

GOVERNMENT POLYTECHNIC SHEOHAR
BRANCH: MECHANICAL ENGINEERING | 5TH SEMESTER
SUBJECT: HYBRID AUTOMOBILE ENGINEERING

100 Important Questions Bank

1. Define a Hybrid Electric Vehicle (HEV).
2. What are the main components of an electric vehicle?
3. Explain the environmental benefits of adopting hybrid vehicles.
4. Compare Internal Combustion Engine (ICE) vehicles with Electric Vehicles (EV).
5. What is the basic principle of operation of a hybrid vehicle?
6. Discuss the current market trends for EVs and HEVs in India.
7. What are zero-emission vehicles?
8. Describe the concept of well-to-wheel emissions.
9. Explain the major challenges in the widespread adoption of HEVs.
10. What is a Plug-in Hybrid Electric Vehicle (PHEV)?
11. Differentiate between Micro, Mild, and Full hybrid vehicles.
12. Explain the role of government policies and subsidies in promoting EVs.
13. What is a Fuel Cell Electric Vehicle (FCEV)?
14. List the primary advantages and disadvantages of HEVs.
15. How does a hybrid vehicle improve overall fuel efficiency?
16. Explain the concept of downsizing the ICE in a hybrid setup.
17. What are the general safety concerns associated with high-voltage hybrid systems?
18. Discuss the impact of HEVs on the regional power grid.
19. What is the typical life cycle of a hybrid vehicle?
20. Explain the social and economic impact of hybrid automobile engineering.
21. Explain the Series Hybrid Drivetrain architecture with a neat sketch.
22. What are the main advantages of a Series Hybrid vehicle?
23. Describe the Parallel Hybrid Drivetrain architecture.
24. How does a Series-Parallel (Power Split) hybrid drivetrain work?
25. Explain the function of a planetary gear set in a power-split hybrid.
26. What is the role of a power control unit in a hybrid drivetrain?
27. Compare Series and Parallel hybrid architectures.
28. What are the different operating modes of a Parallel HEV?
29. Explain the concept and working of regenerative braking.
30. How is braking energy recovered and stored in an HEV?
31. Discuss the mechanical power path versus the electrical power path in a hybrid.

32. What is a Through-the-Road (TTR) hybrid architecture?
33. Explain the function of a clutch in a parallel hybrid system.
34. Describe the torque coupling mechanism in hybrid vehicles.
35. Describe the speed coupling mechanism in hybrid vehicles.
36. What is an Integrated Starter Generator (ISG)?
37. Explain the start-stop system in mild hybrid vehicles.
38. How does torque assist work in a hybrid vehicle?
39. Discuss the efficiency map of an ICE and how hybridization optimizes its operation.
40. Explain the continuous variable transmission (e-CVT) systems used in hybrid vehicles.
41. What are the essential requirements of an energy storage system for an HEV?
42. Define Specific Energy and Specific Power of a battery.
43. Explain the working principle of a Lead-Acid battery.
44. Why are Lithium-ion batteries preferred for modern HEVs?
45. Discuss the construction and working of a Nickel-Metal Hydride (NiMH) battery.
46. Compare Li-ion and NiMH batteries in the context of hybrid vehicles.
47. Define State of Charge (SOC) and State of Health (SOH) of a battery.
48. Explain the concept of Depth of Discharge (DOD).
49. What is a Battery Management System (BMS)?
50. List the primary functions and components of a BMS.
51. How is the thermal management of batteries achieved in HEVs?
52. Explain the phenomenon and importance of cell balancing in a battery pack.
53. What are ultracapacitors (supercapacitors)?
54. How do ultracapacitors complement batteries in hybrid vehicles?
55. Explain the working principle of a hydrogen fuel cell.
56. Discuss the advantages of fuel cells over traditional batteries.
57. What are the common failure modes of HEV batteries?
58. Explain the charging and discharging characteristics of a Li-ion battery.
59. Discuss the recycling process and environmental impact of EV batteries.
60. What is a flywheel energy storage system and how can it be used in vehicles?
61. What are the basic requirements of an electric motor used in HEVs?
62. Explain the working principle of a standard DC motor.
63. Why are DC series motors historically used for traction applications?
64. Describe the construction and working of a Brushless DC (BLDC) motor.
65. What are the advantages of BLDC motors over conventional DC motors?
66. Explain the operation of a Three-Phase Induction Motor.
67. Discuss the torque-speed characteristics of an induction motor.

68. What is a Permanent Magnet Synchronous Motor (PMSM)?
69. Why is PMSM widely used in modern hybrid vehicles?
70. Explain the working of a Switched Reluctance Motor (SRM).
71. Compare BLDC, Induction, and PMSM motors for EV applications.
72. What is an inverter, and what is its specific role in an HEV?
73. Explain the function of a DC-DC converter in a hybrid vehicle.
74. How is motor speed controlled in an electric propulsion system?
75. Describe the principle of vector control in AC motors.
76. What is the four-quadrant operation in an electric drive?
77. Explain the cooling methods used for electric motors in HEVs.
78. How does motor efficiency impact the overall range of a hybrid vehicle?
79. What are the mechanical and thermal challenges in designing motors for automotive applications?
80. Discuss the role of power electronics in hybrid propulsion.
81. What is an Energy Management Strategy (EMS) in HEVs?
82. Differentiate between rule-based and optimization-based control strategies.
83. Explain the thermostat control strategy for a series hybrid vehicle.
84. How does a power-follower control strategy work?
85. Discuss the role of Electronic Control Units (ECUs) in hybrid vehicles.
86. What is a CAN bus, and why is it critical in HEV communication?
87. Explain the concept of Vehicle-to-Grid (V2G) technology.
88. Discuss the different types of EV charging stations (Level 1, Level 2, DC Fast Charging).
89. What are the infrastructural challenges in establishing widespread charging stations?
90. Explain the concept of wireless (inductive) charging for vehicles.
91. How do driving cycles (e.g., NEDC, WLTP) affect the design and testing of HEVs?
92. What are the standard testing procedures for hybrid vehicles under SBTE guidelines?
93. Discuss the maintenance differences between an ICE vehicle and an HEV.
94. What specific safety precautions must a technician take while servicing an HEV?
95. Explain the operation of electrically driven accessories (e.g., AC compressor, power steering) in an HEV.
96. How is cabin heating achieved in a vehicle without a constantly running ICE?
97. What are the upcoming future trends in hybrid automobile engineering?
98. Discuss the engineering potential of solar-assisted hybrid vehicles.
99. Explain how smart algorithms can optimize HEV energy management.
100. What role do autonomous driving technologies play in the future of electric and hybrid mobility?