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**PRESIDENCY UNIVERSITY**

**Bengaluru**

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| **End - Term Examinations – MAY 2025** |
| **Date:** 22-05-2025 **Time:** 09:30 am – 12:30 pm |

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| **School:** SOE | **Program:** B.Tech - EEE | |
| **Course Code:** EEE3001 | **Course Name:** Electrical Drives | |
| **Semester**: VI | **Max Marks**: 100 | **Weightage**: 50% |

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| **CO - Levels** | **CO1** | **CO2** | **CO3** | **CO4** | **CO5** |
| **Marks** | **26** | **24** | **26** | **24** | **-** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

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| **Answer ALL the Questions. Each question carries 2marks. 10Q x 2M=20M** | | | | |
| **1.** | The main philosophy in Electrical Drives is the motor speed torque (T) characteristics are controlled/shaped by the power converter according to the requirement of the industrial load torque (Tl) characteristics. What would be the equilibrium condition of the drive systems? | **2 Marks** | **L1** | **CO1** |
| **2.** | In a car wash application, an induction motor is used as a compressor to increase the pressure of the water. Identify the quadrant of operation in speed torque plane? | **2 Marks** | **L1** | **CO1** |
| **3.** | An electric vehicle takes 60 sec to reach the steady state speed of 50 kmph. What would be the value of dynamic torque at steady state condition. | **2 Marks** | **L1** | **CO1** |
| **4.** | A 220V, 10.5A, 1300rpm separately excited DC motor is used for a wood cutting application, A DC shunt motor is controlled by a single-phase controlled rectifier. It is required to obtain the maximum output voltage from the converter. What is the value of the firing angle of the rectifier? | **2 Marks** | **L1** | **CO2** |
| **5.** | A 180V, 8A, 1500rpm separately excited DC motor is used for a metal cutting application. The DC shunt motor is controlled by a single-phase fully controlled rectifier. What is value of Maximum voltage of the converter to control the motor? | **2 Marks** | **L1** | **CO2** |
| **6.** | What is the principle of stator voltage control in induction motors and how does it affect motor torque? | **2 Marks** | **L1** | **CO3** |
| **7.** | Mention the speed control methods of Induction motors | **2 Marks** | **L1** | **CO3** |
| **8.** | Induction motor is controlled by static rotor resistance control method, if the rotor resistance referred to stator side is 2Ω/phase and 1.5Ω resistance is connected across the transistor, what would the value of external resistance added in to rotor circuit, if the duty cycle is “1”. | **2 Marks** | **L1** | **CO3** |
| **9.** | 8 MW, 3-phase, 6600V, 6-pole, 50Hz , UPF, star connected synchronous motor is controlled by a line commutated inverter. What is the value of the output power delivered by the motor when operating as half rated torque? | **2 Marks** | **L1** | **CO4** |
| **10.** | An induced draft fan is controlled by a 3-phase 5kW, 440V, 0.8 PF lag, star connected synchronous motor has stator winding resistance of 0.2ohms/phase, synchronous reactance of 8 ohms/phase and filed current of 1A. It is required to operate in braking mode at maximum torque condition, what would be the value of the torque angle of the motor? | **2 Marks** | **L1** | **CO4** |

**Part B**

**Answer the Questions. Total Marks 80M**

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| 11. | a. | An Induction motor in paper mill drives four loads. Two have rotational motion and two translational motion. The moment of inertia of motor is 3 kg-m2. Motor runs at a speed of 1500rpm. The following are the details present in Table 1. Compute Equivalent moment of Inertia of the motor drive system.  Table.1   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Load** | **Type of Motion** | **Speed** | **Inertia/Mass** | **Torque/**  **Force** | | I | Rotational | 300rpm | 8kg-m2 | 10 N-m | | II | Rotational | 200rpm | 5kg-m2 | 6 N-m | | III | Translational | 5m/sec | 10kg | 20N | | IV | Translational | 10m/sec | 20kg | 30N | | 20 Marks | L3 | CO1 |
| Or | | | | | |
| 12. | **a.** | An electrical motor is used as a traction motor for electric vehicle application and has following parameters J=10 kg-m2, T=100-0.1N, N-m, and the passive load torque Tl= 0.05N, N-m where N is in rpm. At the time of braking the motor characteristic is changed to T=-100-0.1N, N-m.   1. Compute the new equilibrium speed? 2. If the motor torque is changes its polarity, compute the new equilibrium speed 3. If the Moment of Inertia is changed to 15 kg-m2, Comment on the equilibrium speeds. | **20 Marks** | **L3** | **CO1** |

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| 13. | a. | ABB make Model M3BP250MLB3, 440V, 25A, 2000 rpm DC shunt motor is used in a heavy-duty material handling crane. While lifting and lowering loads, it is required to rotate at a speed of 800 rpm in both directions at rated torque. The available power converters in the workshop are a three-phase fully controlled rectifier and a three-phase semi-converter, both fed with a 3-phase 400V, 50Hz supply.  i. Choose the suitable converter for the application and justify it. ii. Compute the firing angle required to control the motor at 1000 rpm at rated torque. iii. Compute the firing angle required to control the motor at -1000 rpm at rated torque. | 20 Marks | L3 | CO2 |
| Or | | | | | |
| 14. | **a.** | Describe the performance equations of dc shunt motor and identify the control parameters to vary the speed and torque of a dc shunt motor. | **10 Marks** | **L2** | **CO2** |
|  | **b.** | Explain the working of a three-phase fully controlled rectifier-fed DC motor with the help of a neat circuit diagram and relevant waveforms. Comment on the effect of firing angle on the motor's speed and performance | **10 Marks** | **L2** | **CO2** |

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| 15. | a. | A MENZEL make MEBKSD500-10, three-phase squirrel cage motor used as a pump drive for cooling water pump in fertilizer factory as shown in Fig. 4. The specifications of the motor are 1370kW, 6.6kV, 50Hz, 550 rpm and 10 poles. The parameters referred to stator side are Rs=2Ω, Rr’=5Ω, Xs=Xr’=5Ω, Xm=80Ω. When driving the pump it runs at rated speed at rated voltage.  a) As an engineer suggest the suitable method to control the motor and justify it?  b) Chose the stator connection of your choice and compute the value load torque at a speed of 450rpm. | 20 Marks | L3 | CO3 |
| Or | | | | | |
| 16. | **a.** | A **Kirloskar Electric** make **3-phase, 415 V**, 8-pole, 50 Hz, **delta-connected slip-ring induction motor** is used to drive an **industrial blower**. The rotor resistance is **0.3 Ω** and the rotor leakage reactance is **0.9 Ω per phase**, both referred to the stator side.   * At full load, the motor operates at a **slip of 5%**. * It is desired to **reduce the speed to 675 rpm** for energy-saving mode under partial load conditions. * The **stator-to-rotor turns ratio** is **2.5**. * Neglect the **stator impedance** and the **magnetizing branch** for simplification.  1. **What value of external resistance per phase must be inserted in the rotor circuit** to achieve the desired speed of **675 rpm** under the given conditions? 2. Compute the torque of the motor for the above condition. | **20 Marks** | **L3** | **CO3** |

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| 17. | a. | A 500 kW, 3-phase, 3.3 kV, 50 Hz, 0.85(lagging) power factor, 4 pole, star connected synchronous motor which is used as a blower in paper mills is as shown in Fig. 5. The motor is having the following parameters: Xs=15Ω, Rs=0Ω. The rated field current is 10A. For drying the material, it is required to blow out the hot air at maximum pullout torque. It is observed that the motor is running at synchronous speed and operating voltage and excitation are at the rated values but the motor is not giving its positive pullout torque.   1. Identify the problem in the motor operation to exhibit the maximum pullout torque. 2. Compute the current drawn by the motor at half rated torque and field current, UPF. 3. Compute the power factor at field current of 15A and rated output. | 20 Marks | L3 | CO4 |
| Or | | | | | |
| 18. | **a.** | In present day cement industries, variable frequency drives are used in various sections such as  (i) Raw mill and cement mill drives  (ii) Kiln drive  (iii) Crusher drives  (iv) Waste gas fan drive  (v) Compressor drives etc.  a) Identify the suitable electric motors at different sections in the process of manufacturing cement.  b) Slip power recovery scheme is the efficient one to send the power back to the source instead of wasting in rotor resistances. Identify the section where slip power recovery scheme can be implemented.  c) Comment on the electric motors used in primary crusher and suction fan. | **20 Marks** | **L2** | **CO4** |