A   **Reg. No. :**

Question Paper Code: U3410

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2024

Professional Elective

Electrical and Electronics Engineering

21EEV410 - INTRODUCTION TO HYBRID AND ELECTRIC VEHICLE ENGINEERING

(Regulations 2021)

Duration: Three hours   Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

1. The force from the propulsion unit of an EV is known as_____.   CO1-U

    (a) Tractive force   (b)   Road   (c)   Resistive   (d) Net force
                                Load Force   force

2. In the following expression, the term F_{RL} is _____.

    CO1-U

    $$F_{RL} = F_{gxT} + F_{roll} + F_{AD}$$

    (a) Road Loss force   (b) Road Load Force

    (c) Rotation Loss Force   (d) Relative Loss Force

3. In batteries, reduction means ____.   CO1-U

    (a) Deficiency of electrons   (b) Increase in electrons

    (c)No change in electrons   (d) None of these

4. The positive electrode gets chemically reduced as it absorbs electrons from
    the external circuit and the negative electrode gets oxidized during ___.   CO1-U

    (a) Charge of battery   (b) Discharge of battery

    (c)State of charge   (d) State of discharge

5. A _____ is essential for an IC engine to match the vehicle speed with the
    narrow high-power speed range of the engine   CO1-U

    (a) Battery pack   (b) Transmission   (c) Piston   (d) None of these

6. The electric motor for propulsion in the EV/HEV is desired to have a _____ to meet acceleration requirements   CO1-U

   (a) low starting torque   (b) high starting torque

   (c) Zero starting torque   (d) None of these

7. The _____ of a vehicle starts with the IC engine or the electric motor that processes the stored energy and ends with the delivery of the power at the wheels   CO1-U

   (a) Gears   (b) Clutch   (c) Powertrain   (d) Tyre

8. The technique that captures a vehicle's kinetic energy and converts it into electricity that can be stored or used immediately is called as _____.   CO1-U

   (a) Forward collision warning   (b) Regenerative braking

   (c) Antilock braking   (d) Traction Control

9. The propulsion component needed in a series HEV is/are ____.   CO1-U

   (a) IC Engine   (b) Generator   (c) Motor   (d) All these

10. In the _____ hybrid configuration, the output shafts of the electric motor and the IC engine are connected through a mechanical coupling before the mechanical transmission gearbox.   CO1-U

    (a) Pre-transmission   (b) Post-transmission   (c) No-transmission   (d) None of these

PART – B (5 x 2= 10 Marks)

11. An EV of mass 165 Kg experiences a tractive force of 60 N. The opposing road load force is estimated to be 15N. Find the acceleration of the EV in the tangential direction. Assume the rotational inertia coefficient km as 1.09.   CO2 -Ap

12. What is State of Discharge (SoD) of a battery? State its significance.   CO1-U

13. Compare motor and IC Engine as a propulsion system of a vehicle.   CO2 -Ap

14. List any four motor parameters that are to be considered for usage in EV.   CO2 -Ap

15. State the difference between Pre- and Post-transmission Hybrids.   CO1-U

PART – C (5 x 16= 80 Marks)

16. (a) Explain the functional components of a typical EV, with neat diagram.   CO1 U   (16)

    Or

    (b) List the various forces that act on a vehicle and explain the significance of each of them with a neat graphical representation   CO1 U   (16)

17. (a) Explain in detail about the constructional details and the chemical CO1 U (16)
reactions that take place in a battery.

Or

(b) Explain the role of the Battery Management System (BMS) in CO1 U (16)
ensuring the safety, efficiency, and longevity of batteries in electric
vehicles (EVs)

18. (a) Explain in detail about the role of Induction machines in EV with CO1 U (16)
necessary diagram.

Or

(b) Discuss the role of Permanent magnet machines in the propulsion CO1 U (16)
systems of hybrid electric vehicles.

19. (a) Write a detailed note on the working and role of Clutch Differential in CO1 U (16)
EVs.

Or

(b) With a diagram, explain the concept of regenerative braking in CO1 U (16)
modern vehicles, focusing on its role in improving energy efficiency
and sustainability in EVs.

20. (a) Discuss the architecture of a series-parallel hybrid electric vehicle CO1 U (16)
with necessary sketch and list the advantages and disadvantages of
this configuration.

Or

(b) List and describe the various specifications that are to be considered CO1 U (16)
in EV powertrain component sizing with an example.

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