## VASAVI COLLEGE OF ENGINEERING (AUTONOMOUS), HYDERABAD
*Accredited by NAAC with A++ Grade*
### B.E. (E.E.E.) VII-Semester Main & Backlog Examinations, Dec.-23/Jan.-24
### Electrical Drives and Static Control (PE-I)

Time: **3 hours**                                                      Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

### Part-A (10 × 2 = 20 Marks)

| Q. No. | Stem of the question | M | L | CO | PO |
|---|---|---|---|---|---|
| 1. | Define an electric drive. | 2 | 1 | 1 | 1,2 |
| 2. | Draw the block diagram of current limit control of the closed loop control of drives. | 2 | 1 | 1 | 1,2 |
| 3. | Draw the speed torque characteristics of a chopper controlled separately excited DC motor in first and second quadrants. | 2 | 2 | 2 | 1,2 |
| 4. | Figure out the effective value of the braking resistance for the chopper controlled separately excited DC motor. | 2 | 4 | 2 | 1,2 |
| 5. | Write the equation that correlates speed and developed torque in a separately excited DC motor controlled by a three-phase fully controlled rectifier. | 2 | 2 | 3 | 1,2 |
| 6. | List the advantages of circulating current mode of dual converter. | 2 | 2 | 3 | 1,2 |
| 7. | Draw the speed-torque characteristics of a three-phase induction motor under variable frequency control. | 2 | 4 | 4 | 1,2 |
| 8. | What limitations or drawbacks are associated with a cycloconverter induction motor drive? | 2 | 3 | 4 | 1,2 |
| 9. | How could you reverse the speed of switched reluctance motor? | 2 | 3 | 5 | 1,2 |
| 10. | Draw the waveform shape of the back electromotive force (EMF) in a BLDC (Brushless DC) motor. | 2 | 2 | 5 | 1,2 |

### Part-B (5 × 8 = 40 Marks)

| | | | | | |
|---|---|---|---|---|---|
| 11. a) | Discuss the multi-quadrant operations of an electric drive using an example and a clear diagram. | 4 | 3 | 1 | 1,2 |
| b) | Explain in detail the factors to be considered for selection of electric drives for a specific application. | 4 | 4 | 1 | 1,2 |
| 12. a) | Illustrate the four-quadrant operation of a chopper fed drive with a neat diagram | 4 | 2 | 2 | 1,2 |
| b) | A DC chopper fed from 150 V feeds a load comprising $R = 0.2\ \Omega$, $L = 0.1$ mH and a back emf of 20 V. Consider $T_{ON}/T = 0.33$ and the period is 3 ms.<br>  i) Determine the mode of operation of the chopper.<br>  ii) Find the average values of output voltage and current. | 4 | 4 | 2 | 1,2,3 |

| | | | M | L | CO | PO |
|---|---|---|---|---|---|---|
| 13. | a) | Discuss the dynamic model of DC motor with a neat block diagram along with necessary equations | 3 | 2 | 3 | 1,2 |
| | b) | For a separately excited motor rated at 230 V, 1500 rpm, and 20 A, possessing an armature resistance of 0.8 Ω, connected to a 3-phase fully controlled rectifier, supplied by a 415 V, 50 Hz AC source. Find the armature terminal voltage and the firing angle when the motor operates at 800 rpm with its rated torque. Assume the motor terminal voltage is equal to the rated voltage when the converter's firing angle is zero. | 5 | 4 | 3 | 1,2,3 |
| 14. | a) | Explain the operation of AC voltage controller fed induction motor drive with a neat schematic and control characteristics. | 3 | 2 | 4 | 1,2 |
| | b) | A slip ring induction motor has the following motor parameters: 415 V, 50 Hz, 4-pole, 1500 rpm, $R_s = 0.412$ Ω, $R_r = 1.2$ Ω, $X_s = 0.857$ Ω, $X_r = 1.5$ Ω. A chopper is used to control the rotor resistance of the motor consisting of a switch connected in parallel with a resistance of 20 Ω. Consider the duty ratio of switch as 0.6 and assume the supply current of the chopper is 10 A . Find the effective rotor resistance of the motor and determine the power consumed by the rotor resistance. | 5 | 4 | 4 | 1,2,3 |
| 15. | a) | Illustrate the operational principles of a BLDC motor through a clear diagram and an explanation. | 4 | 1 | 5 | 1,2 |
| | b) | Explain the operation of a variable reluctance motor using a clear diagram and a detailed explanation. | 4 | 2 | 5 | 1,2 |
| 16. | a) | Explain the closed-loop torque control of electric drives with a neat block diagram. | 4 | 2 | 1 | 1,2 |
| | b) | Derive the expressions for minimum and maximum armature currents of a chopper fed separately excited DC motor under continuous conduction mode. | 4 | 3 | 2 | 1,2 |
| 17. | | Answer any *two* of the following: | | | | |
| | a) | Provide a diagram and explanation for the control of a separately excited DC motor using a single-phase fully controlled rectifier. | 4 | 2 | 3 | 1,2 |
| | b) | Conduct a comparative analysis between the static Kramer drive and the Scherbius drive. | 4 | 1 | 4 | 1,2 |
| | c) | Draw a schematic of the split rail converter circuit and explain its operation for a switched reluctance motor. | 4 | 1 | 5 | 1,2 |

M : Marks;   L: Bloom's Taxonomy Level;   CO; Course Outcome;   PO: Programme Outcome

| | | |
|---|---|---|
| i) | Blooms Taxonomy Level – 1 | 20% |
| ii) | Blooms Taxonomy Level – 2 | 40% |
| iii) | Blooms Taxonomy Level – 3 & 4 | 40% |

*****