Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – May/June 2026

Date: 18-05-2026 **Time:** 01:00pm – 04:00pm

School: SOE	**Program:** Electrical and Electronics Engineering	
Course Code : EEE3027	**Course Name:** Electric Vehicle Technology	
Semester: VI	**Max Marks**:100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	2	10	24	28	36

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.	An electric car starts from rest at a traffic signal and accelerates forward. Name the force required against the traction at the wheels to move the vehicle with equation.	**2 Marks**	**L1**	**CO1**
2.	Outline any two advantages of series EHV over Parallel EHV	**2 Marks**	**L2**	**CO3**
3.	In a hybrid car, both the engine and electric motor are connected to the wheels and can drive them together. Identify this hybrid architecture.	**2 Marks**	**L3**	**CO3**
4.	An EV requires a motor that can provide high starting torque and operate over a wide speed range. Interpret the type of the motor.	**2 Marks**	**L2**	**CO4**
5.	A vehicle moves backward while parking. The Motor runs with a Speed of −1200 rpm having a Torque of −150 Nm, Relate the quadrant and mode of operation.	**2 Marks**	**L2**	**CO4**
6.	The speed of an EV induction motor is controlled by changing supply frequency using an inverter. Choose the control method.	**2 Marks**	**L1**	**CO4**

7.	A BLDC propulsion motor runs at 2800 rpm when PWM duty cycle is 70%. Select the speed if duty cycle = 50%.	**2 Marks**	**L3**	**CO4**
8.	Illustrate the representation of a battery pack with series cells and parallel strings	**2 Marks**	**L2**	**CO5**
9.	A current of 5 A flows for 2 hours. Solve total charge passed in the system	**2 Marks**	**L3**	**CO5**
10.	Battery original capacity is 100 Ah, current capacity is 80 Ah. Interpret the State of Health.	**2 Marks**	**L2**	**CO5**

Part B

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

11.	**a.**	Summarize the subsystems and architecture of an electric vehicle system with neat diagrams.	**5 Marks**	**L2**	**CO2**
	b.	An electric vehicle of mass 1200 kg is moving on a level asphalt road. The rolling resistance coefficient of the tire is fr=0.015. Determine, i) Rolling resistance force Fr ii) Rolling resistant torque Tr. Given that the effective wheel radius r_d=0.3 m and take g=9.81 m/s2.	**5 Marks**	**L3**	**CO2**
Or					
12.	**a.**	Calculate the Front axle and Rear axle load distribution of a vehicle from the following given Data: A passenger car has the following data: Vehicle mass, $M_v = 1500kg$ Wheelbase, $L = 2.5\,m$ Distance of CG from front axle, $L_a = 1.1m$ Distance of CG from rear axle,$L_b = 1.4m$ Height of CG,$h_g = 0.55m$, Road inclination, ($\alpha = 0^\circ$)----flat road Vehicle acceleration,$\frac{dV}{dt} = 2m/s^2$, Rolling resistance and drag neglected $F_r = 0$, Take $g = 9.81\,m/s^2$	**10 Marks**	**L3**	**CO2**

13.	**a.**	Demonstrate the torque speed characteristics of electric vehicles performance for different regions of operations.	**5 Marks**	**L2**	**CO3**
	b.	Develop the relationship between wheel torque, gear ratio, and motor torque from the principles of vehicle power plant.	**5 Marks**	**L3**	**CO3**
Or					
14.	**a**.	Differentiate between the series and parallel hybrid electric vehicles by comparing their working principles, architecture, advantages and disadvantages.	**10 Marks**	**L2**	**CO3**

15.	**a.**	Summarize the control strategies used in Electric and Hybrid Vehicles.	**10 Marks**	**L2**	**CO3**
		Or			
16.	**a.**	An electric vehicle of mass **1500 kg** must accelerate from rest to **60 km/h** in **10 seconds** on a level road. The rolling resistance is **220 N** and aerodynamic drag at 60 km/h is **350 N**. The wheel radius is **0.3 m**. Transmission efficiency is **90%** and gear ratio is **4:1**. Determine: Required tractive effort, Wheel torque, Motor torque, Motor power at 60 km/h, Battery energy required for 1 hour of operation.	**10 Marks**	**L3**	**CO3**

17.	**a.**	A manufacturer designs an electric scooter where the motor is placed directly inside the wheel hub, eliminating the need for transmission components. Describe the working principle, advantages, and limitations of this hub motor drives in electric propulsion systems.	**10 Marks**	**L2**	**CO4**
		Or			
18.	**a.**	A DC series motor used in an electric propulsion system operates at a Supply voltage of 240 V, Armature resistance is 0.5 Ω, Armature current is 40 A, Back EMF constant is 0.8 V/rpm, Calculate the motor speed.	**5 Marks**	**L3**	**CO4**
	b.	An EV customer must select between DC motor, Induction motor, and Permanent Magnet motor drives for a new vehicle. Discuss the advantages and disadvantages of each motor drive and recommend the most suitable propulsion motor.	**5 Marks**	**L2**	**CO4**

19.	**a.**	An electric vehicle motor operates under the following conditions during a driving cycle: a. Vehicle accelerates forward; b. Vehicle slows down while moving forward using regenerative braking; c. Vehicle moves backward while parking; d. Vehicle slows down while reversing. Demonstrate the four-quadrant operation for the above conditions using electric propulsion motor drives, speed and torque change in each quadrant.	**10 Marks**	**L3**	**CO4**
		Or			
20.	**a.**	Describe the smooth speed control for different driving conditions is achieved using induction motor drives in electric vehicles.	**5 Marks**	**L2**	**CO4**
	b.	An EV motor operates at a speed of Speed = 3000 rpm and the Torque during braking is −180 Nm; Calculate regenerative power with energy flow in the propulsion system.	**5 Marks**	**L3**	**CO4**

21.	**a.**	An electric bus frequently stops and starts in city traffic, requiring quick bursts of energy. Illustrate the functioning of super capacitor in place of battery in this scenario.	**5 Marks**	**L2**	**CO5**

	b.	The Gibbs free energy change of a battery reaction is –200 kJ/mol, and 2 electrons are transferred. Calculate the EMF of the battery	**5 Marks**	**L3**	**CO5**
		Or			
22.	**a.**	In an EV battery pack, some cells reach 4.2 V while others are still at 3.9 V. Develop the required BMS setup using cell balancing techniques.	**5 Marks**	**L3**	**CO5**
	b.	Demonstrate the working of Ni-Cd battery and discuss memory effect.	**5 Marks**	**L2**	**CO5**

23.	**a.**	An electric vehicle battery pack is rated at 400 V and 100 Ah. During operation, the battery delivers 30 Ah, and due to aging, its present capacity is reduced to 80 Ah. The battery is supplying a current of 50 A. During operation, the Battery Management System (BMS) performs cell balancing in which 4 cells dissipate 3 W each for 2 hours. Additionally, the battery generates 600 W of heat for 10 minutes. Due to a fault, the battery is also overcharged by 5%. Calculate the State of Charge (SOC), the State of Health (SOH), power delivered, the total energy stored, the energy loss during cell balancing, heat energy generated during operation, the excess energy due to overcharging**.**	**10 Marks**	**L3**	**CO5**
		Or			
24.	a.	An EV startup is designing a city electric car. They are considering Lithium-ion battery and Lead-acid battery technologies. Describe a suitable battery with its working details.	**5 Marks**	**L2**	**CO5**
	b.	A lithium battery is at risk of thermal runaway. Identify a suitable BMS that detects and prevents it.	**5 Marks**	**L3**	**CO5**

25.	**a.**	A battery has a theoretical voltage of 3.7 V but delivers only 3.2 V during operation. Identify the reason for the difference between thermodynamic voltage and practical voltage.	**5 Marks**	**L3**	**CO5**
	b.	A battery has EMF = 12 V and internal resistance = 1 Ω. Load resistance = 5 Ω. Calculate the Current and terminal voltage	**5 Marks**	**L3**	**CO5**
		Or			
26.	**a.**	Demonstrate the working of lithium-ion battery and its advantages over other batteries in EV applications.	**5 Marks**	**L2**	**CO5**
	b.	A flywheel ($I = 6\ kg{\cdot}m^2$) increases speed from 100 rad/s to 180 rad/s. Calculate the increase in energy.	**5 Marks**	**L3**	**CO5**