Shirpur Education Society's

R. C. Patel Institute of Technology, Shirpur

(An Autonomous Institute)

Course Structure and Syllabus Booklet

Honors Degree Program in Electric Vehicle (Mechanical Engineering)

with effect from Year 2024-25

Shahada Road, Near Nimzari Naka, Shirpur, Maharashtra 425405 Ph: 02563 259 802,
Web: www.rcpit.ac.in

Department of Mechanical Engineering
(Autonomous - RCP23 NEP)

Honors Program in Electric Vehicle (w.e.f. 2024-25)

Sr	Course Category	Course Code	Course Title	Teaching Scheme (hrs.)			Evaluation Scheme (CA) (marks)				ESE (marks)	Total	Credit
				L	T	P	TA	Term Test 1 (TT1)	Term Test 2 (TT2)	Average (TT1 & TT2)			
							[A]			[B]	[C]	[A+B+C]	
Sem-III													
1	H	RCP23MCH1301	Fundamentals of Electric Vehicles	4	-	-	20	20	20	20	60	100	4
Sem-IV													
2	H	RCP23MLH1401	Electric Vehicle Laboratory I	-	-	4	25	-	-	-	25	50	2
Sem-V													
3	H	RCP23MCH1501	Electric Drives and Controls	3	-	-	20	20	20	20	60	100	3
4	H	RCP23MLH1501	Electric Vehicle Laboratory II	-	-	2	25	-	-	-	-	25	1
Sem-VI													
5	H	RCP23MCH1601	Energy Source Management	3	-	-	20	20	20	20	60	100	3
6	H	RCP23MLH1601	Electric Vehicle Laboratory III	-	-	2	25	-	-	-	-	25	1
Sem-VII													
7	H	RCP23MCH1701	Electric Vehicle System Design	4	-	-	20	20	20	20	60	100	4
Total				14	-	8	155	80	80	80	265	500	18

H – Honors

Prepared by
Prof. R. R. Ozarkar

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BOS Chairman
Prof. P. L. Sarode

Dean Academic/Dy. Director
Prof. Dr. P. J. Deore

C.O.E.
Prof. S. P. Shukla

Director
Prof. Dr. J. B. Patil

R. C. Patel Institute of Technology, Shirpur
SES Education Society
Autonomous

Fundamentals of Electric Vehicles (RCP23MCH1301)

Teaching Scheme
Lectures : 04 Hrs./week
Credits : 04

Examination Scheme
Term Test : 20 Marks
Teacher Assessment : 20 Marks
End Sem Exam : 60 Marks
Total Marks : 100 Marks

Prerequisite:

1. Fundamental of mechanical, electronics and electrical engineering
2. Fundamentals of chemistry, physics and engineering mechanics

Course Objectives:

1. To study different automotive components and subsystems used in electric vehicles.
2. To develop a comprehensive understanding of vehicle dynamics and stability principles.
3. To provide a broad understanding of transmission systems used in electric vehicles.
4. To understand the principles of electrochemical reactions in batteries and analyze the parameters governing battery performance and efficiency.
5. To equip students with the knowledge and skills necessary for the selection and sizing of electric motors fordiverse applications, covering criteria assessment, performance analysis, and matching to load requirements.

CO	Course Outcomes	Blooms Level	Blooms Description
CO1	To explain the fundamentals of electric vehicles and its major parts.	L1	Remember
CO2	Classify the chassis used in electric vehicle and select a suitable body type for given requirements.	L2	Understand
CO3	Apply vehicle dynamics and stability principles to analyze and optimize vehicle performance, including maximum speed, gradeability, and acceleration.	L3	Apply
CO4	Differentiate between different types of transmission systems, including manual, automatic, AMT, and CVT, and select suitable transmission system for a vehicle to be designed.	L4	Analyze
CO5	Evaluate different types of batteries based on their electrochemical properties and determine their suitability for specific applications.	L5	Evaluate
CO6	Evaluate vehicle requirements, motor criteria, and interpret performance characteristics to effectively select and size electric motors for various applications.	L5	Evaluate

Course Contents

Unit-I 10 Hrs.

Introduction to Electric Vehicles (EV):

Brief history of EV, Electric vehicle market, Need of EV, Types of EVs and their components: Battery Electric Vehicles (BEVs), Plug-in Hybrid Electric Vehicles (PHEVs), Hybrid Electric Vehicles (HEVs), EV specifications, General layouts of the EVs; Introduction to the various sub-systems used in EVs, EV classification: Battery Electric Vehicles (BEVs), Fuel-Cell Electric Vehicles (FCEVs), Comparison of EV with other types of vehicles, Advantages and Disadvantages of EV, Overview of EV manufacturers, National Policy for adoption of EVs.

Unit-II 04 Hrs.

Vehicle Mechanics :

Introduction to chassis, Classification of chassis, Frame, EV classification based on body types, Body and Chassis Materials, Vehicle dimensions, Government regulations.

Unit-III 10 Hrs.

Vehicle Dynamics and Stability :

Types of wheel rims, wheel dimension, Tyre: properties, specifications, types, construction, tread patterns, Study principles of rolling, pitch and yaw velocity and moments, Drag, lifts, resistance, body loads and load calculation, Vehicle resistance: rolling resistance, grading resistance, aerodynamic drag, Dynamic equation, Vehicle performance (Maximum speed, gradeability and acceleration), Calculation of acceleration force, maximum speed, Tractive effort, Torque required on the wheel, Torque speed characteristics of electric vehicle, Aesthetics and ergonomics consideration for stability and control.

Unit-IV 08 Hrs.

Transmission Systems :

Transmission gears, Manual Transmission (MT), Automatic Transmission (AT), Automated Manual Transmissions (AMT), Continuously Variable Transmissions (CVT), Manual transmissions powertrain layout and Manual Transmission Structure, Power Flows and Gear Ratios, Manual Transmission Clutch and its structure. Drivetrain andDifferential.

Unit-V 10 Hrs.

Power Unit: Batteries Technologies :

Types of batteries: Lead acid battery, Nickel based batteries, Sodium based batteries, Lithium based batteries Li-ion and Li-poly, Metal air battery, Zinc chloride battery, Graphene Battery, Introduction to Electrochemical Battery, Electrochemical Reactions, Battery Parameters: Battery capacity, discharge rate, charging rate, SOC, SOD, SOH, DOD, thermodynamic voltage, specific energy, specific power, energy efficiency, Energy Storage

Systems: Ultra capacitors; Flywheel Energy Storage System; Hydraulic Energy Storage System; Comparison of different Energy Storage System.

Unit-VI 10 Hrs.

Selection/ Sizing of Electric Motor :

Overview of electric drives and their applications, Comparison of various types of electric drives, Motion profile: acceleration, steady operation and deceleration profiles, Criteria for selecting electric motors: torque, speed, power rating, efficiency, etc., Understanding motor performance characteristics: torque-speed curve, efficiency map, etc. , Considerations for motor sizing and matching to load requirements. Suitability of electric motor in different domain for 2-, 3-, 4-wheeler and large size vehicles, Real life examples/case studies;

Text Books:

1. Vehicle Powertrain Systems by Behrooz Mashadi and David Crolla, Wiley, 2012
2. Automotive Aerodynamics by Joseph Katz, Wiley, 2016
3. Automotive Chassis Engineering, by David C. Barton and John D. Fieldhouse, Springer, 2018
4. Automotive Engineering Powertrain, Chassis System and Vehicle Body Edited by David A. Crolla, Elsevier,2009
5. Automotive Power Transmission Systems by Yi Zhang and Chris Mi, Wiley, 2018
6. Linear Electric Machines, Drives, and MAGLEVs Handbook, by Ion Boldea, CRC Press. 2013
7. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles by Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, and Ali Emadi, CRC Press 2005
8. Electric Vehicle Technology Explained by James Larminie and John Lowry, John Wiley, 2003
9. Electric and Hybrid Vehicles- Design Fundamentals by Iqbal Husain, CRC Press, 2005.

Reference Books:

1. Engineering Design Synthesis: Understanding, Approaches and Tools, A. Chakrabarti, Springer, 2002.
2. Encyclopaedia of Automotive Engineering edited by David Crolla et al, Wiley, 2014
3. Design and Control of Automotive Propulsion Systems by Zongxuan Sun and Guoming Zhu, CRC Press, 2015
4. The Automotive Transmission Book by Robert Fischer, Ferit Küçükay, Gunter Jürgens, Rolf Najork, and
5. Burkhard Pollak, Springer, 2015
6. Noise and Vibration Control in Automotive Bodies by Jian Pang, Wiley, 2019

Web References :

1. Electric Vehicles Part 1 (https://nptel.ac.in/courses/108102121)
2. Introduction to Hybrid and Electric Vehicles (https://nptel.ac.in/courses/108103009)
3. Fundamentals of Electric vehicles: Technology & Economics (https://nptel.ac.in/courses/108106170)
4. Electric vehicles and Renewable energy (https://nptel.ac.in/courses/108106182)

Evaluation Scheme:

Theory :

Continuous Assessment (A):

Subject teacher will declare Teacher Assessment criteria at the start of semester.

Continuous Assessment (B):

1. Two term tests of 20 marks each will be conducted during the semester.
2. Average of the marks scored in both the tests will be considered for final grading.

End Semester Examination (C):

1. Question paper based on the entire syllabus, summing up to 60 marks.
2. Total duration allotted for writing the paper is 2 hrs.