LEVEL 3 DIPLOMA IN ELECTRIC VEHICLE TECHNOLOGY

Programme Outcome

I. Demonstrate comprehensive knowledge of electric vehicle components and systems.

II. Understand the principles of electric propulsion and energy storage.

III. Apply principles of electric vehicle design and integration.

IV. Demonstrate proficiency in integrating electric vehicle components for optimal performance.

V. Understand and design electric vehicle charging infrastructure.

VI. Evaluate different charging technologies and their implications.

VII. Adhere to safety protocols related to electric vehicle technologies.

VIII. Understand ethical considerations in the design, production, and use of electric vehicles.

IX. Engage themselves in life-long learning by recognizing the need and technological changes.

Level 3 Diploma in Electric Vehicle Technology

List of Units

Unit Code	Unit Name	Level	Credits	TQT
EVT001	Fundamentals of Electric Vehicle	3	10	100
EVT002	Basics of Electrical and Electronics	3	10	100
EVT003	Electric Drives and Controls	3	10	100
EVT004	Energy Storage Device and Management	3	10	100
EVT005	Battery Charging and Infrastructure	3	10	100
EVT006	Safety Maintenance and Repair of lithium Batteries.	3	10	100
		Total	**60**	**600**

All Units are mandatory. The qualification is 60 credits

Guided Learning Hours-240 Hours

1 Credit = 10 hours of effort (10 hours of learning time which includes everything a learner has to do to achieve the outcomes in a qualification including the teaching learning process, assessment procedures and practical's).

Fundamentals of Electric Vehicle

Unit Aim:

This module helps the student to know the History of electric vehicles (EVs), fundamental concepts of electric vehicles (EVs) and describe some basic applications. This module covers the differences between Battery electric vehicle (BEVs), Hybrid Electric Vehicle (HEVs) and its classifications, Fuel Cell Electric Vehicle (FCEVs), the advantages of electric motors over internal combustion engines. The basic types of EV frames and its comparison. Basic factors to be consider in Electric Vehicle Design.

Learning Outcomes and Assessment Criteria

Learning Outcomes	Assessment Criteria
Understand the basics concepts of electric vehicles and its types	Explain the Difference between IC engine powered Vehicle and Electric Powered vehicle. Explain briefly about Hybrid Electric Vehicle (HEVs) and its classifications with neat sketch. Describe Fuel cell electric vehicle, Its Advantages and Limitations
Understanding the structure of EV vehicle and factors to be consider in EV design	Explain briefly about EV frames and its applications and how it differs from Conventional vehicle frames Draw and explain the sematic diagram of EV structures with applications. Explain briefly, the factors need to be considered in EV Design.

References

Larminie, J., & Lowry, J. (2012). Electric Vehicle Technology Explained. John Wiley & Sons.

Hensher, D. A., Haynes, K. E., & Rose, J. M. (2010). Electric Vehicles: Technology, Policy and Commercial Development. CRC Press

Basics of Electrical and Electronics

Unit Aim

This module helps the students to know the fundamentals of current, voltage and resistance and Ohm's law. In addition, the module introduces essential concepts such as the relationship between temperature and resistance, electron velocity, and the direction of current flow. The module also covers the difference between work and energy and explains the methodology of calculating power consumption. Also, its deals the study of components such as Resistors, Capacitors, Inductors Diodes, Transistors, Semiconductors and Integrated Circuits (ICs) etc.

Learning Outcomes and Assessment Criteria

Learning Outcomes	Assessment Criteria
understanding the fundamentals of Current, voltage and resistance, also various laws in electrical.	Define the terms Current, Voltage and Resistance and how its measured. State Ohm's Law, Electric and Magnetic Circuits Kirchhoff Law, and Coulomb's Law. Its applications. Express Joule's Law of Electrical Heating Effect also explain the relationship between temperature and resistance.
Understanding the relationship between work, energy and power. And also functions of Resistors, Capacitors, Inductors Diodes, Transistors, Semiconductors and Integrated Circuits (ICs) and its applications.	Define the terms Work, Energy and Power and how its measured. Write brief note about Capacitors, Inductors Diodes, Transistors also its characteristic and applications. Explain briefly about Semiconductors and Integrated Circuits (ICs) and its applications

References

1. Fundamentals of Electrical Engineering I author Don H. Johnson
2. An Introduction to Electrical Safety for Engineers

3. Introduction to Electronic Engineering1stedition© 2010 Valery Vodovozov.

Electric Drives and Controls

Unit Aim

The aim of this unit is about the basic's principles of motors and motor control. Construction of various motors and study of its characteristic (DC and AC) motors. And also, how to control the motors, including braking systems. DC -Generators.

Learning Outcomes and Assessment Criteria

Learning Outcomes	Assessment Criteria
Understand the features, constructions, and operations of different motors used in electric vehicle	Explain the working principles of motor and its law. With a neat circuit diagram Explain the construction and principle of operation of DC Motor. Also Explain the different types of dc motor with neat sketch Explain the construction, working principle of single-phase Induction motor. And Three Phase motor.
Understand the functions of motor controller for DC and AC Motors. Also, the braking system and DC generator.	Explain the function of motor controller for DC and AC Motors. Explain the various types of braking system in motor. Also briefly explain about regenerative braking. With a neat circuit diagram Explain the construction and principle of operation of DC Generator

References

Hughes, A., & Drury, B. (2013). Electric Motors and Drives: Principles, Types and Applications. Newnes.

Filizadeh, S. (2016). Electric Motors and Drives: Fundamentals, Types and Applications. Elsevier.

Energy Storage Device and Power converters.

Unit Aim

The aim of this unit is about Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery& Metal hydride battery vs lead-acid battery, Working principle of supercapacitor, types of supercapacitors, cycling and performance characteristics, difference between battery and supercapacitors, Introduction to Hybrid electrochemical supercapacitors, Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems. DC-DC converter and DC-AC inverter.

Learning Outcomes and Assessment Criteria

Learning Outcomes	Assessment Criteria
Understand the Working principle of batteries, performance evaluation methods, major battery chemistries and their voltages.	Explain the working principles of batteries and its performance evaluations. Comparison between Li-ion battery& Metal hydride battery vs lead-acid battery. Also, short notes about supercapacitor. Explain briefly about fuel cell and its types. also explain about hybrid fuel cell-battery systems, hybrid fuel cell-supercapacitor systems.
Understanding the operation of DC-DC converter DC-AC inverter	Explain briefly about DC-DC converter and its types with circuit diagram. Explain briefly about DC-AC inverter with circuit diagram.

References

- Frank S. Barnes and Jonah G. Levine, Large Energy Storage Systems Handbook (Mechanical and Aerospace Engineering Series), CRC press (2011)
- Ralph Zito, Energy storage: A new approach, Wiley (2010)

Battery Management Systems and Battery Charging

Unit Aim

The objective of this course student can learn introduction to Battery Management System (BMS), C-Rating, charging, discharging and mode of charging. Battery design for transportation, Mechanical Design and Packaging of Battery Packs for Electric Vehicles, Advanced Battery-Assisted Quick Charger for Electric Vehicles, Thermal run-away for battery systems, Thermal management of battery systems, State of Charge and State of Health Estimation Over the Battery Lifespan, Recycling of Batteries from Electric Vehicles.

Learning Outcomes and Assessment Criteria

Learning Outcomes	Assessment Criteria
Understanding the basic functions of battery management systems. Charging and discharging. Battery pack design.	Explain briefly about Battery management system (BMS) with functions. Write a short note about role of C-Rating in batteries, how to find charging and discharging time also mode charging. Explain how to design a battery pack for EV application with example.
Understanding the basic of thermal run away, state of charge and sate health estimation also life span and recycling of batteries.	Explain briefly about various charging method involved in EV applications. Define State of Charge and State of Health Estimation and also effect of quick charging in life span of battery. Write a short note about recycling of various batteries used for electric vehicle applications.

References

Sachan, S., Sanjeevikumar, P., & Deb, S. (2022). Smart Charging Solutions for Hybrid and Electric Vehicles. Wiley. ISBN: 978-1-119-77173-9

Istoia, Gianfranco, and Boryann Liaw. Behaviour of Lithium-Ion Batteries in Electric Vehicles: Battery Health, Performance, Safety, and Cost. Springer International Publishing AG, 2018.

Robert A. Huggins, Energy storage, Springer Science & Business Media (2010)

Safety Maintenance and Repair of lithium Batteries.

Unit Aim

The aim of this is to Provide the Users of Lithium and Lithium-Ion Batteries with Guidance to Facilitate the Safe Handling of Battery Packs and Cells Under Normal and Emergency Conditions. Primary Or Non-Rechargeable Metallic Lithium Cells, Secondary or Rechargeable Lithium-Ion Cells. Cell Handling Procedures, Cell Storage, Hazard Control Measures. Hazard Analysis Terms. Emergency Procedures, Lithium Battery Fire Extinguisher Selection Table, First Aid Procedures and Waste Management. Battery Checks, Test and diagnosis Cell Replacement - Replace the damaged cells Full Battery Replacement, Cooling System Maintenance

Learning Outcomes and Assessment Criteria

Learning Outcomes	Assessment Criteria
Understand how to handle the primary and secondary lithium-ion cells. also, about cell storage. how to measure hazard and hazard analysis terms	Explain briefly about primary and secondary lithium-ion cells and its characteristic. Write the cell handling procedure and the storage methods What are the functions of Environmental, Health & Safety (EH&S) Department, write shorts notes about hazard analysis
Understand about, first aid procedure and waste management. Battery Checks, Test and diagnosis Cell Replacement and cooling system.	What are the safety precautions need to be followed at the time of battery pack fabrications. Write short notes about Lithium Battery Fire Extinguisher Selection Table and first aid procedures and waste management. Explain briefly about cell replacement in battery pack also about battery cooling system in electrical vehicle.

References

Weicker, P. (2014). A Systems Approach to Lithium-Ion Battery Management. Artech House.

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