Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May / June 2026

Date: 25-05-2026 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** B.Tech	
Course Code: EEE3103	**Course Name:** Electric Vehicles and Battery Technology	
Semester: VI	**Max Marks**:100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	14	24	14	22	26

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Mention the importance of electric vehicles in the modern transport system.	**2 Marks**	**L1**	**CO1**
2.	Tabulate the advantages of electric vehicles compared to internal combustion vehicles.	**2 Marks**	**L1**	**CO1**
3.	Label various types of hybrid electric vehicles adopted for the propulsion system.	**2 Marks**	**L1**	**CO2**
4.	Mention the importance of inverter arrangement in a series hybrid electric vehicle.	**2 Marks**	**L1**	**CO2**
5.	Summarize the need for an energy storage system in electric vehicles.	**2 Marks**	**L2**	**CO3**
6.	List the importance of the State of Charge (SOC) in a battery.	**2 Marks**	**L1**	**CO3**
7.	Mention the types of fuel cells used in electric and hybrid electric vehicles.	**2 Marks**	**L1**	**CO4**

8.	A battery has a maximum capacity of 60 Ah. Currently, it has 36 Ah remaining. Calculate the Depth of Discharge (DOD).	**2 Marks**	**L3**	**CO5**
9.	Classify the BMS system based on its applications.	**2 Marks**	**L2**	**CO5**
10.	List the applications of the battery management system.	**2 Marks**	**L1**	**CO5**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	An electric vehicle is parked on a hilly road section in a residential area to charge at a roadside charging station. The vehicle has a mass of 1200 kg and is resting on a road inclined at an angle of 20° to the horizontal. Determine the normal force acting on the vehicle due to gravity. Take $\boldsymbol{g = 9.81}$ m/s^2.	**10 Marks**	**L3**	**CO1**
		Or			
12.	**a.**	Employ the six possible modern configurations, comprising motor, gearbox, and differential, for a better electric vehicle propulsion system.	**10 Marks**	**L3**	**CO1**

13.	**a.**	A parallel hybrid electric vehicle of mass 1400 kg accelerates uniformly from rest to 54 km/h in 9 seconds on a flat road. The given data are: Rolling resistance coefficient, $\boldsymbol{C_r = 0.014}$ Aerodynamic drag coefficient, $\boldsymbol{C_d = 0.31}$ Frontal area, $\boldsymbol{A = 2.4\ m^2}$ Air density, $\boldsymbol{\rho = 1.225\ kg/m^3}$ Electric motor contribution = 40% of tractive effort IC engine contribution = 60% of tractive effort Calculate: i. Vehicle acceleration ii. Tractive effort required for acceleration iii. Tractive effort shared by the motor and the engine Total traction power at 54 km/h.	**10 Marks**	**L3**	**CO2**
		Or			
14.	**a.**	Classify the different types of electric drive train configurations with a neat diagram, considering the advantages and disadvantages.	**10 Marks**	**L3**	**CO2**

15.	**a.**	A newly established automobile manufacturer is designing a Series Hybrid Electric Vehicle (SHEV) for both urban commuting and long-distance highway travel. The vehicle incorporates a battery pack along with a fuel tank to satisfy	**10 Marks**	**L3**	**CO2**

		different driving power requirements. Select the series hybrid electric drive configuration, and illustrate how the battery pack and fuel tank contribute to the propulsion of the vehicle.			
		Or			
16.	**a.**	A hybrid electric vehicle operates in different propulsion modes. Identify the power flow for pure engine mode and pure electric mode in a hybrid electric vehicle using a suitable block diagram.	**10 Marks**	**L3**	**CO2**
17.	**a.**	With a neat diagram, analyze the cell discharging operation in a battery used in an electric propulsion system, and examine how the battery manages unequal cell voltages and temperature variations during the charging process.	**10 Marks**	**L4**	**CO3**
		Or			
18.	**a.**	A Lithium-ion battery used in an electric device has a nominal voltage of 3.8 V and a capacity of 3000 mAh. Find the energy stored in the battery in Wh. Analyze what if the battery capacity is increased to 5000 mAh.	**10 Marks**	**L4**	**CO3**
19.	**a.**	Draw the electric vehicle architecture with a fuel cell used for the propulsion system and illustrate the power flow during acceleration and regenerative braking**.**	**10 Marks**	**L3**	**CO4**
		Or			
20.	**a.**	A PEM fuel cell stack delivers 4 kW of power at a voltage of 48 V. The hydrogen utilization factor is 85%. Determine i) Stack current ii) Hydrogen consumption rate (mol/s) and iii) Actual hydrogen supply required.	**10 Marks**	**L3**	**CO4**
21.	**a.**	Illustrate the chemical operation of a fuel cell in generating electricity with a neat cell diagram, and employ your understanding to describe the flow of ions and electrons during the energy conversion process in the given scenario.	**10 Marks**	**L3**	**CO4**
		Or			
22.	**a.**	A solid oxide fuel cell operates at 0.85 V and supplies a current of 42 A. The fuel cell runs for 1 hour. Determine: i) Total electrical energy produced ii) Hydrogen consumed (in moles) iii) Efficiency (given theoretical voltage = 1.23 V).	**10 Marks**	**L3**	**CO4**
23.	**a.**	An electric vehicle is cruising at a constant speed where the mechanical drive requires a torque of 160 Nm at an angular velocity of 300 rad/s. Also, a). Motor Efficiency ($\boldsymbol{\eta}_m$) is about 92%	**10 Marks**	**L3**	**CO5**

		b). Power Converter Efficiency (ηp) is 95%. Calculate, i). The mechanical power output in kW. ii). The total electrical power that the Battery Pack must deliver to the Power Converter to sustain this motion.			
		Or			
24.	**a.**	Draw the architecture of the Battery Management System used in electric and hybrid electric vehicles and examine how the BMS monitors, protects, and balances the battery pack under the given conditions.	**10 Marks**	**L3**	**CO5**
25.	**a.**	Interpret how the state of charge, state of discharge, depth of discharge and cycle life affect the performance of the battery management system used in the electric vehicle applications.	**10 Marks**	**L3**	**CO5**
		Or			
26.	**a.**	The Battery Management System (BMS) monitors a battery pack consisting of 96 cells connected in series. Each cell has a nominal voltage of 3.8 V and a capacity of 60 Ah. Data: The vehicle consumes an average of 180 Wh/km. To prolong battery life, the BMS restricts the usable State of Charge (SoC) between 10% and 90%. Determine: i). The total energy capacity of the Battery Pack in kWh. ii). The effective driving range of the vehicle based on the usable SoC energy.	**10 Marks**	**L3**	**CO5**