Academic Program: PG

Academic Year 2025-26

Electrical & Electronics Engineering (Lead Department)

Jointly with

Electronics & Communication Engineering

Mechanical Engineering

M.Tech. in Electric Vehicle Technology

III & IV Semester Syllabus

SHRI DHARMASTHALA MANJUNATHESHWARA COLLEGE OF ENGINEERING & TECHNOLOGY,
DHARWAD – 580 002
(An Autonomous Institution Approved by AICTE & Affiliated to VTU, Belagavi)
Ph: 0836-2447465Fax: 0836-2464638 Web: www.sdmcet.ac.in

SDM College of Engineering & Technology, Dharwad
Department of Electrical & Electronics Engineering
*(Our motto: Professional **C**ompetence with **P**ositive **A**ttitude)*

College Vision and Mission

Vision:
To develop competent professionals with human values.

Mission:
1. To have contextually relevant Curricula.
2. To promote effective Teaching Learning Practices supported by Modern Educational Tools and Techniques.
3. To enhance Research Culture.
4. To involve Industrial Expertise for connecting classroom content to real life situations.
5. To inculcate Ethics and impart soft-skills leading to overall Personality Development.

SDMCET- Quality Policy
- In its quest to be a role model institution, committed to meet or exceed the utmost interest of all the stake holders.

SDMCET- Core Values
- Competency
- Commitment
- Equity
- Team work and
- Trust

Department Vision and Mission

Vision:
To develop globally acceptable Electrical and Electronics Engineering professionals with human values.

Mission:
1. Adopting the state of the art curricula
2. Practicing effective and innovative teaching-learning methodologies
3. Initiating complementary learning activities to enhance competence
4. Inculcating positive attitude and commitment to society.

SDM College of Engineering & Technology, Dharwad

It is certified that the scheme and syllabus for III & IV semester M.Tech .in Electric Vehicle Technology is recommended by the Board of Studies of Electrical & Electronics Engineering, Electronics & Communication Engineering and Mechanical Engineering Departments and approved by the Academic Council, SDM College of Engineering & Technology, Dharwad. This scheme and syllabus will be in force from the academic year 2025-26 till further revision.

Chairmen BoS & HoDs **Principal**

Program Educational Objectives (PEOs):

I. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms.

II. To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise.

III. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, research, design and implementation skills.

IV. To prepare graduates who will thrive to pursue life-long reflective learning to fulfil their goals.

Program Outcomes (POs):

PO1: An ability to independently carry out research / investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report / document.

PO3: Student should be able to demonstrate a degree of mastery over the area of Electric Vehicle Technology.

PO4: Exposure to the state of the art practices in the domain of Electric Vehicle Technology

Scheme of Teaching and Examinations – 2025-2026
M. Tech. (Electric Vehicle Technology)
III Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
24PEVC300	IoT and Vehicle Communication	4-0-0	4	50	100	3	-	-
24PEVEXXX	Elective 4	4-0-0	4	50	100	3	-	-
24PEVEXXX	Elective 5	4-0-0	4	50	100	3	-	-
24PEVEXXX	Elective 6	4-0-0	4	50	100	3	-	-
OR								
24PEVL301	Internship in Industry or R&D organization	** Min 4 weeks during vacation after 2nd sem	4	50	-	-	100	3
24PEVL302	*** Project phase - I	0-0-6	6	50	-	-	50	3
Total		**16-0-6/12-4weeks-6)**	**22**	**250**	**400/300**	**-**	**50/150**	**-**

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

The students are expected to undergo training in industry for a period of ***four weeks* during the vacation immediately after completion of II Semester examination. A faculty is to be allotted to guide the student. A committee consisting of three faculty members shall evaluate the work carried out and the knowledge the students have acquired.**OR The students can take one elective course if they do not undergo internship.**

***Project phase-I: The students are expected to formulate the problem and carry out the intensive literature survey along with preliminary investigations supporting the project phase-II in IV semester.

Course Code	Elective 5, 6 & 7
24PEVE310	Data Science using Python
24PEVE311	Battery and Fuel cell Technology
24PEVE312	Noise, Vibrations and Harshness in EV
24PEVE313	Power Electronics and Control
24PEVE314	Analog and Digital Electronics
24PEVE315	Automotive Safety

Scheme of Teaching and Examinations – 2025-2026
M. Tech. (Electric Vehicle Technology)
IV Semester

Course Code	Course Title	Teaching		Examination				
		L-T-P (Hrs/Week)	Credits	CIE	Theory (SEE)		Practical (SEE)	
				Max. Marks	*Max. Marks	Duration in hours	Max. Marks	Duration in hours
24PEVL400	Project phase-II	0-0-22	18	100	-	-	100	3
24PEVOA1	***BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
24PEVOA2	***BOS recommended ONLINE course	-	Audit (PP)	-	-	-	-	-
Total		**0-0-22**	**18**	**100**	**-**	**-**	**100**	**-**

CIE: Continuous Internal Evaluation **SEE**: Semester End Examination

L: Lecture **T**: Tutorials **P**: Practical

*SEE for theory courses is conducted for 100 marks and reduced to 50 marks.

** Project phase-II: The students are expected to work on a project for the full semester in an industry or an institution

III – Semester

24PEVC300	IoT and Vehicle Communication	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on fundamental principles of Electronic Engine control system, construction and operation of sensors and actuators, role of electronics in vehicle motion control, instrumentation and advanced features for safety and comfort in vehicles.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Discuss the basics of IoT, enabling technologies and its domain applications	-	1	4
CO-2	Analyse and Compare IoT design methodologies, case studies on IoT and describe python programming environment for IoT	3	-	-
CO-3	Describe the basic theories and principles, technologies, standards, and system architecture of vehicular ad-hoc networks (VANET) or inter-vehicle communication networks.	-	3	4
CO-4	Analyse, Design, and Evaluate vehicular communication platforms for various kinds of safety and infotainment applications.	4	3	-
CO-5	Assimilate new technological development in VANNET related fields.	-	4	-

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	2.0	-	2.33	1.75

Pre-requisites: Basics of Automobiles and Engine, Analog and Digital electronics Circuits, Control systems and microcontrollers

Contents:

1) **Introduction to Internet of Things:** Introduction, Definition characterization of IoT, Physical Design of IoT, Logical Design of IoT, IoT Enabling Technology, IoT Levels and Deployment Templates **08 Hrs.**
2) **Domain Specific IoTs:** Introduction, Home Automation, Smart Cities, Environment, smart Energy, Logistics, Agriculture, Industry, Health and life style. **08 Hrs.**
3) **IoT Platforms Design Methodology :**IoT Design Methodology , Case Study on IoT System for Weather Monitoring , Importance of Python in IoT, IoT Systems Design using Python , Python Data Types , Data Structures , Control flow, Functions, Modules, Packages and File handling, Data Operations, Classes. **12 Hrs.**
4) **Introduction to VANET and Vehicular Safety Applications:** Basic Principles and Challenge, Past and Ongoing VANET Activities, Introduction to Vehicular Safety Applications, Enabling Technologies, Cooperative System Architecture, Mapping for Safety Applications, VANET-enabled Active Safety Applications. **12 Hrs.**
5) **Information Dissemination in VANETs:** Introduction, Obtaining Local Measurements, Information Transport, Summarizing Measurements, Geographical Data Aggregation.

   VANET Convenience and Efficiency Applications: Introduction, Limitations, Applications, Communication Paradigms. **12 Hrs.**

Reference Books:

1) Vijay Madisetti, Arshdeep Bahga, Adrian McEwen (Author), Hakim Cassimally, “Internet of Things A Hands-on-Approach” Arshdeep Bahga& Vijay Madisetti, 2014.
2) Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Aves and, David Boyle, “From Machine to Machine to Internet of Things”, Elsevier Publications, 2014.
3) H. Hartenstein and K. P. Laberteaux, VANET: Vehicular Applications and Inter Networking Technologies, Wiley, 2010.
4) P. H. J. Chong, I. W. H. Ho, Vehicular Networks: Applications, Performance Analysis and Challenges, Nova Science Publishers, 2019.

24PEVE310 Data Science using Python (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The course focuses on learning various aspects of data science. Python language is used to verify the concepts by implementing the programs. Descriptive statistics and statistical inference will be studied which form the foundations of data science. The practical applications like recommender systems will be dealt with based on sentiment analysis.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyse different introductory aspects of data science and Python language.	1	2	-
CO-2	Analyse the methods of data preparation and perform the continuous distribution analysis.	1,2	-	-
CO-3	Analyse the statistical inference techniques.	1	2	-
CO-4	Relate different aspects of supervised learning and undertake the case studies.	1	2	3
CO-5	Apply the natural language processing methods to perform sentiment and hence build the recommender systems.	1	2	-

POs	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	2.2	1.0	-

Pre-requisites: Basics of statistics and a programming language

Contents:

1) **Introduction to Data Science:** What is data science? Tool boxes for Data Scientists, Why Python?, Fundamentals of python libraries for data scientists, Data Science Ecosystem, Web Integrated Development Environment (WIDE), Python for Data Scientists. **10 Hrs.**

2) **Descriptive Statistics:** Introduction, Data Preparation, Exploratory Data-Summarizing the Data, Data Distributions, Outlier Treatment, Measuring Asymmetry: Skewness and Pearson's Median Skewness Coefficient, Continuous Distribution Analysis, Kernel Density, Estimation-Sample and Estimated Mean, Variance and Standard Scores, Covariance, and Pearson's and Spearman's Rank Correlation. **11 Hrs.**
3) **Statistical Inference:** Introduction, the Frequentist approach, measuring the variability in estimates, hypothesis testing. **10 Hrs.**
4) **Supervised Learning:** Introduction, the problem, the first steps, learning curve, training, validation and test, two learning models, case study, Introduction to Regression Analysis, linear regression, and logistic regression. **11 Hrs.**
5) **Recommender Systems:** Introduction, working of recommender systems, modelling the user preferences, evaluating recommenders, case studies. Introduction to Statistical Natural Language Processing for Sentiment Analysis, Data cleaning, text representation, case studies. **10 Hrs.**

Reference Books:

1) Laura Igual, Santi Segui, "Introduction to Data Science: A Python Approach to Concepts, Techniques and Applications", Springer, ISBN 978-3-319-50016-4, 2017.
2) Jake Vander Plas, "Python Data Science Handbook: Essential Tools for Working with Data", O'Reilly, Revised first edition, 2017.

24PEVE311 Battery and Fuel Cell Technology (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The objectives of this course are to make the student to learn:

1. Significance of fuel cells in present energy context of India
2. Working of different batteries
3. Working of different fuel cell and thermodynamics
4. Hydrogen production and storage methods

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Explain energy scenario and fuel cells as future source of power	-	1	-
CO-2	Describe the working of primary and secondary types of batteries	-	1	-

CO-3	Explain the working principles of fuel cells.	-	1	-
CO-4	Evaluate efficiency and thermodynamic parameters related to fuel cells.	-	1	3
CO-5	Describe different methods of production and storage of hydrogen for fuel cells.	-	1	-

POs	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	-	1.0	-

Prerequisites: Basic storage elements.

Contents:

1) Indian energy scenario, sector wise energy patterns, need for alternate sources of energy, fuel cell as an alternate sources of energy pros and cons, brief historical background of fuel cells and batteries , basic working principle and comparison of fuel cell and batteries , international and national status of fuel cell development and application. Fuels for Fuel Cells: Hydrogen, methane, methanol - Sources and preparation, reformation processes for hydrogen. **10 Hrs.**
2) **Batteries:** Introduction, working of primary and secondary batteries: The chemistry, fabrication, and performance aspects, packing classification and rating of the following batteries: Zinc-carbon, zinc alkaline zinc/air batteries; Lithium primary cells - liquid cathode, solid cathode and lithium-ferrous sulphide cells Secondary batteries: Lead acid, nickel-cadmium, nickel-zinc, nickel-metal hydride batteries, lithium-ion batteries, ultrathin lithium polymer cells. Advanced Batteries for electric vehicles, requirements of the battery, depth of discharge, sodium-beta and redox batteries. **10 Hrs.**
3) **Fuel Cells:** Description, working principle, anodic, cathodic and cell reactions, fabrication of electrodes and other components, applications, advantages, disadvantages and environmental aspects of the following types of fuel cells: Proton Exchange Membrane Fuel Cells, alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate, direct methanol fuel cells. Membranes for fuel cells: Nafion – Polymer blends and composite membranes; assessment of performance – recent developments. **12 Hrs.**
4) **Thermodynamics of fuel cells:** First law second law, heat potential reaction enthalpies, Gibbes free energy, reversible voltages, fuel cell efficiency, Nernst equation analysis effect of temperature and pressure and concentration, concept of electrochemical potential calculation of standard electrode potential.

10 Hrs.

5) **Hydrogen production and storage:** Advantages and disadvantages of using hydrogen as fuel, hydrogen production methods, hydrogen storage, recent developments in storage and production of hydrogen. **10 Hrs.**

Reference Books:

1) M. Aulice Scibioh and B. Viswanathan "Fuel Cells – principles and applications", University Press, India, 2006.
2) F. Barbir, "PEM fuel cells: theory and practice", Elsevier, Burlington, MA, 2005.
3) Dell, Ronald M Rand, David A J, "Understanding Batteries", Royal Society of Chemistry, 2001.
4) G. Hoogers, "Fuel cell handbook", CRC, Boca Raton, FL, 2003.
5) Ryan P. O'Hayre, Suk-Won Cha, Whitney Colella and Fritz B. Prinz, Fuel cell fundamentals, John Wiley and Sons, 2006

24PEVE312 Noise, Vibrations and Harshness in EV (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

1. To enable students to gain knowledge and understanding Automobile NVH Fundamentals.
2. To study the electric motor vibration & noise effects from various sources.
3. To study sound quality of BEV & its impact, damping/control of vibrations.
4. To learn performance parameters of vibrations in BEV using different techniques & aerodynamics fundamentals.

Description of the Course Outcomes: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Analyse the challenges & significance of Battery Electric Vehicles, Automobile NVH Fundamentals	-	-	1
CO-2	Identify and analyse the Electric Motor Vibration & Noise effects from various sources	-	-	1
CO-3	Identify the impact due to sound quality of BEV & damping/vibration control	-	3	-
CO-4	Evaluate the vibration of BEV using experimental/FEA techniques, aerodynamics fundamentals	-	-	1

POs	PO-1	PO-2	PO-3	PO-4
Mapping Level	1.0	-	2.0	-

Contents:

1) **Introduction:** Challenges & Significance of studies on Battery Electric Vehicles (BEVs), Characteristics of BEV, Power train system. Automotive NVH Fundamentals, Vehicle NVH target & Refinement, Driveline NVH, Vibration isolation of power system, Road/Tire-induced NVH, Wind Noise, Whole Vehicle Vibration under Road Excitation. **10 Hrs.**
2) **Electric Motor Vibration & Noise:** Motor -induced NVH, Electromagnetic Forces & Torque Pulsation, Motor System NVH, NVH of BEV, Metrics to Assess BEV NVH, NVH Development of BEV, NVH Targets & Target decomposition/Cascading. Motor NVH, Motor Whine, Gear box NVH, Gear mesh Whine & Rattle, Driveline NVH, Power Electronics NVH, Inverter High-Frequency Sideband/Tonal Noise, NVH of Specific Components/Accessories. **12 Hrs.**
3) **Sound Quality of BEV:** Psychoacoustic parameters & Sound, Quality Matric, Loudness, Roughness, Sharpness, Fluctuation strength, Sound Quality Development of BEV, Vibration Isolation & Control, Unconstrained & Constrained layer damping treatment, add on damping & stiffeners, Introduction to Active Vibration control. **10 Hrs.**
4) **Vibration Measurements & Instrumentation:** Definition of Modal Properties, Modal Analysis theory, FE & Experimental Modal Analysis, Transducers & Accelerometers Excitation Sources, Impact Excitation, Laser based Vibration measurements. **10 Hrs.**
5) **Automotive Aerodynamics:** Scope-historic development trends, Aerodynamic Drag of Cabs, Shape optimization of Cabs, Vehicle handling, Wind Tunnel for Automotive Aerodynamics. **10 Hrs.**

Reference Books:

1) Lijun Zhang, Dejian Meng, Gang Chen, Publisher: SAE International Specs: Published by SAE International with a Product Code of R-481, ISBN of 978-0-7680-9964-5.
2) Hucho, W.H, “Aerodynamics of Road Vehicles”, Butterworth Co. Ltd.,1987
3) Vehicle Aerodynamics, SP-1445, SAE, 1996.

24PEVE313 Power Electronics and Control (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

The students will be able to learn the various Single phase & Three Phase Converters for different load; Switching Regulators; Different Motors & Control

Techniques.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Analyse Single Phase & Three Phase AC – DC Converters	3	-	-
CO-2	Analyse the working of DC – DC and AC – DC converters	3	-	-
CO-3	Analyse the working of various switching voltage regulators	3	-	-
CO-4	Demonstrate the control schemes of different motors applicable to electric vehicles.	3	-	-

POs	PO-1	PO-2	PO-3	PO-4
Mapping Level	-	-	3.0	-

Prerequisites: Fundamentals of EV, Vehicle Technology, MATLAB/Simulink, RICARDO

Contents:

1) **Single Phase & Three Phase AC – DC Converters**

   Single Phase Half & Full Controlled Converters (using SCR/IGBT/Power MOSFET), analysis with R, RL load, Effect of Source Inductance on both circuits, Three Phase - Half, Full Converter & Semi Converter, analysis with RLE loads, continuous conduction only, Effect of Source Inductance, Single-Phase Dual Converters – Circulating & Non-Circulating Current Operation. **12 Hrs.**

2) **DC – DC and AC – DC Converters**

   DC – DC Converters: Step-down chopper, Step- up chopper, analysis with RL & RLE load, Control Strategies, Two-Quadrant & Four-Quadrant Chopper, Voltage Commutated Chopper, Current Commutated Chopper. AC – DC Converters: Three Phase Voltage Source Inverters, 180^0 and 120^0 mode of conduction, PWM Inverters, Power Factor Improvement Techniques. **13 Hrs.**

3) **Switching Voltage Regulators**

   Introduction; Linear Power Supply (Voltage Regulators); Switching Voltage Regulators; Review of basic dc-dc voltage regulator configurations -Buck,

Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter, Cuck converter; Design criteria for SMPS; Multi-output switch mode regulator.

13 Hrs.

4) Motors & Control

DC Series Motor, Brushless DC Motor, Permanent Magnet Synchronous Motor (PMSM), Three Phase AC Induction Motors, Switched Reluctance Motors (SRM): Constructional features-principle of operation-Inductance Profile-Torque equation- Types of Power controllers and converter topologies used, different control techniques used, Microcontroller based control. **14 Hrs.**

Reference Books:

1) Power Electronics – Converters, Applications and Design Ned Mohan, Tore M. Undeland and William P. Robbins, John Willey & sons
2) Power Electronics - Circuits, Devices and Applications Muhammad H. Rashid Prentice Hall of India
3) High Power Converters and AC Drives Bin Wu, John Willey & sons, Inc.,
4) Power Electronics Handbook Muhammad H. Rashid Elsevier
5) Power Electronics Essentials and Applications L. Umanand Wiley India Pvt Ltd
6) AC Motor Control and Electrical Vehicle Applications, 2nd Edition, Kwang Hee Nam
7) Power Electronics for the microprocessor Age, Kenjo, T. Oxford University Press1994.
8) Modern Power Electronics & AC drives, B.K. Bose, Prentice-Hall of India Pvt. Ltd., New Delhi, 2001.
9) Electric Motor Drives – Modelling, Analysis and Control, R. Krishnan Prentice-Hall of India Pt. Ltd., New Delhi, 2003.

24PEVE314 Analog and Digital Electronics (4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course focuses on the study of discrete electronic components such as transistors for various applications. The students are expected to learn MOS devices and development of oscillator circuits. The students are also know the fundamentals of digital electronics and design of combinational and sequential circuits both at gate and IC levels.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		Mapping to POs (1 to 4)		
		Substantial Level (3)	Moderate Level (2)	Slight Level (1)
CO-1	Narrate the characteristics of diodes, transistors and MOSFET.	1	-	3
CO-2	Design oscillator and related circuits.	1	-	3
CO-3	Design combinational circuits using MSI components.	1	-	3
CO-4	Design sequential circuits and locate faults in digital circuits.	1	-	3

POs	PO-1	PO-2	PO-3	PO-4
Mapping Level	3	-	1	-

Contents:

1) **Diode Applications:** Clippers, Clampers and Rectifier circuits. **05 Hrs.**
2) **MOS Field -Effect Transistors**: Device structure and Physical operation, current voltage characteristics, MOSFET circuits at DC, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits. **06 Hrs.**
3) **Feedback and oscillator circuits:** Feedback concepts, feedback connection types, practical feedback circuits, oscillator operation, phase-shift oscillator, wien-bridge oscillator, tuned oscillator circuits, crystal oscillator **08 Hrs.**
4) **Review of combinational circuits and sequential circuits**: digital time display unit design, sequence detector, sequential data path and control. **09 Hrs.**
5) **Capabilities, minimization, and transformation of sequential machines:** the finite- state model, further definitions, capabilities and limitations of finite - state machines, state equivalence and machine minimization, simplification of incompletely specified machines **12 Hrs.**
6) **State-identifications and fault-detection experiments**: homing experiments, distinguishing experiments, machine identification, fault detection experiments, design of diagnosable machines, second algorithm for the design of fault detection experiments, fault-detection experiments for machines which have no distinguishing sequences**,** multipliers, dividers, ADC and DAC design**. 12 Hrs.**

Reference Books:

1) Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 10/e, PHI, 2012.
2) Adel S. Sedra and Kenneth C. Smith, “Microelectronic Circuits Theory and Applications”, Fifth edition, International Version.
3) Charles H. Roth, Jr. Lizy Kurian John, Byeong Kil Lee, “Digital Systems Design Using Verilog”, First Edition, Cengage Learning, 2014.
4) Zvi Kohavi, “Switching and Finite Automata Theory”, 2nd Edition. Tata McGraw Hill Edition.

24PEVE315	Automotive Safety	(4-0-0) 4

Contact Hours: 52

Course Learning Objectives (CLOs):

This course intends to provide an in-depth understanding of the safety considerations specific to electric vehicles (EVs). It aims to familiarize students with the various safety systems and components integrated into EVs and to analyse the key safety challenges and potential hazards related to EVs.

Course Outcomes:

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify and explain the key safety components and systems in electric vehicles, such as high-voltage systems and advanced driver-assistance systems (ADAS).	1, 2	-	4
CO-2	Assess safety concerns and hazards related to electric vehicle technology and propose effective safety measures.	2	3	-
CO-3	Demonstrate the ability to diagnose and troubleshoot safety-related issues in EVs, including battery safety and charging infrastructure safety.	1, 3	-	4

CO-4	Apply safety guidelines and best practices in real-world scenarios, including maintenance, inspections, and handling of electric vehicle safety systems.	-	2, 3	-
CO-5	Collaborate effectively in teams to address safety-related challenges in the electric vehicle industry through case studies and projects.	4	2, 3	1

POs	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	2.5	2.25	1.66

Course contents:

1) Introduction to Electric Vehicles and Safety, Overview of electric vehicle technology and its impact on automotive safety, Unique safety challenges and considerations in electric vehicles, Introduction to relevant safety standards and regulations for electric vehicles. **06 Hrs.**
2) Electrical Safety Fundamentals, Basics of electrical safety, including high-voltage safety protocols. Hazards associated with EV battery systems and methods for safe handling. Safety practices when working on electric vehicle electrical components. **10 Hrs.**
3) EV Battery Safety, Understanding battery technologies used in electric vehicles. Battery management systems and their role in ensuring safety. Mitigating risks associated with EV battery fires and thermal events. **12 Hrs.**
4) Vehicle Safety Systems and ADAS Overview of safety systems in electric vehicles, including airbags, seatbelts, and stability control., In-depth study of Advanced Driver Assistance Systems (ADAS) and their safety implications., Evaluating the effectiveness of ADAS in preventing accidents and enhancing safety. **14 Hrs.**
5) Charging Infrastructure Safety, Electric vehicle charging technologies and safety standards, Safety considerations during EV charging, including home and public charging stations, Addressing safety concerns in charging infrastructure to ensure user safety. **10 Hrs.**

Reference Books:

1) James Larminie and John Lowry, "Electric Vehicle Technology Explained" Second edition, 2012, Wiley Publication.
2) Iqbal Husain, “Electric and Hybrid Vehicles”, CRC Press, 2021.

3) Ralph M. Steingart, Automotive Safety in Electric Vehicle Technology, 1st Edition, CRC Press, 2019

4) Mingqiu Zhang, David J. Smith, and John W. Evans. Electric Vehicle Safety: A Systems Approach. 1st ed. John Wiley & Sons, 2019.

5) Arun Kumar Mishra, Pawan Kumar Jain, and Sanjay Kumar Tiwari. Electric Vehicle Safety: A Comprehensive Guide. 1st ed. CRC Press, 2017.

24PEVL301 Internship in Industry or R&D organization 4 Credits

Duration: 4 weeks

Course Learning Objectives (CLOs):

Internship provides the opportunity for the students to get exposure to the real time systems that include personal training , time and stress management, presentations, marketing, liability and risk management, maintenance and responding to emergencies etc. Further they learn to relate theory and practice. They also learn the significance of adhering to the professional standards in the field.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Know the industrial environment.	-	3	1
CO-2	Acquire knowledge and skill to use in professional career.	-	3	1
CO-3	Acquire the ability of report preparation and presentation skills.	2	-	-
CO-4	Follow the code of practice in EV related activities.	-	4	-

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	1.0	3.0	2.0	2.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

Contents:

1) The students are expected to undergo industrial training in EV technology or

related domain. They are required to know the functions of Engineers in managing the floor. The skills required in design, development operation service and maintenance shall be studied. The organizational behavior and management need to be understood. The above skills obtained need to be documented and presented.

2) Know the current challenges inEV technology implementation and try suggesting solutions.

Reference materials/books:

1) Industrial reference manuals
2) Data sheets.
3) Software packages.
4) Product information brochures.
5) Interaction with industrial experts.
6) Internet

24PEVL302 Project Phase - I (0-0-6) 6

Working Hours: 78

Course Learning Objectives (CLOs):

The students are expected to learn carrying out literature survey to locate the state of the art technology while formulating/defining the project problem in EV technology domain. The students are expected to select a topic from an emerging area relevant to EV technology and relevant field. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase. The same work shall be continued in the next phase in IV semester.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level(3)	**Moderate Level(2)**	**Slight Level(1)**
CO-1	Carry out the literature survey to locate the state of the art technology in EV field.	-	1	4
CO-2	Define/formulate the problem for the project work	-	1	3
CO-3	Design, develop, analyze, test, interpret the results, fabricate, simulate, write code, prepare	-	3	-

	report, etc. relevant to his/her project work			
CO-4	Summarize the work in to a project report and present	2	-	-

PO's	PO-1	PO-2	PO-3	PO-4
Mapping Level	2.0	3.0	1.5	1.0

Prerequisites: Knowledge of both theory and practical courses learnt in all the previous semesters and relevant value-added information.

Contents:

1) The students are expected to locate the state of the art technology in EV domain through proper literature survey and select a topic from an emerging area relevant to EV domain. The literature survey, visits, data collection, preliminary design, analysis etc. is to be done in this phase.
2) Know the current challenges in EV technology implementation and try suggesting technical solutions.

Reference materials/books:

1) Engineering books pertaining to their work.
2) International reputed Journals.
3) Manuals and data sheets.
4) Software packages.
5) Previous project reports.
6) Product information brochures.
7) Interaction with academia and industrial experts.
8) Internet Material.

IV – Semester

24PEVL400	Project Phase – II	(0-0-22) 18

Course Learning Objectives (CLOs):

The students are expected to find out solutions individually in EV related problems preferably. They are expected to carry out the intensive literature survey to locate the state of the art technology in EV domain. They must learn to formulate/define/locate real time problem for the project work. They will also learn to design, develop, analyse, test, interpret the results, fabricate, simulate, write code, and convert report in to papers for publication in journals to add value to the existing literature. They are also expected to acquire the skills of summarizing the work in to a project report and present the same.

Course Outcomes (COs):

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level(2)**	**Slight Level (1)**
CO-1	Carry out the literature survey to locate the state of the art technology in EV domain.	-	1	4
CO-2	Define/formulate/locate real time problem for the project work	-	1	3
CO-3	Design, develop, analyse, test, interpret the results, fabricate, simulate, write code, prepare papers etc.	3	-	-
CO-4	Summarize the work in to a project report and present the same	2	-	-

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	2.0	3.0	2.0	1.0

Prerequisites:

Knowledge of both theory and practical courses learnt in all the previous Semesters and relevant value added information.

Contents:

The students are expected to continue the work with EV technology and related challenges and providing feasible solutions.

Reference materials/books:

1) Engineering books pertaining to their work.
2) International reputed Journals.
3) Manuals and data sheets.
4) Software packages.
5) Previous project reports.
6) Product information brochures.
7) Interaction with academia and industrial experts.
8) Internet Material.

24PEVEOA1	BOS recommended ONLINE course	Audit

Contact Hours: As Specified by the Organization

Course Learning Objectives (CLOs):

The students are expected to identify their field of interest and undergo learning by taking ONLINE courses and attending classes.

Classes and evaluation procedures are as per the policy prescribed for online courses by the respective organizations and PP is a must for the award of the Degree**.**

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify his/her field of interest.	1	-	3
CO-2	Demonstrate the knowledge acquired in the selected course/field.	1	-	3

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	-	1.0	-

24PEVEOA2	BOS recommended ONLINE course	Audit

Contact Hours: As Specified by the Organization

Course Learning Objectives (CLOs):

The students are expected to identify their field of interest and undergo learning by taking ONLINE courses and attending classes.
Classes and evaluation procedures are as per the policy prescribed for online courses by the respective organizations and PP is a must for the award of the Degree.

Description of the Course Outcome: At the end of the course the student will be able to:		**Mapping to POs (1 to 4)**		
		Substantial Level (3)	**Moderate Level (2)**	**Slight Level (1)**
CO-1	Identify his/her field of interest.	1	-	3
CO-2	Demonstrate the knowledge acquired in the selected course/field.	1	-	3

PO's	**PO-1**	**PO-2**	**PO-3**	**PO-4**
Mapping Level	3.0	-	1.0	-