

**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024**

Seventh Semester

**Mechanical Engineering**

**20MEEL705 - HYBRID VEHICLES**

Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

**PART - A (MCQ) (20 × 1 = 20 Marks)**

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. Which component is essential in hydraulic hybrid vehicles for energy storage? (a) Fuel tank      (b) Hydraulic accumulator      (c) Battery      (d) Carburetor	1	K1	CO1
2. What is a significant aspect of energy consumption in electric vehicles? (a) Engine displacement      (b) Battery efficiency and driving habits (c) Type of fuel used      (d) Transmission fluid level	1	K1	CO1
3. Tell During normal driving, tractive effort must overcome which forces? (a) Gravitational force only      (b) Aerodynamic drag and rolling resistance (c) Electrical resistance      (d) Magnetic force	1	K1	CO1
4. Which factor is NOT typically considered in the fuel efficiency analysis of electric drive-trains? (a) Battery capacity      (b) Motor efficiency      (c) Aerodynamics      (d) Tire size	1	K2	CO2
5. Which type of hybrid drive-train topology allows the vehicle to run on electric power alone, engine power alone, or a combination of both? (a) Series      (b) Parallel      (c) Series-parallel      (d) Hydraulic	1	K2	CO2
6. What is considered in the fuel efficiency analysis of hybrid drive-trains? (a) Engine displacement      (b) Electric motor power      (c) Sunroof size      (d) Paint color	1	K1	CO2
7. Which of the following is a primary advantage of EVs? (a) Higher fuel consumption      (b) Zero tailpipe emissions (c) Complex design      (d) Increased noise	1	K1	CO3
8. In a DC motor, which component is responsible for converting electrical energy into mechanical energy? (a) Rotor      (b) Stator      (c) Commutator      (d) Armature	1	K1	CO3
9. What is the primary source of torque in an induction motor? (a) Magnetic field interaction      (b) Electrical resistance (c) Heat generation      (d) Mechanical force	1	K1	CO3
10. What type of battery is most commonly used in electric vehicles? (a) Lead-acid battery      (b) Nickel-cadmium battery (c) Lithium-ion battery      (d) Alkaline battery	1	K1	CO4
11. Which parameter is the most critical when analyzing the performance of a battery for electric vehicles? (a) Voltage output      (b) Battery capacity (c) Number of wheels in the vehicle      (d) Paint type on the vehicle	1	K2	CO4
12. What type of battery is most commonly used in electric vehicles? (a) Lead-acid battery      (b) Nickel-cadmium battery (c) Lithium-ion battery      (d) Alkaline battery	1	K1	CO4
13. What is the main business opportunity provided by e-mobility? (a) Increase in gasoline consumption (b) Transition to sustainable transport and new market for electric vehicles (c) Use of fossil fuels in public transportation (d) Growth of traditional automotive repair services	1	K1	CO5

14. Select one major challenge in the electrification of vehicles is: 1 K1 CO5  
 (a) Abundant supply of raw materials for batteries  
 (b) High market penetration of electric vehicles  
 (c) Lack of public charging infrastructure  
 (d) Decreased global demand for EVs
15. Which aspect is essential for the success of the e-mobility business? 1 K2 CO5  
 (a) Fossil fuel subsidies (b) Development of EV charging networks  
 (c) Reducing renewable energy adoption (d) Increasing CO2 emissions
16. Which policy initiative in India aims to promote electric mobility? 1 K1 CO5  
 (a) Faster Adoption and Manufacturing of Electric Vehicles (FAME)  
 (b) Bharat Stage Emission Standards  
 (c) Coal Subsidy Scheme  
 (d) Gasoline Vehicle Adoption Plan
17. In a parallel hybrid vehicle, which situation might favor the use of the internal combustion engine over the electric motor? 1 K1 CO6  
 (a) Slow city driving (b) High-speed highway driving  
 (c) When the vehicle is idling (d) During regenerative braking
18. Tell main advantage of regenerative braking in electric vehicles is: 1 K1 CO6  
 (a) Reduced fuel consumption  
 (b) Increased power to the internal combustion engine  
 (c) The ability to recharge the battery by converting kinetic energy into electrical energy  
 (d) Providing additional torque to the wheels
19. Which component in an electric vehicle is responsible for converting DC from the battery into AC for the electric motor? 1 K2 CO6  
 (a) Inverter (b) Transmission (c) Fuel cell (d) Converter
20. A key performance metric for electric vehicles is energy efficiency, which is measured in: 1 K1 CO6  
 (a) Miles per gallon (MPG) (b) Horsepower per liter (HP/L)  
 (c) Kilowatt-hours per mile (kWh/mile) (d) Torque per revolution

**PART - B (10 × 2 = 20 Marks)**

Answer ALL Questions

21. List two parameters used to evaluate vehicle performance. 2 K1 CO1
22. What is the significance of tractive effort in everyday driving conditions? 2 K1 CO1
23. Which of the following function of the power split device in a hybrid drive-train? 2 K2 CO2
24. Select the purpose of the electric generator in hybrid vehicles? 2 K1 CO2
25. Match two applications of Permanent Magnet Synchronous Motors (PMSM). 2 K1 CO3
26. Define the principle of operation of a Switched Reluctance Motor (SRM). 2 K1 CO3
27. How do super capacitors differ from batteries in terms of energy storage? 2 K2 CO4
28. List two applications of super capacitors in electric vehicles. 2 K1 CO4
29. Why is battery management important in different electric vehicle configurations? 2 K2 CO5
30. What role does the inverter play in the performance of electric vehicles? 2 K1 CO6

**PART - C (6 × 10 = 60 Marks)**

Answer ALL Questions

31. a) Explain the differences between hydraulic hybrid vehicles and conventional hybrid vehicles. 10 K2 CO1
- OR**
- b) Summarize the advantages and disadvantages of electric vehicles compared to conventional vehicles. 10 K2 CO1
32. a) Compare the basic concepts of electric and hybrid drive-trains. 10 K2 CO2

**OR**

b) Explain how regenerative braking is implemented in electric and hybrid drive-trains. 10 K2 CO2

33. a) Show how armature voltage control and field flux control methods regulate the speed of a DC motor. 10 K2 CO3

**OR**

b) Relate the permanent magnets in PMSMs differ from electromagnets used in traditional motors? and explain it briefly. 10 K2 CO3

34. a) Explain the working principle of a hydrogen fuel cell in energy storage for electric vehicles. 10 K2 CO4

**OR**

b) Summarize the role of the Z-converter in electric vehicle battery charging systems, and why is it used? 10 K2 CO4

35. a) Illustrate the major electrification challenges faced by the e-mobility sector, particularly in emerging markets. 10 K2 CO5

**OR**

b) Infer a case study on the E-mobility Indian Roadmap and explain its implications for the development of connected and autonomous mobility in India. 10 K2 CO5

36. a) Interpret the working principle of plug-in hybrid electric vehicles (PHEVs) and analyze how their dual power sources affect performance in various driving conditions. 10 K2 CO6

**OR**

b) Explain the working principle of an electric vehicle with in-wheel motors and discuss how this configuration impacts traction, handling, and overall performance. 10 K2 CO6