

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK



V SEMESTER

PEE401 – ELECTRIC VEHICLE ARCHITECTURE

Regulation – 2023

Academic Year 2025 – 2026 (ODD)

Prepared by

Dr.R.KARTHIK
Professor-EEE, Head -R&D



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SUBJECT: PEE401 – ELECTRIC VEHICLE ARCHITECTURE

SEM / YEAR : V / III

UNIT I - VEHICLE ARCHITECTURE AND SIZING

Electric Vehicle History, Evolution of Electric Vehicles. Series, Parallel and Series parallel Architecture, Types of EVs-Micro and Mild architectures. Mountain Bike – Motorcycle - Electric Cars and Heavy Duty EVs. -Details and Specifications

PART-A (2 marks)

Q.No	Questions	BT Level	Competence	COs
1.	What advancement helped the recent growth of EVs	1	Remember	CO1
2.	Give the difference between hybrid and an electric vehicle	1	Remember	CO1
3.	When was the first electric vehicle invented	1	Remember	CO1
4.	Enumerate the recent developments in electric vehicle technology	2	Understand	CO1
5.	What is the role of government in promoting EV	2	Apply	CO1
6.	Discuss about the current state of EV market	2	Understand	CO1
7.	What is an Electric vehicle architecture	2	Evaluate	CO1
8.	List out three main types of EV Technology	1	Apply	CO1
9.	What is Electric vehicle Sizing	1	Apply	CO1
10.	Point out some factors that influence EV sizing	1	Remember	CO1
11.	Analyze the factors that influence the size of an EV battery pack	3	Analyze	CO1
12.	Illustrate the importance of vehicle weight in EV design	3	Remember	CO1
13.	What is an Electric vehicle	3	Analyze	CO1
14.	Highlight the main challenge facing the adoption EV	4	Analyze	CO1
15.	Classify the types of EV currently available in India	4	Evaluate	CO1
16.	What is hybrid EV (HEV)	4	Understand	CO1
17.	List out some of the benefits of HEV	6	Create	CO1
18.	State the principle behind the working of Hybrid Electric vehicle	5	Understand	CO1
19.	List out the various availability of HEV	5	Create	CO1
20.	What is the difference between full hybrid and a plug-in hybrid	6	Remember	CO1
21.	What is series electric vehicle	1	Remember	CO1
22.	Give a note on Parallel electric vehicle	1	Remember	CO1
23.	What do you understand from Micro EV	3	Analyze	CO1
24.	Discuss about Mountain bike	2	Understand	CO1

PART-B (15 marks)				
1.	Briefly compare EV and conventional vehicle	2	Evaluate	CO1
2.	Discuss elaborately about various problems solved in EV	3	Apply	CO1
3.	Describe the evolution and history of EVs in detail	1	Evaluate	CO1
4.	Explain in detail about comparing Micro and Mild EVs	1	Remember	CO1
5.	Highlight various stages of history of EV in INDIA	3	Remember	CO1
6.	With a neat architecture diagram explain hybrid electric vehicle	2	Understand	CO1
7.	Briefly discuss about series Hybrid Electric vehicle	2	Analyze	CO1
8.	Briefly discuss about Parallel HEV	4	Understand	CO1
9.	Briefly discuss about Series-Parallel HEV	4	Apply	CO1
10.	Discuss about Parallel Hybrid electric propulsion system with a neat layout	1	Remember	CO1
11.	Elaborately discuss about Hybrid vehicle system components	1	Remember	CO1
12.	Describe in detail about Power flow of HEV in both series and parallel type	4	Analyze	CO1
13.	What is a mountain bike and describe the specifications of a mountain bike	4	Analyze	CO1
14.	With a neat sketch, explain the parts of an electric two-wheeler	5	Analyze	CO1
15.	Discuss in detail about electric car with specification's details	4	Apply	CO1
16.	Explain in detail about Heavy duty electric vehicles and describe the specifications of heavy-duty electric vehicle	5	Evaluating	CO1
17.	Differentiate between micro-hybrid, mild-hybrid, and full hybrid electric vehicles. Discuss their energy management strategies and levels of electrification	6	Creating	CO1

UNIT II - VEHICLE MECHANICS

Vehicle mechanics- Roadway fundamentals, Laws of motion, Vehicle Kinetics, Dynamics of vehicle motion, propulsion power, velocity and acceleration, Tire –Road mechanics, Propulsion System Design.

PART-A (2 marks)				
Q.No	Questions	BT Level	Competence	Cos
1.	List out the types of forces acting on moving vehicle	2	Remember	CO2
2.	Highlight the role of tires in a vehicle	2	Remember	CO2
3.	Give the difference between acceleration and deceleration in a vehicle	2	Remember	CO2
4.	What is the maximum torque available at zero speed in an electric vehicle	1	Remember	CO2
5.	Discuss about regenerative braking in EV	1	Remember	CO2
6.	Give the difference between AC and DC motors in an EV	1	Understand	CO2
7.	Justify the role of motor controller in an EV	2	Apply	CO2
8.	What is the relationship between power and acceleration in an EV	1	Analyze	CO2

9.	List out various laws of motion	1	Understand	CO2
10.	Define -Law of Inertia	1	Understand	CO2
11.	Define -Law of Acceleration	3	Remember	CO2
12.	Define -Law of Acceleration and Reaction	3	Understand	CO2
13.	List out various forces acting on a vehicle	3	Remember	CO2
14.	What are the various dynamic parameters included in designing of an EV	4	Create	CO2
15.	Classify various key areas of vehicle dynamics	4	Evaluate	CO2
16.	What is aerodynamic drag	4	Evaluate	CO2
17.	What is aerodynamic drag force	6	Analyze	CO2
18.	Highlight the concept of Rolling resistance force	5	Analyze	CO2
19.	Gradability of vehicle-Discuss	5	Understand	CO2
20.	What do you understand from rolling resistance force	6	Create	CO2
21.	What is linear and angular acceleration	1	Remember	CO2
22.	List out main components of EV propulsion system	1	Remember	CO2
23.	State Newton's First Law of Motion	2	Apply	CO2
24.	What is inertia in vehicle dynamics?	2	Apply	CO2
PART-B (15 marks)				
1.	Briefly discuss about various forces acting on vehicles	1	Remember	CO2
2.	Discuss elaborately about tire road mechanism	1	Remember	CO2
3.	Briefly discuss about tractive force and how its derived.	1	Remember	CO2
4.	Explain about dynamic parameters included in designing an EV	2	Apply	CO2
5.	Explain about the dynamics of vehicle motion in detail	3	Remember	CO2
6.	Discuss about the road way fundamentals	2	Understand	CO2
7.	Explain about propulsion system design	2	Understand	CO2
8.	Discuss about traction force at tire -road interface	2	Analyze	CO2
9.	State and explain Newton's laws of motion. Illustrate how each law applies to the dynamics of a moving vehicle.	4	Analyze	CO2
10.	Briefly discuss about Quarter car model	1	Analyze	CO2
11.	Explain about Traction limit and control	1	Analyze	CO2
12.	Briefly explain about Laws of motion	1	Apply	CO2
13.	Discuss elaborately about vehicle kinetics	5	Create	CO2
14.	Briefly discuss about force transmission at Tire-Road interface	4	Evaluate	CO2
15.	An electric vehicle has a mass of 1200 kg and is travelling on a flat road at a velocity of 60 km/h. The rolling resistance coefficient of tires is 0.01 and aerodynamic drag coefficient is 0.2. The frontal area of vehicle is 2.5 m ² and the air density is 1.2 kg/m ³ . The electric motor can deliver a max power of 100 kW. What is the max tractive force that the vehicle can achieve at this velocity	2	Analyze	CO2
16.	An electric vehicle has a mass of 1200 kg and is travelling on a flat road at a velocity of 30 m/s. The rolling resistance coefficient of tires is 0.01 and aerodynamic drag coefficient is 0.3. The frontal area of vehicle is 2.5 m ² and the air density is 1.2 kg/m ³ . The	4	Evaluate	CO2

	electric motor can deliver a max power of 100 kW at 5000 RPM. The gear ratio between the motor and the wheel is 10:1. What is the max tractive force that the vehicle can deliver			
17.	Explain the tire-road interaction mechanism. How does it affect traction, stability, and braking performance?	5	Analyze	CO2

UNIT III - POWER COMPONENTS AND BRAKES

Power train Component sizing- Gears, Clutches, Differential, Transmission and Vehicle Brakes. EV power train sizing, HEV Powertrain sizing, Example

PART-A (2 marks)

Q.No	Questions	BT Level	Competence	COs
1	What is power train component sizing	1	Create	CO3
2	List out various gears used in EV	1	Arrange	CO3
3	Classify various types of clutches used in EV	3	Analyze	CO3
4	What is the role of differential in EV	3	Remember	CO3
5	Highlight the types of transmission used in EV	3	Apply	CO3
6	Electric Vehicle Brake-Discuss	4	Remember	CO3
7	What do you understand from HEV powertrain sizing	1	Remember	CO3
8	Give the difference between static and dynamic balance in a vehicle	1	Understand	CO3
9	Justify the purpose of suspension in vehicle	4	Understand	CO3
10	What is the role of brakes in a vehicle	4	Remember	CO3
11	What is meant by vehicle stability	5	Apply	CO3
12	Highlight the function of differential in vehicle	2	Remember	CO3
13	What is the difference between understeer and oversteer in a vehicle	5	Remember	CO3
14	Give the purpose of a transmission in a vehicle	2	Analyze	CO3
15	What is the function of brake booster in an EV	6	Understand	CO3
16	Highlight the difference between regenerative braking and friction braking in EV	6	Understand	CO3
17	What is the purpose of an Anti-Lock Braking system (ABS) in an EV	1	Evaluate	CO3
18	What is the role of parking brake in EV	2	Evaluate	CO3
19	Highlight the function of brake pad in an EV	2	Apply	CO3
20	What is the primary function of gears in a powertrain	1	Create	CO3
21	What is the effect of a high gear ratio in vehicles?	2	Apply	CO3
22	How does a clutch help during gear shifting?	1	Understand	CO3
23	Name two types of vehicle transmission systems	2	Analyze	CO3
24	Mention two factors influencing EV powertrain sizing	5	Analyze	CO3
PART-B (15 marks)				
1	Obtain the mathematical modelling of EV to describe its performance characteristics and to design control system for Optimal operation	1	Analyze	CO3
2	Briefly discuss about power train component sizing	2	Apply	CO3
3	Discuss elaborately about power transmission	1	Analyze	CO3

	components also with a discussion about EV powertrain			
4	Explain briefly about Gears with gear ratio	1	Remember	CO3
5	Discuss elaborately about Planetary gear set	2	Understand	CO3
6	Briefly discuss about Clutches	2	Understand	CO3
7	Briefly explain about Transmission system in EV	2	Understand	CO3
8	Explain elaborately about Manual Transmission	3	Analyze	CO3
9	Explain elaborately about Automatic Transmission	2	Understand	CO3
10	Discuss briefly about Continuously variable transmission (CVT)	6	Evaluate	CO3
11	Briefly explain about Vehicle brakes and conventional brake system	4	Remember	CO3
12	Discuss briefly about HEV powertrain sizing	5	Remember	CO3
13	Explain the sizing of a series -parallel 2x2 HEV	4	Analyze	CO3
14	Describe the working principle, types, and selection criteria of clutches used in automotive vehicles	4	Remember	CO3
15	Describe the different types of vehicle transmission systems. Explain how transmission is sized for a particular application	2	Understand	CO3
16	What are the key components of an electric vehicle powertrain? Discuss the methodology for sizing each component	4	Analyze	CO3
17	What is regenerative braking? Explain its working and integration in EVs. Compare with traditional braking systems	4	Analyze	CO3

UNIT IV - HYBRID VEHICLE CONTROL STRATEGY

Vehicle supervisory control, Mode selection strategy, Modal Control strategies

PART-A (2 marks)

Q.No	Questions	BT Level	Competence	COs
1.	What is vehicle supervisory control	2	Remember	CO4
2.	Mention the purpose of vehicle supervisory control	2	Understand	CO4
3.	List out examples of vehicle supervisory control	6	Evaluate	CO4
4.	What is hybrid vehicle control strategy	1	Apply	CO4
5.	Give the types of hybrid vehicle control strategies	2	Remember	CO4
6.	How does a power split hybrid vehicle control strategy work	1	Evaluate	CO4
7.	What is regenerative braking in a hybrid vehicle	1	Remember	CO4
8.	How does a hybrid vehicle control strategy improve fuel efficiency	1	Remember	CO4
9.	Give the benefits of using a hybrid vehicle control strategy	5	Understand	CO4
10.	What is a modal control strategy in HEV supervisory control	1	Understand	CO4
11.	Give the objective of modal control strategies in HEV supervisory control	1	Understand	CO4
12.	What is the difference between regenerative braking and friction braking in EV?	2	Remember	CO4

13.	Define utility factor	3	Apply	CO4
14.	What are the types of vehicle supervisory control methods?	2	Analyze	CO4
15.	Define hybrid control.	6	Analyze	CO4
16.	Name any two objectives of a supervisory control system	1	Analyze	CO4
17.	What are the key inputs to the supervisory controller in a hybrid vehicle	3	Apply	CO4
18.	Mention any two control strategies used in supervisory control.	4	Understand	CO4
19.	What is blended control in hybrid systems?	4	Create	CO4
20.	On what basis does the mode selection strategy decide the driving mode?	5	Remember	CO4
21.	What is the role of a supervisory controller in regenerative braking?	3	Apply	CO4
22.	What is the difference between centralized and distributed control systems?	3	Apply	CO4
23.	What is mode selection in a hybrid vehicle?	1	Remember	CO4
24.	Name a common modal control strategy in HEVs.	3	Apply	CO4
PART-B (15 marks)				
1.	Explain the vehicle supervisory control in detail	2	Remember	CO4
2.	Explain about the deterministic Rule-Based Methods	1	Remember	CO4
3.	Discuss briefly about the Fuzzy-Rule based methods	1	Remember	CO4
4.	Elaborately discuss about the mechanical Power-split hybrid modes	1	Remember	CO4
5.	Briefly explain about the Hybrid modes of series-parallel 2x2 HEV	3	Understand	CO4
6.	Explain about the energy storage system control used in HEV	3	Understand	CO4
7.	Discuss in brief about regeneration control used in HEV	2	Apply	CO4
8.	Briefly explain electrical braking system in detail.	2	Apply	CO4
9.	Explain adaptive mode selection strategy for series parallel hybrid EV	4	Understand	CO4
10.	Discuss briefly about mathematical modelling of EV	1	Evaluate	CO4
11.	Explain the architecture and role of a supervisory control system in hybrid electric vehicles. Illustrate with a block diagram	1	Analyze	CO4
12.	Describe the key functions performed by the supervisory controller in a hybrid vehicle. How does it manage power distribution	6	Analyze	CO4
13.	Discuss the differences between rule-based and optimization-based supervisory control strategies. Highlight their advantages and limitations.	4	Analyze	CO4
14.	Explain the different operating modes in a hybrid vehicle (EV mode, engine mode, hybrid mode). When and why are they selected?	5	Create	CO4
15.	Discuss various modal control strategies used in hybrid vehicles and explain how they impact vehicle	1	Remember	CO4

	performance and emissions.			
16.	Explain power-split control strategy in hybrid vehicles. How does it manage energy flow between engine, battery, and motor?	5	Analyze	CO4
17.	Design a case study comparing the performance of two hybrid control strategies (e.g., rule-based vs. model predictive control) under varying driving conditions	5	Analyze	CO4

UNIT V - PLUG-IN HYBRID ELECTRIC VEHICLE

Introduction-History-Comparison with electrical and hybrid electrical vehicle-Construction and working of PHEV-Block diagram and components-Charging Mechanisms-Advantages of PHEVs

PART-A (2 marks)

Q.No	Questions	BT Level	Competence	Cos
1.	What is plug-in hybrid electric vehicle	2	Remember	CO5
2.	How does a plug-in hybrid electric vehicle differ from a conventional Hybrid EV	1	Remember	CO5
3.	Give the typical electric-only range of a plug-in hybrid EV	1	Analyze	CO5
4.	How is the battery pack of a plug-in Hybrid EV charged	1	Remember	CO5
5.	What is regenerative braking in plug-in Hybrid EV	1	Understand	CO5
6.	How does the electric motor of a plug-in hybrid electric vehicle work	2	Apply	CO5
7.	What is the role of Internal combustion engine in a plug-in hybrid electric vehicle	2	Remember	CO5
8.	List the advantages of plug-in hybrid electric vehicle	2	Apply	CO5
9.	Highlight the fuel economy of plug-in hybrid electric vehicle compared to conventional hybrid electric vehicle	3	Analyze	CO5
10	What is the charging time of plug-in hybrid electric vehicle	4	Understand	CO5
11	List the disadvantages of plug-in hybrid electric vehicle	4	Create	CO5
12	Give the max speed of a plug-in hybrid electric vehicle when driving on electric power	3	Understand	CO5
13	What is the difference between a series plug-in hybrid electric vehicle and a parallel plug-in hybrid electric vehicle	3		CO5
14	What is the average cost of plug-in hybrid electric vehicle	1	Understand	CO5
15	What is the range of a plug-in hybrid electric vehicle on a full tank of gasoline	1	Apply	CO5
16	How long does it take to charge the battery pack of a PHEV	4	Evaluate	CO5
17	What is the charging mechanism of plug-in hybrid electric vehicle	5	Remember	CO5
18	How long does it take to charge the battery pack of a	6	Analyze	CO5

	PHEV using a Level 1 charger			
19	How long does it take to charge the battery pack of a PHEV using a Level 2 charger	5	Understand	CO5
20	What is the max charging rate of a PHEV	6	Analyze	CO5
21	How is the charging rate of a PHEV determined	2	Apply	CO5
22	What are the challenges in Plug in EVs	5	Analyze	CO5
23	What is a DC fast charger for PHEVs	2	Apply	CO5
24	Highlight the key difference between a PHEV and a Battery Electric Vehicle	2	Apply	CO5
PART-B (15 marks)				
1.	Briefly discuss about the history of PHEV	1	Remember	CO5
2.	With a neat architecture of PHEV explain about types of PHEV	3	Remember	CO5
3.	Compare in brief about PHEV with EVs and HEVs	3	Understand	CO5
4.	Discuss about Well -to- wheel efficiency	4	Apply	CO5
5.	Briefly discuss about PHEV fuel economy and utility factor	4	Understand	CO5
6.	In CD mode, a blended PHEV consumes 10 kWh of electric energy from the onboard battery and 1.5 L of gasoline in its first 64 km. Beyond 64 km, the car enters CS mode, which consumes 6.25 L of gasoline per 100 km. The car has a total range of 724 km. Calculate the fuel economy of the car.	4	Remember	CO5
7.	Briefly discuss about power management schemes of PHEV	4	Remember	CO5
8.	Explain about component sizing of PHEV	2	Understand	CO5
9.	Elaborately discuss about component sizing of ERHEVs	2	Apply	CO5
10.	Discuss about replacement of battery packs during conversion of EV to PHEV	1	Analyze	CO5
11.	Explain about Cold start emissions reduction in PHEVs	1	Analyze	CO5
12.	Explain in detail about the Vehicle -to- Grid technology	1	Analyze	CO5
13.	How V2G mode is used for peak shaving	5	Create	CO5
14.	How V2G mode is used for reactive power compensation	6	Evaluate	CO5
15.	Explain in detail about plug-in battery charger design	2	Apply	CO5
16.	Discuss the reason for usage of power factor correction circuit in battery charger design	6	Evaluate	CO5
17.	Describe the different charging mechanisms available for PHEVs. How do Level 1 and Level 2 charging differ?	6	Evaluate	CO5

COs	Course Outcome
CO1	Ability to summarize the History and Evolution of EVs, Hybrid and Plug-In Hybrid EVs
CO2	Ability to describe the various EV components.
CO3	Ability to describe the concepts related in the Plug-In Hybrid Electric Vehicles
CO4	Ability to analyze the details and Specifications for the various EVs developed
CO5	Ability to describe the hybrid vehicle control strategy