

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

QUESTION BANK



VII SEMESTER

PEE406 – GRID INTEGRATION OF ELECTRIC VEHICLES

Regulation – 2023

Academic Year 2026 – 27 (Odd Semester)

Prepared by

Dr. S. Padhmanabha Iyappan, Associate Professor / EEE

UNIT I - DEFINITION AND STATUS OF V2G

Defining Vehicle to Grid (V2G) - History and Development of V2G. Incorporating V2G to the EV, Auditing and Metering, V2G in Practice, V2G - Power Markets and Applications. Electricity Markets and V2G Suitability, Long-Term Storage, Renewable Energy, and Other Grid Applications, Beyond the Grid: Other Concepts Related to V2G-G2V technology.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define Vehicle-to-Grid (V2G).	1	BTL 1	Remember
2.	What is Grid-to-Vehicle (G2V) technology?	1	BTL 1	Remember
3.	State the objectives of V2G technology.	1	BTL 1	Remember
4.	List the major components of a V2G system.	1	BTL 1	Remember
5.	Define bidirectional power flow.	1	BTL 1	Remember
6.	What is smart charging?	1	BTL 1	Remember
7.	Define electricity market.	1	BTL 1	Remember
8.	What is ancillary service?	1	BTL 1	Remember
9.	What is peak shaving?	1	BTL 1	Remember
10.	What is load shifting?	1	BTL 1	Remember
11.	Define energy storage in V2G systems.	1	BTL 1	Remember
12.	List any four applications of Vehicle-to-Grid technology.	1	BTL 1	Remember
13.	Explain the working principle of V2G technology.	1	BTL 2	Understand
14.	Differentiate between V2G and G2V technologies.	1	BTL 2	Understand
15.	Explain the history and evolution of V2G technology.	1	BTL 2	Understand
16.	Discuss the importance of auditing in V2G systems.	1	BTL 2	Understand
17.	Explain the need for metering in V2G.	1	BTL 2	Understand
18.	Describe how EVs participate in electricity markets.	1	BTL 2	Understand
19.	Explain the role of V2G in renewable energy integration.	1	BTL 2	Understand
20.	Discuss the importance of long-term energy storage in V2G.	1	BTL 2	Understand
21.	Explain the significance of power markets in V2G applications.	1	BTL 2	Understand
22.	Describe the concept of demand response in V2G.	1	BTL 2	Understand
23.	Explain how EV batteries support grid stability.	1	BTL 2	Understand
24.	Summarize the future scope of Vehicle-to-Grid technology.	1	BTL 2	Understand

PART B					
1.	Explain the concept and operational principle of Vehicle-to-Grid (V2G) technology with a neat diagram.	(16)	1	BTL 3	Applying
2.	Illustrate the incorporation of V2G into electric vehicles and explain the required hardware components.	(16)	1	BTL 3	Applying
3.	Discuss the history and development of V2G technology with suitable illustrations.	(16)	1	BTL 3	Applying
4.	Explain auditing and metering techniques used in V2G systems with practical examples.	(16)	1	BTL 3	Applying
5.	Describe the practical implementation of V2G in smart grids.	(16)	1	BTL 3	Applying
6.	Explain the applications of V2G in electricity markets and ancillary services.	(16)	1	BTL 3	Applying
7.	Illustrate the role of V2G in renewable energy integration.	(16)	1	BTL 3	Applying
8.	Explain the operation of Grid-to-Vehicle (G2V) and Vehicle-to-Grid (V2G) modes with suitable diagrams.	(16)	1	BTL 3	Applying
9.	Demonstrate the contribution of electric vehicles as distributed energy resources in modern power systems.	(16)	1	BTL 3	Applying
10.	Analyze the suitability of electricity markets for successful implementation of V2G technology.	(16)	1	BTL 4	Analyzing
11.	Evaluate the role of V2G in long-term energy storage for renewable energy systems.	(16)	1	BTL 4	Analyzing
12.	Analyze the impact of V2G on grid reliability and power quality.	(16)	1	BTL 4	Analyzing
13.	Compare Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V) technologies with suitable examples.	(16)	1	BTL 4	Analyzing
14.	Analyze the communication and control requirements for V2G implementation.	(16)	1	BTL 4	Analyzing
15.	Evaluate the technical and economic significance of V2G participation in power markets.	(16)	1	BTL 4	Analyzing

16.	Analyze future trends and emerging technologies in Vehicle-to-Grid systems.	(16)	1	BTL 4	Analyzing
17.	Discuss the architecture, operation, applications, advantages, limitations, and future scope of Vehicle-to-Grid technology in modern smart grids.	(16)	1	BTL 4	Analyzing

UNIT II - BENEFITS AND CHALLENGES OF V2G

Benefits of V2G, Technical Benefits: Storage Superiority and Grid Efficiency, Economic Benefits: EV Owners and Societal Savings, Environment and Health Benefits: Sustainability in Electricity and Transport, Other Benefits.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define the benefits of Vehicle-to-Grid (V2G).	2	BTL 1	Remember
2.	Explain the technical benefits of V2G.	2	BTL 2	Understand
3.	What is grid efficiency?	2	BTL 1	Remember
4.	Describe the economic benefits for EV owners through V2G.	2	BTL 2	Understand
5.	Define storage superiority in V2G.	2	BTL 1	Remember
6.	Explain how V2G contributes to societal savings.	2	BTL 2	Understand
7.	What is demand response?	2	BTL 1	Remember
8.	Explain the environmental benefits of V2G technology.	2	BTL 2	Understand
9.	Define economic benefits of V2G.	2	BTL 1	Remember
10.	Discuss the role of V2G in renewable energy integration.	2	BTL 2	Understand
11.	What are the societal savings?	2	BTL 1	Remember
12.	Explain the importance of V2G in future smart grids.	2	BTL 2	Understand
13.	Define sustainability in electricity systems.	2	BTL 1	Remember
14.	Describe the contribution of V2G to peak load management.	2	BTL 2	Understand
15.	What is carbon footprint?	2	BTL 1	Remember
16.	Discuss the health benefits associated with reduced emissions through V2G.	2	BTL 2	Understand
17.	Define greenhouse gas emissions.	2	BTL 1	Remember

18.	Explain the storage superiority of V2G systems.		2	BTL 2	Understand
19.	List any four environmental benefits of V2G.		2	BTL 1	Remember
20.	Discuss how V2G improves grid efficiency.		2	BTL 2	Understand
21.	What are ancillary services provided by V2G?		2	BTL 1	Remember
22.	Explain sustainable transportation using V2G technology.		2	BTL 2	Understand
23.	List the technical benefits of Vehicle-to-Grid technology.		2	BTL 1	Remember
24.	Summarize the overall benefits of Vehicle-to-Grid technology.		2	BTL 2	Understand
PART B					
1.	Analyze the technical, economic and environmental benefits of Vehicle-to-Grid technology.	(16)	2	BTL 4	Analyzing
2.	Explain the various technical benefits of Vehicle-to-Grid technology with suitable illustrations.	(16)	2	BTL 3	Applying
3.	Evaluate the effectiveness of V2G in improving grid efficiency and reducing operational costs.	(16)	2	BTL 4	Analyzing
4.	Illustrate the economic benefits of V2G for EV owners and utility operators.	(16)	2	BTL 3	Applying
5.	Analyze the contribution of V2G to renewable energy integration and carbon emission reduction.	(16)	2	BTL 4	Analyzing
6.	Discuss the storage superiority of V2G and explain its role in improving grid efficiency.	(16)	2	BTL 3	Applying
7.	Compare the economic benefits of V2G for EV owners, utilities and society.	(16)	2	BTL 4	Analyzing
8.	Explain how V2G contributes to societal savings and sustainable energy management.	(16)	2	BTL 3	Applying
9.	Analyze the impact of V2G on sustainable transportation and public health.	(16)	2	BTL 4	Analyzing
10.	Discuss the environmental benefits of Vehicle-to-Grid technology with appropriate examples.	(16)	2	BTL 3	Applying
11.	Evaluate the role of Vehicle-to-Grid technology in future smart cities and sustainable power systems.	(16)	2	BTL 4	Analyzing

12.	Illustrate the impact of V2G on renewable energy utilization and smart grid operation.	(16)	2	BTL 3	Applying
13.	Analyze the advantages of V2G over conventional EV charging systems with suitable justification.	(16)	2	BTL 4	Analyzing
14.	Describe the contribution of V2G in demand response and peak load management using suitable examples.	(16)	2	BTL 3	Applying
15.	Discuss the technical, economic, environmental and societal benefits of Vehicle-to-Grid technology and analyze its future potential in modern power systems.	(16)	2	BTL 4	Analyzing
16.	Demonstrate how V2G enhances grid reliability, power quality and operational efficiency.	(16)	2	BTL 3	Applying
17.	Explain the role of V2G in achieving sustainability in electricity generation and transportation with suitable examples.	(16)	2	BTL 3	Applying

UNIT III - CHALLENGES TO V2G

Technical Challenges-Battery Degradation, Charger Efficiency, Charging infrastructure requirements for V2G, Aggregation and Communication, V2G in a Digital Society. The Economic and Business Challenges to V2G - Evaluating V2G Costs and Revenues, EV Costs and Benefits, Adding V2G Costs and Benefits, Additional V2G Costs.

The Evolving Nature of V2G Costs and Benefits. Regulatory and Political Challenges to V2G, V2G and Regulatory Frameworks, Market Design Challenges. Other V2G Regulatory and Legal Challenges.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define battery degradation in electric vehicles.	3	BTL 1	Remember
2.	Explain the impact of battery degradation on V2G performance.	3	BTL 2	Understand
3.	What is charger efficiency?	3	BTL 1	Remember
4.	Describe the charging infrastructure requirements for V2G systems.	3	BTL 2	Understand
5.	Define EV aggregation.	3	BTL 1	Remember
6.	Explain the role of communication systems in V2G.	3	BTL 2	Understand
7.	What is meant by V2G in a digital society?	3	BTL 1	Remember

8.	Discuss the economic challenges associated with V2G implementation.		3	BTL 2	Understand
9.	Define V2G cost and revenue analysis.		3	BTL 1	Remember
10.	Explain the benefits of evaluating V2G costs and revenues.		3	BTL 2	Understand
11.	What are EV ownership costs?		3	BTL 1	Remember
12.	Describe the additional costs involved in V2G implementation.		3	BTL 2	Understand
13.	Define regulatory framework.		3	BTL 1	Remember
14.	Explain the importance of regulatory frameworks in V2G deployment.		3	BTL 2	Understand
15.	What is market design in V2G?		3	BTL 1	Remember
16.	Discuss the evolving nature of V2G costs and benefits.		3	BTL 2	Understand
17.	Define legal challenges in Vehicle-to-Grid systems.		3	BTL 1	Remember
18.	Explain the political challenges affecting V2G implementation.		3	BTL 2	Understand
19.	List the technical challenges of V2G technology.		3	BTL 1	Remember
20.	Describe the importance of charger efficiency in V2G systems.		3	BTL 2	Understand
21.	List any four regulatory challenges in V2G.		3	BTL 1	Remember
22.	Explain the significance of EV aggregation in V2G operations.		3	BTL 2	Understand
23.	What are communication protocols used in V2G?		3	BTL 1	Remember
24.	Summarize the major challenges associated with Vehicle-to-Grid technology.		3	BTL 2	Understand
PART B					
1.	Analyze the technical challenges of Vehicle-to-Grid technology, including battery degradation, charger efficiency, and charging infrastructure requirements.	(16)	3	BTL 4	Analyzing
2.	Explain the causes, effects, and mitigation techniques of battery degradation in V2G systems.	(16)	3	BTL 3	Applying
3.	Evaluate the impact of charger efficiency on the performance and economics of V2G systems.	(16)	3	BTL 4	Analyzing
4.	Illustrate the communication architecture and aggregation techniques used in V2G systems with suitable diagrams.	(16)	3	BTL 3	Applying

5.	Analyze the role of digital technologies in overcoming communication and aggregation challenges in V2G.	(16)	3	BTL 4	Analyzing
6.	Explain the charging infrastructure requirements for successful implementation of Vehicle-to-Grid technology.	(16)	3	BTL 3	Applying
7.	Evaluate the economic and business challenges involved in implementing V2G technology.	(16)	3	BTL 4	Analyzing
8.	Discuss the procedures for evaluating V2G costs and revenues with suitable examples.	(16)	3	BTL 3	Applying
9.	Analyze the costs and benefits associated with EV participation in Vehicle-to-Grid systems.	(16)	3	BTL 4	Analyzing
10.	Explain the evolving nature of V2G costs, revenues, and business opportunities.	(16)	3	BTL 3	Applying
11.	Analyze the regulatory and political challenges affecting the widespread adoption of V2G technology.	(16)	3	BTL 4	Analyzing
12.	Explain the role of regulatory frameworks and market design in facilitating Vehicle-to-Grid implementation.	(16)	3	BTL 3	Applying
13.	Evaluate the legal and regulatory issues associated with Vehicle-to-Grid technology in modern power systems.	(16)	3	BTL 4	Analyzing
14.	Illustrate the impact of communication infrastructure and digital technologies on V2G performance.	(16)	3	BTL 3	Applying
15.	Analyze the interaction between technical, economic, regulatory, and legal challenges in Vehicle-to-Grid implementation.	(16)	3	BTL 4	Analyzing
16.	Discuss the business models for Vehicle-to-Grid technology and explain their economic feasibility.	(16)	3	BTL 3	Applying
17.	Analyze the complete technical, economic, regulatory, political, and legal challenges associated with Vehicle-to-Grid technology and suggest suitable solutions for large-scale deployment.	(16)	3	BTL 4	Analyzing

UNIT IV – IMPACT OF EV AND V2G ON THE SMART GRID AND RENEWABLE ENERGY SYSTEMS

Introduction - Types of Electric Vehicles - Motor Vehicle Ownership and EV Migration - Impact of Estimated EVs on Electrical Network - Impact on Drivers and the Smart Grid - Standardization and Plug-and-Play - IEC 61850 Communication Standard and IEC 61850-7-420 Extension-Impact of V2G on Various Renewable Energy Systems.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define Smart Grid.	4	BTL 1	Remember
2.	Explain the importance of Smart Grid in EV integration.	4	BTL 2	Understand
3.	List the types of Electric Vehicles.	4	BTL 1	Remember
4.	Describe the impact of EV migration on electrical networks.	4	BTL 2	Understand
5.	Define Plug-and-Play technology.	4	BTL 1	Remember
6.	Explain the need for standardization in EV charging systems.	4	BTL 2	Understand
7.	What is IEC 61850?	4	BTL 1	Remember
8.	Discuss the significance of IEC 61850 communication standard in Smart Grid applications.	4	BTL 2	Understand
9.	Define EV migration.	4	BTL 1	Remember
10.	Explain the impact of EV ownership on power demand.	4	BTL 2	Understand
11.	What is IEC 61850-7-420 extension?	4	BTL 1	Remember
12.	Describe the role of IEC 61850-7-420 in renewable energy integration.	4	BTL 2	Understand
13.	Define renewable energy integration.	4	BTL 1	Remember
14.	Explain the impact of EVs on drivers and Smart Grid operation.	4	BTL 2	Understand
15.	What is motor vehicle ownership?	4	BTL 1	Remember
16.	Discuss the benefits of Plug-and-Play functionality in EV systems.	4	BTL 2	Understand
17.	List any four renewable energy sources integrated with V2G.	4	BTL 1	Remember
18.	Explain the impact of V2G on renewable energy systems.	4	BTL 2	Understand
19.	Define communication standard.	4	BTL 1	Remember
20.	Describe the challenges of integrating EVs into Smart Grids.	4	BTL 2	Understand
21.	What is electrical network loading?	4	BTL 1	Remember

22.	Explain the role of EVs in future intelligent power systems.		4	BTL 2	Understand
23.	State the objectives of IEC 61850 communication protocol.		4	BTL 1	Remember
24.	Summarize the impact of EVs on modern electrical networks.		4	BTL 2	Understand
PART B					
1.	Analyze the impact of large-scale electric vehicle penetration on the electrical distribution network.	(16)	4	BTL 4	Analyzing
2.	Explain the different types of Electric Vehicles and their role in Smart Grid applications with suitable illustrations.	(16)	4	BTL 3	Applying
3.	Evaluate the effects of increasing motor vehicle ownership and EV migration on power system planning.	(16)	4	BTL 4	Analyzing
4.	Illustrate the impact of EVs on drivers, consumers, and Smart Grid operation using suitable examples.	(16)	4	BTL 3	Applying
5.	Analyze the importance of standardization and Plug-and-Play technology in EV integration.	(16)	4	BTL 4	Analyzing
6.	Explain the IEC 61850 communication standard and its application in Smart Grid environments.	(16)	4	BTL 3	Applying
7.	Evaluate the role of IEC 61850-7-420 extension in renewable energy and distributed energy resource integration.	(16)	4	BTL 4	Analyzing
8.	Discuss the communication architecture used for Smart Grid-enabled EV integration.	(16)	4	BTL 3	Applying
9.	Analyze the impact of Vehicle-to-Grid technology on various renewable energy systems.	(16)	4	BTL 4	Analyzing
10.	Illustrate the integration of EVs with renewable energy sources using a suitable block diagram.	(16)	4	BTL 3	Applying
11.	Evaluate the technical challenges associated with integrating a large number of EVs into Smart Grid systems.	(16)	4	BTL 4	Analyzing
12.	Explain the influence of EV penetration on electrical network stability and power quality.	(16)	4	BTL 3	Applying
13.	Analyze the role of Smart Grid technologies in supporting sustainable transportation and renewable energy integration.	(16)	4	BTL 4	Analyzing

14.	Explain the implementation of Plug-and-Play functionality in EV charging infrastructure with suitable examples.	(16)	4	BTL 3	Applying
15.	Analyze the communication requirements and interoperability issues between EVs and Smart Grid systems.	(16)	4	BTL 4	Analyzing
16.	Discuss the integration of IEC 61850 communication protocol with EV charging stations and renewable energy resources.	(16)	4	BTL 3	Applying
17.	Analyze the impact of EVs and Vehicle-to-Grid technology on Smart Grid operation, renewable energy integration, communication standards, and future sustainable power systems.	(16)	4	BTL 4	Analyzing

UNIT V - GRID INTEGRATION AND MANAGEMENT OF EVS

Introduction - Machine to Machine (M2M) in distributed energy management systems - M2M communication for EVs - M2M communication architecture (3GPP) - Electric vehicle data logging - Scalability of electric vehicles -M2M communication with scheduling.

PART A

Q.No	Questions	CO	BT Level	Competence
1.	Define Machine-to-Machine (M2M) communication.	5	BTL 1	Remember
2.	Explain the role of M2M communication in distributed energy management systems.	5	BTL 2	Understand
3.	What is distributed energy management system (DEMS)?	5	BTL 1	Remember
4.	Describe the communication requirements of electric vehicles in M2M systems.	5	BTL 2	Understand
5.	What is 3GPP communication architecture?	5	BTL 1	Remember
6.	Explain the architecture of M2M communication for EVs.	5	BTL 2	Understand
7.	Define electric vehicle data logging.	5	BTL 1	Remember
8.	Discuss the importance of data logging in electric vehicle management.	5	BTL 2	Understand
9.	What is scalability in electric vehicle systems?	5	BTL 1	Remember
10.	Explain the need for scalability in EV integration.	5	BTL 2	Understand

11.	Define scheduling in M2M communication.	5	BTL 1	Remember	
12.	Describe the purpose of scheduling in EV communication networks.	5	BTL 2	Understand	
13.	What are the components of an M2M communication system?	5	BTL 1	Remember	
14.	Explain the significance of communication protocols in EV management.	5	BTL 2	Understand	
15.	Define communication gateway.	5	BTL 1	Remember	
16.	Explain how M2M communication improves grid integration of EVs.	5	BTL 2	Understand	
17.	List the applications of M2M communication in EV systems.	5	BTL 1	Remember	
18.	Discuss the role of 3GPP standards in EV communication.	5	BTL 2	Understand	
19.	Define interoperability in EV communication systems.	5	BTL 1	Remember	
20.	Explain the benefits of distributed energy management using M2M communication.	5	BTL 2	Understand	
21.	What is an EV communication network?	5	BTL 1	Remember	
22.	Describe the challenges of large-scale EV communication networks.	5	BTL 2	Understand	
23.	State the objectives of EV data logging.	5	BTL 1	Remember	
24.	Summarize the role of M2M communication in future smart grids.	5	BTL 2	Understand	
PART B					
1.	Analyze the role of Machine-to-Machine (M2M) communication in distributed energy management systems for electric vehicles.	(16)	5	BTL 4	Analyzing
2.	Explain the architecture of M2M communication for EVs based on the 3GPP communication framework with a neat diagram.	(16)	5	BTL 3	Applying
3.	Evaluate the advantages and challenges of M2M communication in large-scale electric vehicle integration.	(16)	5	BTL 4	Analyzing
4.	Illustrate the communication architecture used for EV grid integration and explain its functional components.	(16)	5	BTL 3	Applying
5.	Analyze the importance of electric vehicle data logging in grid monitoring and energy management.	(16)	5	BTL 4	Analyzing

6.	Explain the process of electric vehicle data logging and its applications in distributed energy management systems.	(16)	5	BTL 3	Applying
7.	Evaluate the scalability issues associated with increasing penetration of electric vehicles into the power grid.	(16)	5	BTL 4	Analyzing
8.	Discuss the role of scheduling techniques in M2M communication for efficient EV charging and discharging.	(16)	5	BTL 3	Applying
9.	Analyze the impact of communication latency and network reliability on EV grid integration.	(16)	5	BTL 4	Analyzing
10.	Explain the role of 3GPP standards in supporting reliable M2M communication for electric vehicles.	(16)	5	BTL 3	Applying
11.	Analyze the contribution of distributed energy management systems to Smart Grid-enabled EV integration.	(16)	5	BTL 4	Analyzing
12.	Illustrate the complete M2M communication architecture with scheduling for electric vehicle applications.	(16)	5	BTL 3	Applying
13.	Evaluate the communication and interoperability challenges in EV management systems.	(16)	5	BTL 4	Analyzing
14.	Discuss the implementation of M2M communication with scheduling for coordinated EV charging.	(16)	5	BTL 3	Applying
15.	Analyze the role of communication infrastructure, scalability, and data management in future EV ecosystems.	(16)	5	BTL 4	Analyzing
16.	Explain the integration of electric vehicle communication networks with distributed energy management systems using suitable examples.	(16)	5	BTL 3	Applying
17.	Analyze the complete framework for grid integration and management of electric vehicles and scheduling in modern Smart Grid applications.	(16)	5	BTL 4	Analyzing

COURSE OUTCOMES

CO1. Explain the concepts related with V2G.

CO2. Study the grid connection of 3 phase Q inverter.

CO3. Explain the technical, economics. business, regulatory & political challenges related with V2G.

CO4. Demonstrate the impact of EV and V2G on smart grid and renewable energy system

CO5. Explain the concept of grid integration and management of EVs.