. Transfer function of DC motor
5. Transfer function of DC generator
6. Lag and lead compensation – Magnitude and phase plot
7. Stability analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant system using simulation tools.
8. State space model for classical transfer function using simulation tools.
9. Characteristics of AC servo motor
10. (a) Simulation of P, PI, PID Controller.
    (b) Linear system analysis (Time domain analysis, Error analysis) using suitable software
11. Programmable Logic Controller – Study and Verification of truth tables of logic gates and simple Boolean expressions
12. Design of Lead-Lag compensator for the given system and with specification using suitable software

TEXT BOOKS:

1. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
2. B. C. Kuo, "Automatic Control System", Prentice Hall, 1995.

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering", Prentice Hall, 1991.
2. I. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International, 2009.

1. C.N. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12.

PCB DESIGN

B.Tech. II Year II Sem.

L	T	P	C
0	0	2	1

Course Objectives:

- To understand the basics of PCB types, materials, and design standards.
- To gain hands-on experience with PCB layout software tools.
- To develop skills in schematic capture, component placement, routing, and Gerber generation.
- To fabricate and test a simple single-layer PCB.

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

- **CO1.** Explain the design and fabrication process of PCBs.
- **CO2.** Design schematic diagrams and convert them to PCB layouts.
- **CO3.** Apply routing and layout techniques using EDA tools.
- **CO4.** Generate Gerber files and perform DRC/ERC effectively.
- **CO5.** Troubleshoot the errors of the circuits and correct them

Module I: Fundamentals of PCB Design

- Types of PCBs: Single-layer, Double-layer, Multilayer
- PCB materials and manufacturing process
- PCB design rules and standards (IPC standards)
- Introduction to EDA tools (e.g., KiCad, Eagle, Altium, EasyEDA)

Lab Activity:

- Exploring the user interface of PCB design software
- Setting up design rules

Module II: Schematic Design

- Creating circuit schematics using PCB CAD tools
- Component library management
- Electrical rule checking (ERC)
- Netlist generation

Lab Activity:

- Designing a basic power supply or LED flasher circuit
- Performing ERC and generating netlist

Module III: PCB Layout and Routing

- Importing netlist to layout editor
- Footprint assignment and component placement
- Manual vs auto-routing
- Design Rule Check (DRC)

Lab Activity:

- Placing components and routing for the schematic designed earlier
- Performing DRC and correcting errors

Module IV: PCB Output Files

- Generating Gerber files, drill files, and BOM

1. C.N. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

Lab Activity:

- Generate Gerber files and preview using Gerber viewer

Module V: Mini Project and Testing

- Design for PCB Boards

TEXT BOOKS:

1. Walter C. Bosshart "Printed Circuit Board Design and Technology" Tata McGraw Hill
2. Clyde F. Coombs "Printed Circuit Boards: Design and Technology": McGraw-Hill

REFERENCE BOOKS:

1. Peter Dalmaris "PCB Design Using KiCad 6"
2. *Kraig Mitzner* **"Complete PCB Design Using OrCAD Capture and PCB Editor"**
3. *James Angus* **"Electronic Product Design"**

IPC Standards:

1. IPC-2221: Generic Standard on Printed Board Design
2. IPC-7351: Generic Requirements for Surface Mount Design

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

Annexure – II

Annexure - II

Course Structure of Minor in Electric Vehicles

S. No.	Year/Semester	Course Title	L	T	P	Credits
1.	II-II Semester	Electric Vehicle and Energy Systems	4	0	0	4
2.	III-I Semester	Power Electronics and Control of Electric Machines	4	0	0	3
3.	III-I Semester	Simulation Lab	0	0	3	1.5
4.	III-II Semester	Automotive Transmission and Communication	3	0	0	3
5.	III-II Semester	Electric Mobility Lab	0	0	3	1.5
6.	IV-I Semester	**Electives** 1. Electric Vehicle Dynamics and Testing 2. Battery Charging Technology for EVs 3. Electric Vehicle: Safety, Regulations and Future	3	0	0	3
7.	IV-I semester	Internship/Mini Project	0	0	3	2
					Total	**18**

ELECTRIC VEHICLE AND ENERGY SYSTEMS

B. Tech. II Year II Semester

L	T	P	C
3	0	0	4

Pre-requisite: Basic Electrical Engineering

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1. Analyze the importance of alternative vehicles.
CO2. Identify the opportunities and challenges of electric vehicle mechanics.
CO3. Choose desired system architecture for electric vehicle design.
CO4. Identify & model regenerative braking system.
CO5. Identify the opportunities and challenges of energy storage systems.

UNIT - I

INTRODUCTION TO ALTERNATIVE VEHICLES: History of electric and hybrid vehicle - electric vehicle types – electric and hybrid vehicle components – vehicle mass and performance – electric motor and engine ratings – Well to Wheel analysis – EV/ICEV comparison – electric vehicle market – international standards and codes.

UNIT - II

VEHICLE MECHANICS: Roadway fundamentals – Laws of motion and vehicle kinetics – vehicle resistance - dynamics of vehicle motion – propulsion power – velocity and acceleration – tire-road force mechanics – propulsion system design.

UNIT – III

ALTERNATIVE VEHICLE ARCHITECTURE: Electric vehicles – Hybrid electric vehicles, Plug-in hybrid electric vehicle – power train component sizing – mass analysis and packaging – vehicle simulation – simulation model and standard drive cycles.

UNIT – IV

FUNDAMENTALS OF REGENERATIVE BRAKING: Energy consumption in braking – braking power and energy on front and rear wheels – brake system of EVs and HEVs - series brake –parallel brake – antilock brake system (ABS).

UNIT – V

ENERGY STORAGE: EV batteries and their components - fuel cells – types – model – hydrogen storage systems – fuel cell electric vehicle – ultra capacitors – compressed air storage.

TEXT BOOKS:

1. Electric and Hybrid Vehicles: Design fundamentals. Husain, I., CRC press, 2011.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles, Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. CRC press, 2018.

REFERENCE BOOKS:

1. Hybrid Electric Vehicle System Modeling and Control, Wei Liu, John Wiley & Sons- Inc.- 2017.
2. Hybrid Electric Vehicles, Teresa Donateo, Published by ExLi4EvA- 2017.
3. Electric and Hybrid Vehicles Power Sources- Models- Sustainability- Infrastructure and the Market Gianfranco Pistoia Consultant, Rome- Italy- Elsevier Publications- 2017.

1. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

POWER ELECTRONICS AND CONTROL OF ELECTRIC MACHINES

B. Tech. III Year I Semester

L	T	P	C
3	0	0	3

Pre-requisite: Basic Electrical Engineering

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1. Select appropriate power electronics device and control IC.
CO2. Analyze and design power converters.
CO3. Classify various drives and analyze its performance.
CO4. Design model and modify an electric drive according to customer.
CO5. Alleviate different issues on HEV control.

UNIT – I

POWER ELECTRONIC DEVICES: Overview of power electronics devices: Power diode, Insulated Gate Bipolar Transistor (IGBT), Metal-Oxide-Silicon Field Effect Transistor (MOSFET) – Principle of operation, power density, efficiency.

UNIT – II

POWER CONVERTERS: Converter Topologies: Buck, boost, transformer less - Inverter topology: Basics of single & three phase inverter - sources of loss in power electronics - Conduction, switching, leakage and control losses.

UNIT – III

MACHINES FOR ELECTRIC VEHICLES: DC motor, Induction motor and BLDC motor: Types, principle, construction – Peak Power Source (PPS) - Torque and speed coupling – selection of motors under variable parameters.

UNIT – IV

ELECTRIC VEHICLE DRIVES: Electric drive components – DC drives: Two & Four quadrant chopper, open loop drive, Modes of operation - Operating point analysis – AC drive: PWM techniques (elementary treatment).

UNIT – V

MOTOR DRIVES: BLDC motor drive: Speed and position control– Block diagram of an electric drive, vehicle body – drive & wheel.

TEXT BOOKS:

1. Hybrid electric vehicle system modeling and control, Wie Liu, 2nd Edition, 2017.
2. Advanced Electric Drive Vehicles, Ali Emadi, CRC Press, 1st Edition, 2017.

REFERENCE BOOKS:

1. Electric and hybrid vehicles – Design Fundamentals, Iqbal Husain, CRC Press, 2nd Edition 2010.
2. Vehicular Electric Power System – Land, Air and Space Vehicles, Ali Emadi, Mehrdad Ehsani, John M. Miller, CRC press, 1st Edition, 2003.
3. Electric Drives: An Integrative Approach", Mohan, N, MNPERE (2001).

SIMULATION LABORATORY

B. Tech. III Year I Semester

L	T	P	C
0	0	3	1.5

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1. Understand the basics of simulation.
CO2. Familiarize the matrix operations.
CO3. Analyze basic electric circuits.
CO4. Assess the internal component models of an EV.
CO5. Evaluate the control of motors used in electric vehicles.

Any ten experiments are required to be conducted:

1. Demonstration of basic mathematical, matrix operations using simulation tools.
2. Plotting of Basic 2-Dimensional Graphs Using Simulation Tools
3. Basic electrical circuit analysis using mesh analysis.
4. Basic electrical circuit analysis using nodal analysis.
5. Simulation of a Basic Electric Vehicle Drive train (elementary treatment only)
6. Simulation of DC-DC Buck Converter for EV
7. Simulation of DC-DC Boost Converter for EV.
8. Simulation of Bidirectional DC-DC Converter for EV.
9. Simulation of a single-phase DC-AC converter for EV.
10. Simulation of three phase DC-AC converter for EV.
11. Simulation of kinetics model of EV (elementary treatment).
12. Simulation of DC motor model.

AUTOMOTIVE TRANSMISSION AND COMMUNICATION

B. Tech. III Year II Semester

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1. Analyze the design ratio of gear box used in vehicles.
CO2. Analyze the dynamics of an electric vehicle.
CO3. Design electronic control units to ensure safety in vehicle transmission system.
CO4. Differentiate and analyze the performance of electrification for any application.
CO5. Apply suitable technique for automotive communication.

UNIT I

INTRODUCTION TO VEHICLE TRANSMISSION: Traction demand and torque supply at constant speed and transient driving states – Fuel Economy Optimization – launch and synchronizing speeds – gear ratios and their design.

UNIT II

POWER TRAIN DYNAMICS

Power train model – inertia – spring stiffness – Rotational vibration damping on the transmission input – Vehicle dynamics – Dynamic coupling.

ACTUATION, SERVO AND AUXILIARY SYSTEMS

Fundamentals and active principles – Transfer elements – cooling and lubrication – Electromechanical actuation – Energy and power balance.

UNIT III

VEHICLE CONTROL: Electronic control units – Software architecture – Signal processing – Selecting the shift point – Shift execution – Safety in transmission system.

UNIT IV

POWER TRAIN ELECTRIFICATION: Electric and hybrid power train – Requirements – components and configurations – Functions – strategies case studies – Truck, Bus, Tractor, Motor cycle, racing transmissions

UNIT V

COMMUNICATION IN ELECTRIC VEHICLE: Transmission network – Distribution network – Demand side management and control – Communication standards and technologies

TEXT BOOKS:

1. The automotive transmission book, Technology & Engineering, Springer May 2015.
2. Advanced vehicle Technology, Heinz Heisler, Butterworth-Heinemann, 2002

REFERENCE BOOKS:

1. Electric and hybrid vehicles – Design Fundamentals, Iqbal Husain, CRC Press, 2nd Edition 2010.
2. A survey on communication technologies and requirements for internet of electric vehicles, Iqbal Husain, RASIP Journal on Wireless Communications and Networking, 2014.

ELECTRIC MOBILITY LABORATORY

B. Tech. III Year II Semester

L	T	P	C
0	0	3	1.5

COURSE OUTCOMES

At the end of the course, the student will be able to

CO1. Assemble/Dismantle and construct the wiring layout of electric vehicle.
CO2. Familiarize the working and characteristics of semiconductor devices.
CO3. Design full bridge converter circuits.
CO4. Analyze the speed control of three-phase induction motor drive.
CO5. Design the control circuits for speed control of E-vehicle drives.

Any ten experiments are required to be conducted:

1. Study of the V-I characteristics of SCR
2. Study of the V-I characteristics of TRIAC and MOSFET
3. Study of single-phase half-controlled converter with R and R-L Load
4. Study of single-phase fully controlled converter with R and R-L Load
5. Study of single-phase AC voltage regulator.
6. Study of DC-DC Chopper with R and R-L Load.
7. Simulation of a Single-phase Controlled Rectifier for Onboard EV Charger (AC-DC conversion)
8. Simulation of Battery Modeling for EV
9. Simulation of State-of-Charge (SoC) Estimation of battery for EV
10. Simulation of Speed control of Induction Motor
11. Simulation of Speed control of BLDC Motor
12. Simulation of Forward and Reverse control of PMSM motor.

ELECTRIC VEHICLE DYNAMICS AND TESTING
(Elective)

B. Tech. IV Year I Semester

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

At the end of the course, the student will be

CO1. Understand the design of EV Body.
CO2. Illustrate Manufacturing material.
CO3. Analyze vehicle dynamics.
CO4. Analyze the vehicle stability
CO5. Evaluate the vehicle performance using tests

UNIT I

Vehicle Design: Introduction to body loads: Load cases and load factor, road loads. Driving dynamics and comfort, strength and stiffness of chassis, design features, frame sections, types of frames.

UNIT II

Manufacturing Criteria: Material selection, fabrication, joining methods, types of joints, welding and brazing, pierce riveting and clinching.

UNIT III

Vehicle Dynamics: Wheels and Tyres: Introduction, Types of wheel rims, wheel dimension, properties of tyre, construction, tread patterns, types of tyres, specifications of tyre.

UNIT IV

Vehicle Stability: Drag, resistance, body loads and load calculation, Study principles of rolling, Pitch & Yaw velocity and moments, aesthetics and ergonomics consideration for stability and control.

UNIT V

Vehicle Testing: Need of vehicle testing and homologation, testing organizations, testing standards (AIS), ARAI standards, Hierarchy of testing: Individual component approval/testing, system level approval and whole vehicle approval/testing. Conformity of production tests, crash test, side impact test, rollover test, impact test, track testing.

TEXT BOOKS:

1. Vehicle Body Engineering, J. Pawlowski, Business books limited.
2. Fundamentals of Automobile Body Structure Design, Donald E. Malen, SAE International.

REFERENCE BOOKS:

1. A Textbook of Automobile Engineering-II, P.S.Gill, S.K.Kataria & Sons.
2. Automotive Industrial Standards (AIS).

1. C.N. 2. 3. 4.
5. 6. 7. 8.
9. 10. 11. 12.

BATTERY CHARGING TECHNOLOGY FOR EVS
(Elective)

B. Tech. IV Year I Semester

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1. Select appropriate battery energy storage system.

CO2. Assess an energy efficient battery system.

CO3. Explain faults in charging and electronic fuel control.

CO4. Design battery management system.

CO5. Analyse and estimate energy for battery-based system.

UNIT I

BATTERY ENERGY STORAGE: Batteries in electric and hybrid vehicle – Battery basics – Battery specific parameters – Electrochemical cell fundamentals –Different types of traction batteries – Battery pack management

UNIT – II

BATTERY TECHNOLOGIES: Electrochemical batteries – Electrochemical reactions –Energy efficiency – Battery technologies – Lead acid batteries – Nickel based batteries Nickel/Cadmium system – Nickel Metal Hydride (Ni-MH) Battery – Lithium Based Batteries – Lithium Polymer (Li-P) battery – Lithium – Ion (Li-Ion) Battery.

UNIT – III

CHARGING SYSTEMS AND ELECTRONIC FUEL CONTROL: Requirements of the charging system, charging system principles, advanced charging system technology.

Combustion, engine fueling and exhaust emissions, electronic control injection systems, diesel fuel injection, advanced fuel control technology.

UNIT – IV

BATTERY MANAGEMENT SYSTEMS (BMS): Block diagram - Main functions of a BMS, sensing requirements, cell/module level: cell voltage, cell/module temperature, Pack level: current, precharge temperature, temperature raise during running conditions, thermal system control.

UNIT – V

ENERGY ESTIMATION: Cell balancing: Active versus passive, strategies, estimation requirements, Strategies: Different approaches and benefits of model based approach, State of charge estimation: State of health estimation, power estimation, energy estimation (range estimation).

TEXT BOOKS:

1. Modern electric, hybrid electric, and fuel cell vehicles. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K, CRC press.
2. Automotive Electrical and Electronic Systems', Tom Denton, Routledge, 5th Edition, 2017.

REFERENCE BOOKS:

1. Automotive Electrical Equipment, Young A.P. and Griffiths. L., ELBS & New Press, 1999.
2. Understanding Automotive Electronics, William B. Ribbens, 6th Edition, Elsevier,2003.
3. Automotive Electrical Equipment, Kholi. P. L, Tata McGraw-Hill Ltd, 1975.
4. Automotive Hand Book, Robert Bosch, SAE, 5th Edition, 2000.

1. 2. 3. 4.

5. 6. 7. 8.

9. 10. 11. 12.

ELECTRIC VEHICLE: SAFETY, REGULATIONS AND FUTURE
(Elective)

B. Tech. IV Year I Semester

L	T	P	C
3	0	0	3

COURSE OUTCOMES:

At the end of the course, the student will be able to
CO1. State Vehicular Safety and Norms.
CO2. Describe Government Norms and Regulations.
CO3. Elaborate Electric Vehicle Policy.
CO4. Assess EV Policy Actions.
CO5. Classify charging technologies.

UNIT - I

Vehicular Safety and Government norms: Road and Automotive Safety Systems: Active and passive safety, Safety Regulations for vehicular application, occupant protection, Traffic signs, traffic rules.

UNIT - II

Government Norms, Regulations and Policies: Motor vehicle act: control of transport, RTO and other regulations for EVs, offences, Penalties and procedures.

UNIT - III

Electric Vehicle Policy: Electric Vehicle Policy, Components of Electric Vehicle, Electric Vehicle deployment Objective and Opportunity, Market Barriers

UNIT - IV

Policy Actions: EV models Availability, EV Cost Competitiveness, EV deployment across different fleets, Charging station infrastructure, public awareness.

UNIT - V

Future of EVs: Latest advances in Battery Technologies, Charging infrastructure and Fast Charging technologies, Costs and equalizing.

TEXT BOOKS:

1. Automotive Industrial Standards (AIS). AIS-090 (Rev.1):2019
2. Electric Vehicle Guidebook For Indian States, Aparna Menon, Zifei Yang, Anup Bandivadekar, International Council on Clean Transportation

REFERENCE BOOKS:

1. Motor Vehicle Act - Govt. of India Publications.
2. M.V. Act 1988-RTO rules and Regulation Manual
3. Modern electric, hybrid electric, and fuel cell vehicles. Ehsani, M., Gao, Y., Longo, S., & Ebrahimi, K. CRC press.