

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: B. Tech  
BRANCH: Electrical and Electronics Engineering (OE)**

**SEMESTER : VII  
SESSION : MO/2025**

**SUBJECT: EE585 HYBRID ELECTRIC VEHICLE**

**TIME: 3 Hours**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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		CO	BL
Q.1(a)	Explain the concept of a Hybrid Electric Vehicle (HEV). Describe its advantages, limitations, and the key challenges associated with its development and use	[5] I	II
Q.1(b)	Identify the different types of HEV drivetrain architectures and explain the basic working principle of each type, using suitable block diagrams	[5] I	II
Q.2(a)	Illustrate the concept of maximum tractive effort in vehicle dynamics and apply this concept to derive the expressions for maximum tractive effort for a front-wheel-drive vehicle moving uphill, using standard notations for all vehicle parameters.	[5] II	III
Q.2(b)	Provide the key performance parameters of a vehicle and apply the relevant resistance forces and standard tractive force to derive the expressions for any two selected performance parameters, using standard notations	[5] II	III
Q.3(a)	Analyze the construction and operation of a four-stroke spark-ignition internal combustion engine by illustrating its components with a detailed sketch and explaining the working principle based on the diagram	[5] III	IV
Q.3(b)	Analyse the pressure-volume diagram of a four-stroke spark-ignition IC engine and examine how the relationship between engine torque and mean effective pressure is established based on this diagram.	[5] III	IV
Q.4(a)	Evaluate the general configuration of an electric vehicle (EV) by developing a block diagram that clearly represents all electrical, mechanical, and control links, and justify the interconnections shown.	[5] IV	V
Q.4(b)	For a pure EV application, an electric motor rated at 70 kW with a maximum speed of 4800 RPM is required. Draw the torque-speed and power-speed characteristics for this motor, clearly indicating the peak torque and base speed for three different values of the speed ratio, namely $x = 3, 5,$ and $7$ . Evaluate what transmission modifications would be necessary in a vehicle equipped with a motor having $x = 3$ to achieve wheel-torque characteristics comparable to a vehicle using a motor with $x = 7$ in a single-gear configuration.	[5] IV	V
Q.5(a)	Design a detailed explanation of the possible operating modes in a series hybrid electric vehicle (HEV) drivetrain by constructing an appropriate block diagram. Additionally, design a comparative overview that identifies the components present in a series HEV drivetrain but absent in a parallel HEV drivetrain	[5] V	VI
Q.5(b)	Develop a comprehensive explanation of torque coupling in a hybrid electric vehicle (HEV) by constructing a block diagram that illustrates the configuration. Further, create the generic tractive-effort-versus-speed characteristics for a torque-coupled HEV employing an IC engine with three gears and an electric motor with a single gear having $x = 4$ .	[5] V	VI

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