

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT- 3	Sheet No. 1/5
Branch	Electrical Engineering			Semester	5
Course Code	511	Course Name	Electric Vehicles		
Course Outcome 1	Relate the necessity of electric vehicle in present scenario and compare various electric vehicles.			Teach Hrs	Marks
Learning Outcome E0151111	Discuss the need of Electric Vehicles in present scenario. [Cognitive Domain]			03	05
Contents	<ul style="list-style-type: none"> ➤ Historical journey of hybrid and electric vehicle. ➤ Types of different pollutants produced due to IC engine vehicle (ICEV) and their effect on human health. ➤ Economic and environmental impacts of using Electrical vehicles. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151112	Classify Electric Vehicles based on various configurations. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Classification, Vehicle configuration and challenges of electric vehicles: <ul style="list-style-type: none"> • Pure Electric Vehicle (PEV) : Battery Electric vehicle • Hybrid Electric vehicle (HVE) • Conventional HVE: Micro, Mild and Full hybrid, series hybrid. Parallel hybrid, series parallel hybrid, complex hybrid. • Grid able HVE: plug in hybrid (PHEV), Range Extended (REV) • Fuel cell electric vehicle (FCEV) 				
Method of Assessment	Internal: Mid semester-I theory examination (Pen paper test)				
Learning Outcome E0151113	Identify components of Electric Vehicles used in various applications. [Cognitive Domain]			04	08
Contents	<ul style="list-style-type: none"> ➤ Components used in Hybrid Electric Vehicle. ➤ Solar electric vehicle: Solar electric power trains. ➤ Electric bicycle: Introduction, Electric bicycle propulsion system, Electric bicycle power distribution list. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151114	Compare various vehicles and identify its parts. [Affective & Psychomotor domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Develop block diagram of Electric vehicle and identify parts. ➤ Case study- Compare minimum three vehicles for economic and environmental analysis 				
Method of Assessment	Internal: Viva voce & report submission.				

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT- 3	Sheet No. 2/5
Branch	Electrical Engineering			Semester	5
Course Code	511	Course Name	Electric Vehicles		
Course Outcome 2	Analyze various mechanical factors affecting movement of electric vehicle.			Teach Hrs	Marks
Learning Outcome E0151121	Derive various equations for movement of vehicle. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ General description of vehicle movement ➤ Rolling resistance and its equation ➤ Rolling resistance coefficient, factors affecting rolling resistance, typical values of rolling resistance. ➤ Aerodynamic drag and its equation, typical values of drag coefficient, Grading resistance 				
Method of Assessment	Internal: Quiz & Assignment.				
Learning Outcome E0151122	Compute different resistances affecting vehicle movement. [Cognitive Domain]			04	07
Contents	<ul style="list-style-type: none"> ➤ Grading resistance ➤ Road resistance, ➤ Acceleration resistance, ➤ total driving resistance ➤ Dynamic equation. ➤ Numerical 				
Method of Assessment	External: End semester theory examination (Pen paper test)				

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT-3	Sheet No. 3/5
Branch	Electrical Engineering		Semester	5	
Course Code	511	Course Name	Electric Vehicles		
Course Outcome 3	Choose suitable motor for electric vehicle application.			Teach Hrs	Marks
Learning Outcome E0151131	Explain constructional features & working of motors used in EV. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Difference between the electrical motors for electrical vehicles and for other industrial purpose. ➤ Classification of electrical motors used for EV applications: Induction Motor, Permanent magnet motor, switched reluctance motor. ➤ Construction working and control of permanent magnet motor. ➤ Construction working and control of switched reluctance motor. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151132	Select appropriate motor for EV application. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Factors to be considered for selection of motor. ➤ Regenerative breaking in motors. ➤ Configuration of motor layout: single motor configuration, dual motor configuration, in wheel motor configuration. 				
Method of Assessment	Internal: Mid semester-II theory examination (Pen paper test)				
Learning Outcome E0151133	Control the speed of motors used in electric vehicles. [Affective & Psychomotor domain]			10	15
Contents	<ul style="list-style-type: none"> ➤ To perform speed control experiment on BLDC. ➤ To perform speed control experiment on SRM. ➤ Visit to an Electric vehicle facility center to identify the type of motor configuration & prepare a report on it. 				
Method of Assessment	External: Report submission, Performance of given task and viva voce				

RGPV (DIPLOMA WING) BHOPAL		OBE CURRICULUM FOR THE COURSE		FORMAT- 3	Sheet No. 4/5
Branch	Electrical Engineering			Semester	5
Course Code	511	Course Name	Electric Vehicles		
Course Outcome 4	Improve performance of electric vehicle by managing battery system.			Teach Hrs	Marks
Learning Outcome E0151141	Compare different type of batteries used in EV. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Electrochemical Batteries: lead-acid battery, nickel based batteries, lithium-based batteries. ➤ Battery parameters: Physical Dimensions, Voltage and current rating ,Capacity and power 'C' Rate, Battery Efficiency, Energy Density, Power Density ,Sate of charge (SOC),Depth of discharge (DoD),State of Health (SoH), Operating Temperature ,Lifetime. ➤ Construction and working of lithium-based batteries. ➤ Comparison of batteries with respect to specific energy, specific power, cycle life, cost. ➤ Brief introduction of: Ultra capacitor, Ultra flywheel, Fuel cell. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151142	Manage battery system for EV. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Charging of EV and HEV <ul style="list-style-type: none"> • AC charging • DC Charging • Battery swapping • Smart charging • Wireless charging ➤ Battery Management System <ul style="list-style-type: none"> • Need of battery management system • Block diagram of BMS 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151143	Maintain battery performance. [Affective & Psychomotor domain]			09	15
Contents	<ul style="list-style-type: none"> ➤ Measure normal open circuit voltage, charging voltage & current of a battery used in any vehicle. ➤ Verify Ampere-hour capacity of a battery with any load available. ➤ Visit to an Electric Vehicle charging station to identify the type of charging present there & prepare a report on it. 				
Method of Assessment	External: Report submission, Performance of given task and viva voce				

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Branch	Electrical Engineering		Semester	5	
Course Code	511	Course Name	Electric Vehicles		
Course Outcome 5	Select suitable power electronic converter for EV.			Teach Hrs	Marks
Learning Outcome E0151151	Explain power electronic circuits used in EV. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ EV and EHV configuration based on power electronics. ➤ Converter requirement for on board charger. ➤ battery pack, motor drive, auxiliary battery ➤ Commonly used DC to DC converter in EV and HVE 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151152	Differentiate various converters used in EV. [Cognitive Domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Isolated converter ➤ Non isolated converter ➤ Unidirectional and bidirectional converter ➤ DC to AC converter. 				
Method of Assessment	External: End semester theory examination (Pen paper test)				
Learning Outcome E0151153	Identify specifications of converters used in electric vehicles & prepare test report. [Affective & Psychomotor domain]			06	10
Contents	<ul style="list-style-type: none"> ➤ Prepare a report on specifications of converters used for Electric vehicles ➤ Prepare test procedure for equipment used in Electric vehicle. 				
Method of Assessment	Internal: Viva voce & report submission.				

Reference Books:

1. A.K. Babu, *Electric & Hybrid Vehicles*, Khanna Publishing House, New Delhi (Ed. 2018)
2. Fuhs, A. E. *Hybrid Vehicles and the Future of Personal Transportation*, CRC Press.
3. Husain, I. *Electric and Hybrid Electric Vehicles*, CRC Press.
4. Chan C. C. and K. T. Chau, *Modern Electric Vehicle Technology*, Oxford Science Publication.
5. Gianfranco, *Electric and Hybrid Vehicles: Power Sources, Models, Sustainability, Infrastructure and The Market*, Pistoia Consultant, Rome, Italy.
6. Ehsani, M. *Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*, CRC Press.
7. Lechner G. and H. Naunheimer, *Automotive Transmissions: Fundamentals, Selection, Design and Application*, Springer.
8. Rashid, M. H. *Power Electronics: Circuits, Devices and Applications*, 3rd edition, Pearson.
9. Moorthi, V. R. *Power Electronics: Devices, Circuits and Industrial Applications*, Oxford University Press.
10. Krishnan, R. *Electric motor drives: modelling, analysis, and control*, Prentice Hall.
11. Krause, O. P. ; C. Wasynczuk, S. D. Sudhoff, *Analysis of electric machinery*, IEEE Press.