

Question Bank on Electric Vehicle Charging Infrastructure

1. What are the ideal characteristics of switches in the ON and OFF states?
2. What is the minimum number of half-axes or segments in the static characteristic of a switching device?
3. Explain why regular inspections are important for the maintenance of EV charging stations.
5. Explain why it is important for power utilities to strategically plan upgrades to distribution infrastructure in response to increased EV charging.
6. What is the primary purpose of high-voltage contactors in electric vehicles (EVs) and hybrid electric vehicles?
7. What is the primary purpose of the SAE J1772 standard?
8. Describe the function of the pre-charge contactor and its role in protecting the vehicle's components during startup.
9. Briefly explain the difference between IEC 61851-1 and IEC 61851-23 in terms of their focus within electric vehicle charging.
10. Explain the relationship between the Control Pilot (CP) signal's duty ratio and the maximum charging current allowed in an EV charging session, referencing the IEC 61851-1 standard.
11. Describe the methodology used to determine the breakeven point between ICE and EV models in different vehicle segments. How does daily running distance impact the TCO comparison between these two types of vehicles?
12. Summarize the key operational differences between static and dynamic inductive charging and provide a practical application for each.
13. Analyze the role of the isolation check and pre-charge phase in ensuring the safety and proper functioning of an EV charging process. Explain how these stages contribute to preventing potential hazards.
14. Examine the significance of bidirectional charging (V2G and V2H) in modern EV infrastructure. What additional components are required for implementation, and how do they ensure grid interaction safety?
15. Explain how the Combined Charging System (CCS) enables both AC and DC charging using a single connector. Discuss the advantages of this approach in terms of charging infrastructure and EV adoption.
16. Evaluate the various options for arranging electricity supply for EV charging, including drawing from an existing connection, arranging a new connection, and using a captive renewable energy generation system. Discuss the advantages and disadvantages of each option, and justify which option would be most suitable for different types of EV charging installations (private, semi-public, public).
17. What are the primary considerations in designing power converters for DC fast charging stations? Explain the role of energy density, system efficiency, and bidirectional power flow.
18. Analyze the role of the Control Pilot (CP) and Proximity Pilot (PP) in ensuring safe and efficient charging in CCS. How do these components contribute to proper communication between the EV and EVSE?
19. Describe the working principle of a Level 1 and Level 2 AC charging station, including their power ratings, typical applications, and limitations.
20. Evaluate the effectiveness of the electric bridge switch method for insulation monitoring in DC unearthed distribution systems compared to the current AC injection method. Consider factors such as reliability, accuracy, cost, and complexity. Justify which method would be more suitable for automotive applications, taking into account the specific challenges and safety requirements of electric vehicles.

21. Design a comprehensive plan for implementing a public EV charging network in a densely populated urban area having energy demand from various sectors of EV given as 2W-100 kWhr, 3W-350 kWhr, 4W(Commercial)-500kWhr. Arrive at dedicated power distribution scheme, sizing transformer, circuit breaker, MCCB s, cable size.
22. Design a comprehensive safety protocol for a DC fast-charging station that integrates both the vehicle's and the station's insulation monitoring systems. Propose a system that ensures continuous monitoring and immediate response to insulation faults, while also considering the need to minimize disruptions to the charging process.
23. Design a high-efficiency front-end AC-DC converter for an On-Board Charger (OBC) 7.3kW that operates with single-phase (230V) AC inputs, ensuring power factor correction (PFC) and compliance with IEC 61851-1 standards. It must deliver a regulated DC link voltage (typically 380V-420V DC) with low total harmonic distortion (THD < 5%), ensuring smooth operation for downstream DC-DC isolated converters.
24. Name the three main cost components considered in the TCO methodology.
25. What are the key differences between Level 2 DC charging (DC Wall box) and Level 3 DC fast charging (DCFC) in terms of power levels, applications, and charging time?
26. What factors influence the transient behavior of a switch?
27. Briefly describe the role of authentication in an EV Charging Management System.
28. What is the minimum number of half-axes or segments in the static characteristic of a switching device?
29. Briefly explain the difference between IEC 61851-1 and IEC 61851-23 in terms of their focus within electric vehicle charging.
30. What is the standard width specified for each parking spot in the EV charging infrastructure layout?
31. What is the purpose of "minus metering" as described in the context of EV charging connections?
32. What does the term "roaming" mean in the context of e-mobility service providers (e-MSPs)?
33. Describe the potential impact of high demand for EV charging on the existing electricity network
34. Analyze the key factors driving the growth of the global electric vehicle charging infrastructure market. What role do government policies, technological advancements, and increasing EV sales play in shaping the market trends?
35. Compare and contrast the different charging scenarios for heavy-duty electric vehicles (HDEVs) presented in the case-wise analysis, focusing on the impact of charging location and power availability on grid stress. Discuss the role of innovative charging solutions like battery swapping and electric road systems (ERS) in mitigating grid stress and improving HDEV charging efficiency.
36. How does the Proximity Pin (PP) ensure safe charging disconnection, and what are its key resistance values?
37. Discuss the importance of power modules in DC charging stations. How do AC/DC and DC/DC power stages contribute to efficient charging?

38. Outline the six key steps in the EV charging communication sequence and their significance in optimizing power distribution.
39. Evaluate the guidelines for site planning of EV charging infrastructure, particularly focusing on the principles of maximizing accessibility, utilization, and minimizing cost. Discuss the trade-offs between these principles and justify which principle should be prioritized in different scenarios, such as urban versus rural settings.
40. Discuss the working principle of the EV Charge Controller (CCS2) and the role of Power Line Communication (PLC) in the charging process.
41. Analyze the advantages and challenges of implementing battery swapping stations for electric vehicles, and discuss how the design of the vehicle's battery placement affects the feasibility of battery swapping.
42. Analyze the differences between voltage feedback and current feedback methods used in Pulse Width Modulation (PWM) for controlling high-voltage contactor coil currents. Evaluate the advantages and disadvantages of each method in terms of cost, accuracy, and efficiency.
43. Describe the working principle of a Level 1 and Level 2 AC charging station, including their power ratings, typical applications, and limitations.
44. Evaluate the various options for arranging electricity supply for EV charging, including drawing from an existing connection, arranging a new connection, and using a captive renewable energy generation system. Discuss the advantages and disadvantages of each option, and justify which option would be most suitable for different types of EV charging installations (private, semi-public, public).
45. Design a comprehensive plan for implementing a public EV charging network in a densely populated urban area having energy demand from various sectors of EV given as 2W-100 kWhr, 3W-350 kWhr, 4W(Commercial)-500kWhr. Arrive at dedicated power distribution scheme, sizing transformer, circuit breaker, MCCB s, cable size.
46. Analyze the roles of Charge Point Operators (CPOs) and E-mobility Service Providers (e-MSPs) in the development and operation of public EV charging infrastructure. Compare and contrast their functions, and discuss how their collaboration can enhance the user experience and expand the reach of EV charging networks.
47. Design a back-end converter with input voltage of 400V DC, operating at switching frequency of 1kHz for a 3.3 kW single phase charging board (EVSE), limiting the output voltage 1% and limiting THD to 5%.
48. Explain the core functions of Charging Network Management and discuss the role of a Charging Station Management System (CSMS) in overseeing EV charging infrastructure.
49. Describe the Wired Ethernet Star topology as it applies to EV charging networks. Discuss its key advantages and a potential disadvantage in the context of scalability.
50. Compare and contrast the Wired Ethernet Bus topology with the Wired Ethernet Star topology for EV charging networks, highlighting one advantage and one significant drawback of the bus topology.
51. Discuss the potential significant impact of increasing EV adoption on the electricity grid. Explain the challenges this poses and suggest a proactive approach for power utilities to mitigate these issues.

52. Explain why the future demand for public EV charging infrastructure is expected to diverge significantly from past patterns. Discuss the two main reasons outlined in the text that contribute to this shift.
53. Explain the concept of an "Objective Function" in the context of EV charging infrastructure planning. Provide two distinct examples of objective functions and briefly describe what each aims to achieve.
54. Describe the role of "Constraints" in the optimization process for EV charging infrastructure planning. Provide three different examples of constraints and explain why each is important to consider.
55. Outline the key steps in the functioning of an EV Charging Management System (CSMS) from user initiation to session termination. Briefly explain the purpose of authentication and power allocation within this process.
56. Discuss the importance of regular maintenance for EV charging stations. Explain three key reasons why routine inspections and servicing are crucial for the successful operation of EV charging infrastructure.
57. Identify and briefly describe three key challenges associated with data analytics adoption in the EV charging ecosystem. Explain why addressing these challenges is important for effective infrastructure management and growth.
58. Explain the fundamental difference between AC and DC charging systems for electric vehicles. In your explanation, describe the role of the On-Board Charger (OBC) and provide a typical application for Level 1 and Level 2 AC charging.
59. Describe the projected growth in the electric vehicle market by 2030, highlighting the anticipated increase in the number of EVs in the US and the global energy demand for charging them. What is the estimated need for public chargers to support this growth?
60. Compare and contrast Level 2 DC charging with Level 3 DC Fast Charging (DCFC) in terms of power levels and charging time to reach 80% State of Charge (SOC). What is a key architectural difference that allows DC charging stations to achieve these higher power levels?
61. Explain the concept of the Totem Pole Power Factor Correction (PFC) topology used in AC/DC power conversion for EV charging stations. What are two key advantages of this topology compared to a conventional boost PFC?
62. Identify and briefly describe three key international standards (IEC, ISO, SAE) that are relevant to the safety of EV charging infrastructure. For each standard, mention one specific aspect it addresses.
63. Explain the significance of communication standards like ISO/IEC 15118 in the context of EV charging. What are two key aspects or functionalities that these standards aim to facilitate between the EV and the EVSE?
64. Discuss the importance of electrical safety and grounding in EV charging infrastructure and vehicles. Briefly describe the different voltage levels present and the primary aim of protective measures at the charging station.
65. Explain the function of high-voltage contactors in EVs and HEVs, particularly focusing on their role as a safety device. Describe the typical arrangement of main contactors and the pre-charge contactor and their respective purposes.

66. Describe the concept of insulation barrier leakage monitoring in unearthed DC distribution systems used in EVSE. Explain the warning and fault thresholds mentioned and the general principle of how insulation monitoring devices operate to ensure safety.