POST DIPLOMA IN ELECTRIC VEHICLE TECHNOLOGY

(P D E V T)

FULL TIME (ONE YEAR)

COURSE STRUCTURE

VISHWAKARMA INSTITUTE OF KAUSHALYA AND SWAVLAMBAN (VIKAS)

GUJARAT VIDYAPITH : AHMEDABAD – 09

Details :

1. Name of the Course :- Post Diploma in Electric Vehicle Technology.

2. Eligibility :- Degree Engineering / Diploma Engineering /ITI (NCVT/GCVT) + 2 Yrs. Experience / Any Graduate.

3. Duration :- 1 (one) Year (Full Time)

4. Intake :- 30 (Thirty) Student.

5. Course Fee :- Rs. 18,000/- (9,000/- per Semester)

6. Medium of Teaching :- Gujarati

7. Admission Procedure :- As per University Rules.

Course Description

Diploma in Electric Vehicle (EV) Technology is a comprehensive program designed to equip individuals with the knowledge, skills, and expertise required to excel in the rapidly evolving field of electric mobility. With a focus on practical learning and industry relevance, this diploma program covers a wide range of topics essential for understanding, designing, and implementing electric vehicle technologies.

Job Market

The electric vehicle job market in March 2024 reflects the rapid evolution and expansion of the EV industry, offering diverse career opportunities for professionals across various disciplines. With on going technological advancements, supportive government policies, and increasing consumer acceptance, the future of electric mobility presents exciting prospects for individuals passionate about shaping the future of transportation towards sustainability.

Electric vehicles have seen a huge growth in the industry and are expected to grow 10 fold by 2025. Governments are encouraging their citizens to buy hybrid electric vehicles and electric vehicles in order to reduce carbon emission. This means that companies are looking for candidates that are well qualified in this field and have relevant skills during the ev courses that they can contribute for the growth of the company.

Apart from this, the market has also opened a myriad of opportunities for freshers. With very few people in the industry with the required knowledge in this field, learning this course, increases your chances of landing a job in a company.

Job Opportunities:

Battery Engineer/Scientist: Develops and optimizes battery technologies for electric vehicles, focusing on performance, energy density, and safety.

Electric Vehicle Design Engineer: Designs and engineers electric vehicle components, including powertrains, chassis, and thermal management systems.

Charging Infrastructure Specialist: Manages the planning, installation, and maintenance of EV charging stations, ensuring reliability and compatibility with various vehicle models.

Electric Powertrain Engineer: Designs and optimizes electric powertrain systems, including motors, inverters, and control algorithms, to enhance vehicle performance and efficiency.

EV Policy Analyst: Analyzes government policies, regulations, and incentives related to electric vehicles, providing insights to industry stakeholders and policymakers.

EV Sales Representative: Educates consumers about electric vehicle options, facilitates test drives, and assists with the sales process at dealerships or online platforms.

EV Technician: Performs maintenance, diagnostics, and repairs on electric vehicles, including battery inspections, software updates, and electrical system troubleshooting.

Sustainability Manager: Implements environmental sustainability initiatives within organizations, including the adoption of electric vehicles, renewable energy integration, and carbon footprint reduction strategies.

STRUCTURE, SUBJECT AND PAPER CODE

(ONE YEAR FULL-TIME)

2 Semester , 40 Credit Course (20 Credit/ Semester)

Semester-I

(Per Week)

Paper Code	Name of Subject	Credit	Credit (Theory Hours)	Credit (Practical Hours)
PDEVT 101	Elements of Electrical & Mechanical Engineering (EEME)	4	3 (3)	1 (2)
PDEVT 102	Electric Vehicle & Its System(EVIS)	4	3 (3)	1 (2)
PDEVT 103	Power Electronics Converters for Vehicles (PECV)	4	3 (3)	1 (2)
PDEVT 104	Energy Management in Electric Vehicles	4	3 (3)	1 (2)
PDEVT 105	Testing Certification for Electric Vehicles	4	3 (3)	1 (2)

Note : Theory : 1 credit = 15 Hours
Practical : 1 Credit = 30 Hours

Semester-II

Paper Code	Name of Subject	Credit		
PDEVT 201	Seminar	1		
PDEVT 202	Mini Project	4		
PDEVT 203	On Job Training	15		

Note : Internship : 1 credit = 45 hours. (8 hours a day & 6 day week)
So, 1 credit per week.
15 credit = 15 to 16 weeks (Internship)

STRUCTURE, SUBJECT AND PAPER CODE

(ONE YEAR FULL-TIME)

2 Semester , 40 Credit Course (20 Credit/ Semester)

Semester-I

Paper Code	Name of Subject	Theory Marks	Practical Marks	Total Marks
PDEVT 101	Elements of Electrical & Mechanical Engineering (EEME)	70	30	100
PDEVT 102	Electric Vehicle & Its System(EVIS)	70	30	100
PDEVT 103	Power Electronics Converters for Vehicles (PECV)	70	30	100
PDEVT 104	Energy Management in Electric Vehicles	70	30	100
PDEVT 105	Testing Certification for Electric Vehicles	70	30	100

Note : Assessment Patters : 60% External & 40% Internal (Theory & Practical)

Semester-II

Paper Code	Name of Subject	Internal Marks	External Marks	
PDEVT 201	Seminar	100	-	100
PDEVT 202	Mini Project	100	100	200
PDEVT 203	On Job Training			

Total : 800 Marks

PAPER – 1

Elements of Electrical & Mechanical Engineering (PDEVT – 101)
(TOTAL MARKS : 100)

Theory Work (42 hours)

1.1: ELECTRICAL CIRCUITS: (8 hours)

DC Circuits::Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff's current and voltage laws, analysis of simple circuits with dc excitation.

AC Circuits: Representation of sinusoidal waveforms, peak and RMS values, Phasor representation of AC quantities, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), Three phase balanced circuits, voltage and current relations in star and delta connections, Power measurement in three phase circuits.

1.2: TRANSFORMER: (4 hours)

Magnetic materials, BH characteristics. Construction and working principle of single phase and three phase transformers. Ideal and practical transformer. Auto-transformer and its applications.

1.3: ELECTRICAL ROTATING MACHINES: (6 hours)

Generation of rotating magnetic fields. Construction and working of following machines: Three-phase induction motor, Single-phase induction motor, separately excited DC motor, Synchronous generators, alternators, special motors.

1.4: ELECTRICAL INSTALLATIONS: (6 hours)

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables. Earthing – Types of earthing and its importance. Safety precautions for electrical appliances.

1.5: BASIC TERMINOLOGY & ENERGY: (6 hours)

Prime movers and its types, Concept of Force, Pressure, Energy, Work, Power, System, Heat, Temperature, Specific heat capacity, Process, Cycle, Internal energy, Enthalpy,

Statements of Zeroth law and First law Applications of Energy sources like Fossil fuels, Nuclear fuels, Hydrogen fuel, Hydro, Solar, Wind, and Bio-fuels, Environmental issues like Global warming and Ozone depletion

1.6: ENGINEERING MATERIALS: (6 hours)

Types, properties and applications of insulating, conducting & semiconductor materials, Ferrous & Nonferrous metals, Timber, Abrasive material, silica, ceramics, glass, graphite, diamond, plastic and polymer. Applications.

1.7: COUPLINGS, CLUTCHES & BRAKES: (6 hours)

Construction and applications of Couplings (Box; Flange; Pin type flexible; Universal and Oldham), Clutches (Disc and Centrifugal), and Brakes (Block; Shoe; Band and Disc) Transmission of Motion and Power: Shaft and axle, Different arrangement and applications of Belt drive; Chain drive; Friction drive and Gear drive

PAPER – 2

Electrical Vehicle & its System (PDEVT – 102)
(TOTAL MARKS : 100)

Theory Work (41 hours)

1.1 : INTRODUCTION TO ELECTRIC VEHICLE (6 Hrs)

History of electric vehicle, Electric vehicle components, Vehicle mass and performance, electric motor and engine ratings, fuel economy, Electric vehicle market.

1.2: VEHICLE MECHANICS (6 Hrs)

Laws of motion, vehicle kinetics, motion dynamics, propulsion power, velocity and acceleration, force mechanics.

1.3: CHARACTERISTICS AND PERFORMANCE OF ELECTRIC VEHICLE (9 Hrs)

Electric vehicle configurations, electric motor characteristics, tractive effort and transmission requirements, tractive effort in normal driving, energy consumption and vehicle performance.

1.4: HYBRID ELECTRIC VEHICLE (7 Hrs)

Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains, Plug-In Hybrid Electric Vehicle, Powertrain Component Sizing, Mass Analysis and Packaging.

1.5: SOLAR POWERED CHARGING SYSTEM (5 Hrs)

Social Benefits of SPCSs, Environmental Benefits of SPCSs, Economic Benefits, Electric Vehicle Supply Equipment, Locations for SPCSs, Energy Storage, Life Cycle Analysis of SPCSs.

1.6: MOBILITY AND CONNECTORS (8 Hrs)

Mobility - Connected Mobility and Autonomous Mobility, E-Mobility, Indian Roadmap Perspective. Policy: EVs in infrastructure system, integration of EVs in smart grid, social dimensions of EVs.

Connectors- Types of EV charging connector, North American EV Plug Standards, DC Fast Charge EV Plug Standards in North America, CCS (Combined Charging System), Tesla, European EV Plug Standards,

PAPER – 3

POWER ELECTRONICS CONVERTERS FOR ELECTRIC VEHICLE (PDEVT – 103)
(TOTAL MARKS : 100)

Theory Work (42 hours)

1.1: ELECTRIC VEHICLE MOTORS (9 Hrs)

Motors (DC, Induction, BLDC, PMSM) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Hub Motors, Stepper Motors.

1.2: CONVERTER AND CHOPPER CONTROL (6 Hrs)

Principle of phase control – Series and separately excited DC motor with single phase and three phase converters – waveforms, performance parameters, performance characteristics Operation with freewheeling diode schemes; Drive employing dual converter. Introduction to time ratio control and frequency modulation; Class A, B, C, D and E chopper controlled DC motor – performance analysis, multi-quadrant control.

1.3: INVERTER FED INDUCTION MOTOR CONTROL (6 Hrs)

AC voltage controller fed induction machine operation – Energy conservation issues – V/f operation theory – requirement for slip and stator voltage compensation. Control methods for Inverter.

1.4: FIELD ORIENTED CONTROL (7 Hrs)

Field oriented control of induction machines – Theory – DC drive analogy – Direct or Feedback vector control - Indirect or Feed forward vector control – Flux vector estimation – Space Vector Modulation control.

1.5: DIRECT TORQUE CONTROL (7 Hrs)

Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy – optimum switching vector selection – reduction of torque ripple, methods.

1.6: ELECTRIC VEHICLE CONTROL STRATEGY (7 Hrs)

Vehicle Supervisory Control, Mode Selection Strategy (Parallel mode, Power Split Mode, Engine Brake mode, Regeneration mode), Hybrid Modes, Modal Control Strategy.

PAPER – 4

ENERGY MANAGEMENT IN ELECTRIC VEHICLE (PDEVT – 104)
(TOTAL MARKS : 100)

Theory Work (42 hours)

1.1: ENERGY STORAGE SYSTEM (6 Hrs)

Batteries: Lead Acid Battery, Nickel based batteries, Sodium based batteries, Lithium based batteries – Li-ion & Li-poly, Metal Air Battery, Zine Chloride battery; Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System.

1.2: BATTERY CHARACTERISTICS & PARAMETERS (9 Hrs)

Cells and Batteries- conversion of chemical energy to electrical energy- Battery Specifications:
Variables to characterize battery operating conditions and Specifications to characterize battery nominal and maximum characteristics; Efficiency of batteries; Electrical parameters- Heat generation- Battery design- Performance criteria for Electric vehicles batteries- Vehicle propulsion factors- Power and energy requirements of batteries- Meeting battery performance criteria- setting new targets for battery performance.

1.3: BATTERY MODELLING (6 Hrs)

General approach to modelling batteries, simulation model of a rechargeable Li-ion battery, simulation model of a rechargeable NiCd battery, Parameterization of the NiCd battery model, Simulation examples.

1.4: BATTERY PACK AND BATTERY MANAGEMENT SYSTEM (10 Hrs)

Selection of battery for EVs & HEVs, Traction Battery Pack design, Requirement of Battery Monitoring, Battery State of Charge Estimation methods, Battery Cell equalization problem, thermal control, protection interface, SOC Estimation, Energy & Power estimation, Battery thermal management system, Battery Management System:

Definition, Parts: Power Module, Battery, DC/DC Converter, load, communication channel, Battery Pack Safety, Battery Standards & Tests.

1.5: OTHER ENERGY STORAGE SYSTEMS: (11 Hrs)

Ultracapacitors, Compressed Air storage system, Flywheel, Electromagnetic Storage system, Fuel Cell, Hydrogen storage system, - characteristics during charging and discharging, energy storage capacity, power density, energy density, Hybrid combination, series & parallel, complex combination of energy storage system.

PAPER – 5

TESTING AND CERTIFICATION OF ELECTRIC AND HYBRID VEHICLES (PDEVT – 105)

(TOTAL MARKS: 100)

Theory Work (42 hours)

1.1 : INTRODUCTION (5 Hrs)

Specification & Classification of Vehicles (including M, N and O layout), Homologation & its Types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR), Type approval Scheme, Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks, Hardware in The Loop (HIL) concepts for EV/HEVs.

1.2 : BATTERY TESTING AND SAFETY MEASURES: (8 Hrs)

Chemical & structure material properties for cell safety and battery design, battery testing, limitations for transport and storage of cells and batteries, Recycling, disposal and second use of batteries. Battery Leakage: gas generation in batteries, leakage path, leakage rates. Ruptures: Mechanical stress and pressure tolerance of cells, safety vents, Explosions: Causes of battery explosions, explosive process, Thermal Runway: High discharge rates, Short circuits, charging and discharging. Environment and Human Health impact assessments of batteries, General recycling issues and drivers, methods of recycling of EV batteries.

1.3 : STATIC TESTING OF VEHICLE (5 Hrs)

physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement of Foot Controls for M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The Requirement of Temporary Cabin For Drive– Away – Chassis, Electric vehicle – Safety Norms, Energy consumption and Power test.

1.4 : DYNAMICS TESTING OF VEHICLE (5 Hrs)

Hood Latch, Grade ability, Pass-by Noise, Interior Noise, Turning Circle Diameter & Turning Clearance Circle Diameter, Steering Effort, Constant Speed Fuel Consumption, Cooling Performance, Speedo-meter Calibration, Range Test, Maximum Speed,

Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broad band / Narrow band EMI Test, Electric vehicle – Range Test.

1.5 : VEHICLE COMPONENT TESTING (10 Hrs)

Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500 kg), Body block test, Head form test, Driver Field Of Vision, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints test, Airbag Test, Accelerator Control System, Motor power, Safety Requirements of Traction Batteries, EMI-EMC (CI, BCI, RE,RI and CTE).

1.6 : TESTS FOR HYBRID ELECTRIC VEHICLES, RETRO-FITMENT AND CHARGING STATION (9 Hrs)

Hybrid Electric Vehicles Tests (M and N category), Tests for Hybrid Electric System Intended for Retro-fitment on Vehicles of M and N Category (GVW < 3500 kg), Test for Electric Propulsion kit intended for Conversion, Test for Electric Vehicle Conductive AC Charging System, and Test for Electric vehicle conductive DC charging system.

PRACTICAL LAB

(Paper : 101,102,103, 104)

Practical Work

1) Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Resistors, Capacitors and Inductors.
2) To verify the DC circuit currents and voltages by calculations and actual measurements.
3) To verify the Kirchoff's current and voltage laws.
4) To obtain sinusoidal steady state response of R-L and R-C circuits – impedance calculation and verification.
5) Observation of phase differences between current and voltage.
6) To verify the resonance in R-L-C circuits.
7) To measure the power in three phase circuits using two wattmeter method.
8) Demonstration of cut-section models and charts of various machines.
9) Demonstration of domestic installations like MCB, ELCB, MCCB etc.
10) Understanding of various safety precautions for electrical installations.
11) Demonstration of various types of wires and cables.
12) Understanding of various electricity bills and calculations for energy consumption.
13) To understand construction, working and application of clutches, couplings and brakes.
14) To understand different arrangement and application of various power transmission drives.
15) To study various materials and understand its application.
16) Modeling and Simulation of DC Motor Characteristics.
17) Modeling and Simulation of Induction Motor Characteristics.
18) Modeling and Simulation of BLDC Motor Characteristics.
19) Modeling and Simulation of energy consumption and performance of electric vehicle.
20) Architecture development of Hybrid Electric Drive Trains.

21) Develop a comparative case Study of different types of batteries with their characteristics & detailed specifications.

22) Develop a simulation model for Lead-acid and Li-ion Batteries.

23) Perform Vibration Test for traction batteries (Lead-Acid/Li-ion) as per AIS 048 standard.

24) Perform Shock Test for traction batteries (Lead-Acid/Li-ion) as per AIS 048 standard.

25) Perform Short Circuit Test for traction batteries (Lead-Acid/Li-ion) as per AIS 048 standard.

26) 11) Perform Overcharge Test for traction batteries (Lead-Acid/Li-ion) as per AIS 048 s standard.

27) Perform Roll-Over Test for traction batteries (Lead-Acid/Li-ion) as per AIS 048 standard.

28) SOC Estimation by Open Source voltage for Lead-Acid battery, Ni-MH battery and Liion battery.

29) SOC Estimation by specific gravity for Lead-Acid battery.

30) SOC Estimation by Coulomb counting method for Lead-Acid battery and Li-ion battery.

31) Design a circuit for Battery monitoring System for Lead acid battery.

32) Design a circuit for passive cell balancing for Li-Ion battery.

PAPER – 6

SEMINAR (PDEVT -201)
(TOTAL MARKS: 100)

Students should give the seminar on any domain related with recent trends in electric vehicle technology**.**

PAPER – 7

PROJECT WORK (PDEVT -202)
(TOTAL MARKS: 150)

Students should undertake mini project in their specialization. Batch of size should not be more than four students.

PAPER – 8

ON JOB TRAINING (PDEVT-203)
(TOTAL MARKS : 250)

Students should undertake on job training at related industries for 4 months to get field exposure. In single company not more than two students to take training.

REFERENCE BOOKS:

[1] Modern Electric Hybrid Electric And Fuel Vehicles 3Rd Edition, Mehrdad Ehsani, CRC Press.

[2] Electric Vehicle Battery Systems, Sandeep Dameja, Newnes publication.

[3] Electric & Hybrid Vehicles, A.K. Babu, Khanna publication.

[4] Electric Vehicle Technology Explained, James Larminie, John Lowry, Wiley.

[5] Advanced Electric Drive Vehicles, Ali emadi, CRC press.

[6] Electric Vehicle, Automobiles of the Future, Otto B. Bischof, Ted H. Tanaka, Berkeley, California.

[7] Thermal Management of Electric Vehicle Battery Systems, Halil S. Hamut , Wiley.

[8] Electric and Hybrid Vehicles: Design Fundamentals", Iqbal Hussein, CRC Press, 2003.