Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. / B. Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APRIL/ MAY 2024

ELECTRICAL AND ELECTRONICS ENGINEERING
V / VII Semester
EE5003- ELECTRIC VEHICLE MECHANICS AND CONTROL
(Regulation 2019)

Time: 3hrs Max.Marks: 100

CO 1	Understand the architecture and dynamics of EVs and HEVs
CO 2	Design an EV for standard drive cycle
CO 3	Understand the electrical motors' characteristics and its application for vehicle dynamics
CO 4	Workout the energy requirements and energy sources for EV application
CO 5	Mode of operation and control architecture

BL – Bloom's Taxonomy Levels
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	What is the significance of "V-G" and its impact?	2	CO1	L1
2	Compare between full and mild hybrid vehicles.	2	CO1	L1
3	State the need for EMS for hybrid vehicles.	2	CO2	L2
4	Draw the Tractive efforts vs Vehicle Speed characteristics of a gasoline engine vehicle with four-gear transmission and an electric vehicle with single-gear transmission.	2	CO2	L1
5	Name any two control strategies that are well-suited for Induction motors in electric vehicles.	2	CO3	L2
6	Draw a schematic diagram of a four-quadrant chopper circuit and indicate the direction of power flow during the reverse operation mode of an electric vehicle (EV) motor.	2	CO3	L1
7	Define state of charge.	2	CO4	L2
8	Suggest a suitable energy storage system for achieving very high power density and justify.	2	CO4	L2
9	Sketch the power train model of a series-parallel hybrid electric vehicle	2	CO5	L1
10	State the functions of Power splitter.	2	CO5	L2

PART- B (5 x 13 = 65 Marks)

Q. No	Questions	Marks	CO	BL
11 (a)	Analyze and explain the architecture and operation of a complex Hybrid Electric Vehicle (HEV) through a labeled diagram.	13	CO1	L4
	OR			
11 (b)	How significantly does a well-to-wheel analysis, considering both manufacturing and operational	13	CO 1	L4

	emissions, impact the argument for electric vehicles as the environmentally preferable transportation option? Illustrate with neat sketches.			
12 (a)	Draw and explain any two popular standard drive cycle widely adopted for city driving conditions.	**13**	CO2	L4
	OR			
12 (b)	How do factors like rolling resistance, aero dynamic drag and grade affect the tractive effort required for an EV to move? Explain with a suitable illustration.	**13**	CO2	L4
13 (a)	Why do we prefer PMSM drive as a propeller for Electric vehicle? Draw and explain its construction, control scheme and operation in detail.	**13**	CO3	L4
	OR			
13 (b)	Analyze and discuss a control strategy that is well-suited for configuring a BLDC motor to function as a propeller for an electric vehicle.	**13**	CO3	L4
14 (a)	Describe the different architectures used in Battery Management Systems (BMS). For one of these architectures, critically assess its strengths and weaknesses with a clear diagram to illustrate your explanation.	**13**	CO4	L4
	OR			
14 (b)	Describe the components of a fuel cell electric vehicle (FCEV) powertrain using a labeled diagram. Also Identify a type of fuel cell commonly used in FCEVs. Assess its operational principle, highlighting the chemical reactions involved in generating electricity.	**13**	CO4	L4
15 (a)	Explain the Supervisor control architecture employed in Hybrid Electric Vehicles (HEVs). Discuss its functionalities and decision-making process in optimizing powertrain operation. Illustrate your explanation with a well-labeled diagram depicting the different components and their interactions within the Supervisory control system.	**13**	CO5	L4
	OR			
15 (b)	Draw and discuss the series parallel modes operation of HEV in detail.	**13**	CO5	L4

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16.	Design an electric vehicle optimized for highway driving by selecting and justifying the most efficient powertrain components. Consider factors like energy source, motor type, converter topology, and component sizing. Explain the vehicle's various operating modes and how the energy management system optimizes performance.	**15**	CO5	L6