A **Reg. No. :** | | | | | | | | | | | | |

Question Paper Code: U3402

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

Professional Elective

Electrical and Electronics Engineering

21EEV402- DESIGN OF MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES

(Regulations 2021)

Duration: Three hours Maximum: 100 Marks

Answer All Questions

PART A - (10 x 1 = 10 Marks)

1. What is the primary source of propulsion in an electric vehicle? CO1- U

   (a) Gasoline (b) Diesel (c) Electric motor (d) Hydrogen fuel cell

2. What is the main component that stores electrical energy in an electric vehicle? CO1- U

   (a) Radiator (b) Battery pack (c) Carburetor (d) Exhaust pipe

3. What happens to the torque in a motor when the speed is increased above the rated speed? CO2- U

   (a) Torque increases (b) Torque decreases

   (c) Torque remains constant (d) Torque and speed are not related

4. Which motor control method is commonly used for torque control below the rated speed? C02- U

   (a) Voltage control (b) Frequency control

   (c) Field weakening (d) Pulse-width modulation (PWM)

5. What is used to represent the relationship between input and output in a transfer function? CO3- U

   (a) Equation (b) Function (c) Model (d) Graph

6. The locations where the denominator of a transfer function equals zero are known as: CO3- U

   (a) ZerosZ (b) Poles (c) Roots (d) Gains

7. What does PWM stand for in the context of power converters? CO4- U

(a) Pulse (b) Power (c) Phase (d) Proportional

8. In power stage modeling, what component primarily stores energy in a buck converter? CO4- U

(a) Inductor (b) Capacitor (c) Resistor (d) Diode

9. In a buck-boost converter, the transfer function from input voltage to output voltage is known as the CO5- U

(a) Voltage (b) Current (c) Power (d) Gain

10. The mode of operation where the inductor current is continuous in a buck-boost converter is called: CO5- U

(a) Discontinuous (b) Continuous (c) Normal (d) Steady

PART – B (5 x 2= 10Marks)

11. Mention the importance of electric vehicles. CO1- U

12. Explain the concept of speed and torque control in electric motors. CO1- U

13. Describe the process of deriving a transfer function from a given differential equation. CO1- U

14. Why is frequency response analysis crucial for understanding the performance of a PWM converter? CO1- U

15. Illustrate the key components of the transfer function that relates the duty ratio to the output voltage in a buck-boost converter? CO1- U

PART – C (5 x 16= 80Marks)

16. (a) Discuss the fundamental dynamics of electric vehicles (EVs), focusing on the key forces acting on an EV during motion. CO1 App (16)

Or

(b) Derive the equation for the tractive force required for an electric vehicle to overcome various resistive forces. Illustrate your answer with a calculation example. CO1 App (16)

17. (a) Discuss the principles of speed and torque control in electric motors, focusing on the differences in control strategies above and below the rated speed. CO1- U (16)

Or

	(b)	Explain the concept of the constant power region in electric vehicle (EV) motors. How does operating in this region affect the performance and efficiency of the vehicle?	CO1- U	(16)
18.	(a)	A system has the transfer function: H(s)=s+1s+10H(s)=s+10s+1 i) Sketch the Bode magnitude and phase plots for this transfer function. ii) Examine the significance of the slope changes and phase shifts at the characteristic frequencies.	CO3 Ana	(16)
		Or		
	(b)	Explain the procedure for constructing a Bode plot for a given transfer function. Discuss the importance of Bode plots in analyzing the frequency response of control systems	CO2 App	(16)
19.	(a)	Discover the modeling of the power stage in a PWM converter, including the roles of inductors, capacitors, and switches.	CO2 App	(16)
		Or		
	(b)	Describe the structure and function of the PWM block within a converter system. How does the PWM block generate the control signals necessary for regulating the output voltage?	CO4 Ana	(16)
20.	(a)	Explain the importance of the small-signal model in analyzing PWM converters. Discuss how this model is derived and used to evaluate system stability and dynamic response?	CO1 U	(16)
		Or		
	(b)	Discuss the concept of averaging in the analysis of power stage dynamics for PWM converters. How does averaging simplify the modeling of power stages?	CO1 U	(16)