Roll No. | | | | | | | | | | |

**ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)**

**B.E. /B.Tech / B. Arch (Full Time) - END SEMESTER EXAMINATIONS, APR / MAY 2025**

BIO- MEDICAL ENGINEERING BRANCH
(Common to all branches except EEE branch)
VI Semester

**EE – 5692 & Electric Vehicle Technology**
(Regulations , , 2019)

Time:3hrs Max.Marks: 100

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|---|---|
| CO1 | Able to understand the principles of conventional and special electrical machines |
| CO2 | Acquired the concepts of power devices and power converters. |
| CO3 | Able to understand the control for DC and AC drive systems |
| CO4 | Learned the electric vehicle architecture and power train components |
| CO5 | Acquired the knowledge of mechanics of electric vehicle and control of electric vehicles |

**BL – Bloom's Taxonomy Levels**
(L1-Remembering, L2-Understanding, L3-Applying, L4-Analysing, L5-Evaluating, L6-Creating)

## PART- A(10x2=20Marks)
(Answer all Questions)

| Q.No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 1 | Why magnetic field is stronger than electric field? | 2 | CO1 | L2 |
| 2 | Write the significance of back EMF in a DC Motor | 2 | CO1 | L2 |
| 3 | Compare power diodes and signal diodes | 2 | CO2 | L1 |
| 4 | What is the need for THD? | 2 | CO2 | L1 |
| 5 | Give example for active load torque and passive load torque. | 2 | CO3 | L1 |
| 6 | Why V/f is to be maintained as a constant value in an induction motor drive system? | 2 | CO3 | L2 |
| 7 | Compare IC engine and EVs | 2 | CO4 | L2 |
| 8 | Draw the structure of series HEV power train | 2 | CO4 | L1 |
| 9 | What are the forces will be acting on an electric vehicle? | 2 | CO5 | L1 |
| 10 | How power will be regenerated in an electric vehicle? | 2 | CO5 | L2 |

## PART- B(5x 13=65Marks)
(Restrict to a maximum of 2 subdivisions)

| Q.No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 11 (a) | How torque will be developed in a DC motor and derive the toque equation of a DC motor. | 13 | CO1 | L3 |
| | OR | | | |
| 11 (b) | Explain the working principle of BLDC motor with necessary block diagram and circuits. | 13 | CO1 | L3 |
| | | | | |
| 12 (a) | How MOSFET will be used for high switching frequency applications? Explain the working of MOSFET. | 4+9 | CO2 | L3 |
| | OR | | | |
| 12 (b) | Construct a multilevel inverter (MLI) with a capacity of generating seven levels in the output voltage. Explain its working modes too | 13 | CO2 | L4 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| 13 (a) | How speed of a DC motor can be controlled using a four quadrant chopper? Explain each quadrant of operation. | 13 | CO3 | L4 |
| | **OR** | | | |
| 13 (b) | For steady-state balance conditions the total 3-phase real and reactive power may be expressed as<br>$P_e=3V_sI_s\cos[\Theta_{ev}(0)-\Theta_{ei}(0)]$<br>$Q_e=3V_sI_s\sin[\Theta_{ev}(0)-\Theta_{ei}(0)]$<br>Show that the following expressions are equal to those given above:<br>$P_e=1.5\ (V_{qs}I_{qs}+V_{ds}I_{ds})$<br>$Q_e=1.5\ (V_{qs}I_{ds}-V_{ds}I_{qs})$ | 13 | CO3 | L5 |
| | | | | |
| 14 (a) | Explain Series–parallel 2 × 2 vehicle architecture with necessary block diagram. | 13 | CO4 | L3 |
| | **OR** | | | |
| 14 (b) | Explain the procedure for identifying a motor for EV application and explain the sizing of EV power train. | 13 | CO4 | L3 |
| | | | | |
| 15 (a) | An EV has the following parameter values:<br>$m$ = 800 kg, $C$ = 0.2, $A$ = 2.2 m$^2$ , $C_0$ = 0.008, 1 = 1.6*10$^{-6}$ s$^2$/m$^2$<br>Also, take density of air $\rho$ = 1.18 kg/m$^3$, and acceleration due to gravity $g$ = 9.81 m/s$^2$.<br>The vehicle is on level road. It accelerates from 0 to 65 mi/h in 10 s such that its velocity profile is given by;<br>$v(t) = 0.29055t^2$ for $0 \le t \le 10$ s.<br>a. Calculate tractive force, $F_{TR}(t)$ for $0 \le t \le 10$ s.<br>b. Calculate tractive power, $P_{TR}(t)$ for $0 \le t \le 10$ s.<br>c. Calculate the energy loss due to non-conservative forces $E_{loss}$.<br>d. Calculate change in tractive energy, $\Delta e_{TR}$. | 3+3+3 +4 | CO5 | L4 |
| | **OR** | | | |
| 15 (b) | Explain the following<br>(i) Rolling Resistance Force,<br>(ii) Aerodynamic Drag<br>(iii) Hill Climbing Force<br>(iv) Acceleration Force<br>(v) Total Tractive Effort | 3+3+2 +2+3 | CO5 | L3 |

## PART- C(1x 15=15Marks)

(Q.No.16 is compulsory)

| Q.No. | Questions | Marks | CO | BL |
|---|---|---|---|---|
| 16. | The full converter is connected to a 120 V 60 Hz supply. The load current Ia is continuous and its ripple content is negligible. The turns ratio of the transformer is unity. (a) express the input current in a fourier series. Determine the HF of the input current, DF, and input PF. (b) If the delay angle is α = π/4. Calculate Vdc, Vin, Vrms, HF, DF and P | 5+10 | CO2 | L5 |