CBCS SCHEME

USN | | | | | | | | | | |

21EE752

Seventh Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Electric Vehicles

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. With an example graph of roadway on the fixed co-ordinate system, explain the following terms used in roadway fundamentals :
i) Roadway position vector
ii) Tangential road way length
iii) Roadway percent grade. **(10 Marks)**

b. A straight roadway has a profile in x_F - y_F plane given by, $f(x_F) = 3.9\sqrt{x_F}$ for $0 \le x_F \le 2$ miles, where x_F and y_F are given in feet.
i) Plot the roadway
ii) Find $\beta(x_f)$ calculate the percent grade at x_f = 1 mile
iii) Calculate tangential length. **(10 Marks)**

OR

2 a. Discuss in brief the dynamics of vehicle motion with relevant dynamic modeling equations and block diagram. **(07 Marks)**

b. Discuss in brief the concept of maximum gradability. **(05 Marks)**

c. An electric vehicle has the following parameter values : m = 800 kg, C_D = 0.2, A_F = 2.2 m^2, C_0 = 0.008, C_1 = 1.6 × 10 – 6 s^2/m^2. The density of air p = 1.8 kg/m^3 and acceleration due to gravity g = 9.81 m/s^2. The vehicle is on level road. It accelerates from 0 to 65 mph in 10 seconds, such that its velocity profile is given by,
$V(t) = 0.29055\ t^2$ for $0 \le t \le 10$seconds
Calculate :
i) $F_{TR}(t)$ for $0 \le t \le 10$seconds
ii) $P_{TR}(t)$ for $0 \le t \le 10$seconds
iii) Energy loss due to non –conservative forces
iv) Δe_{TR}. **(08 Marks)**

Module-2

3 a. With a neat diagram, discuss about the conceptual illustration of general EV configuration and list out the variety of possible EV configurations with relevant diagrams due to variation in propulsion design and energy source. **(10 Marks)**

b. Discuss with relevant graphs,
i) Traction motor characteristics
ii) Tractive effect and transmission requirement. **(10 Marks)**

OR

4 a. List out the different architecture of hybrid electric drive trains, also draw the diagram to show conceptual illustrate of hybrid electric derive train. **(04 Marks)**

b. With a neat diagram, explain the series hybrid electric drive train. **(06 Marks)**

c. With a neat diagram, discuss the general configuration of parallel hybrid electric drive train and also draw the diagrams showing the two shaft configurations. **(10 Marks)**

Module-3

5 a. List out any ten battery parameters and briefly discuss about any two of them. **(10 Marks)**

b. With a neat diagram of cell charge and discharge operation of lead-acid battery, discuss in brief the operating principle with relevant chemical reaction equations. **(10 Marks)**

OR

6 a. With a neat diagram, discuss the working principle of Lithium – ion (Li – ion) battery along with chemical reactions and two advantages. **(10 Marks)**

b. List out the any four types of fuel cell and mention the electrolyte used in each of them. **(04 Marks)**

c. Find the curve fitting constants 'n' and 'λ' for Peukert's equation for the two measurements available form a constant current discharge experiment of a battery.

i) $(t_1, I_1) = (10, 18)$

ii) $(t_2, I_2) = (1, 110)$. **(06 Marks)**

Module-4

7 a. Discuss the two quadrant operation of chopper with respect to the following control schemes of DC motor in electric vehicles.

i) Single chopper with a reverse switch

ii) Class –C two quadrant chopper **(10 Marks)**

b. Discuss in brief the following topologies used for SRM drive in electric vehicles :

i) Classic converter

ii) R – dump inverter

iii) C – dump inverter.

(10 Marks)

OR

8 a. Discuss the following control schemes used for BLDC motor drive in electric vehicles.

i) Torque control scheme

ii) Speed control scheme. **(10 Marks)**

b. Discuss the constant v/f control as applicable to induction motor drive for EVs. **(05 Marks)**

c. With a neat diagram (block diagram) explain the power electronic control scheme for constant V/f control. **(05 Marks)**

Module-5

9 a. Discuss the various operating patterns of series hybrid electric derive train for its optimal operation and draw a typical series hybrid electric drive train configuration. **(10 Marks)**

b. For the vehicles with different mission requirements, discuss the various control strategies employed in a series hybrid electric drive train. **(10 Marks)**

OR

10 a. Discuss in detail the parallel torque coupling hybrid drive train with a neat diagram. **(08 Marks)**

b. Discuss in brief the following strategies employed in parallel hybrid electric drive train :

i) Max SOC – of – PPS control strategy

ii) Engine on –off control strategy

iii) Constrained engine on –off control strategy. **(12 Marks)**

* * * * *