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PRESIDENCY UNIVERSITY BENGALURU

SCHOOL OF ENGINEERING

MAKE UP EXAMINATION – JULY 2024

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| **Semester : VI** | **Date : 4-07-2024** |
| **Course Code : EEE3001** | **Time : 1:30PM – 4:30PM** |
| **Course Name : Electrical Drives** | **Max Marks : 100** |
| **Program :EEE** | **Weightage : 50%** |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Question paper consists of 3 parts.*
3. *Scientific and non-programmable calculator are permitted.*
4. *Do not write any information on the question paper other than Roll Number.*

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| **PART A** | | | |
| **ANSWER ANY 4 QUESTIONS 4Q X 5M=20M** | | | |
| 1 | In a cement factory, industrial robots have been used in packing application. The fundamental torque equation for the above application is \_\_\_\_\_\_\_\_\_\_ | (CO 1) | [Knowledge] |
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| 2 | In a cement industry, a three phase, 2.9MW, 4pole, 1000 rpm slip ring induction motor is used as a suction fan. It is required to control the motor at below rated speed and employed with slip power recovery scheme. The name of the drive employed for this application is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | (CO 4) | [Knowledge] |
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| 3 | 1. In a car wash application, an induction motor is used as a compressor to increase the pressure of the water. The quadrant of operation in speed-torque plane is \_\_\_\_\_\_\_\_\_\_\_ | (CO 1) | [Knowledge] |
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| 4 | 1. 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 then the torque angle of the motor is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | (CO 4) | [Knowledge] |
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| 5 | Usually to control and stop the dc motors, dynamic braking, plugging and regenerative braking methods are used. The braking method which is not applicable to dc series motor is \_\_\_\_\_\_\_ | (CO 3) | [Knowledge] |
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| 6 | 1. In a steel rolling mills, a DC shunt motor is controlled by a three phase controlled rectifier and it is required to rotate the spindle which is connected to a shaft of motor in anti-clock wise direction with the positive torque. The suitable power converter for the application is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | (CO 2) | [Knowledge] |
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| **PART B** | | | |
| **ANSWER ANY 5 QUESTIONS 5Q X 10M=50M** | | | |
| 7 | 1. The MITSUBISHI ELECTRIC Company uses Permanent magnet motor drive for Elevator applications. Two motors are shown in Fig. 1. The shaft of the motor is connected to the elevator which is capable enough to lift the weight of 1000kg at uniform speed of 1.5m/s. Coupling between the load and the motor has an efficiency of 85%. Assume the motor inertias in the range of 0.15 to 0.3 kg-m2 and the elevator has to run at an angular velocity of 148.7 rad/sec. 2. https://www.mitsubishielectric.com/elevator/modernization/images/pm_motor.jpgresponse in acceleration and deceleration, suggest the value of moment of inertia?(3M) 3. Chose the different values of moment of inertia of your interest within the range and compute the equivalent torque seen by the motor? (4M) 4. Comment on the equivalent torque seen by the motor for the above results. (3M) | (CO 1) | [Knowledge] |
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| 8 | A Baldor make CDP 3440 model, 90V, 7.6 A, 1750rpm DC shunt motor is used in lathe machine applications and shown in Fig 2(a) & 2(b). While shaping the job piece, It is required to rotate at a speed of 750 rpm in both directions at half rated torque. The available power converters in the workshop are single phase semi converter and single phase fully controlled rectifier, both are fed with 1-phase 230V, 50Hz supply.(Assume armature resistance as 0.05ohms)  http://www.micro-machine-shop.com/9x20_lathe_variable_speed_DC_motor_a.jpg  **Fig. 2(a) DC shunt motor in lathe machine application**  http://www.micro-machine-shop.com/Baldor_CDP3440_DC_motor_1.jpg  **Fig. 2(b) Dc shunt motor in closer view**  Identify the suitable power converter for the job(4M)  Suggest the value of firing angle to rotate the spindle at 750 rpm(3M)  Comment on the variation of firing angle, if operating torque increases.(3M) | (C0 2) | [Knowledge] |
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| 9 | Bharath Electrical make, three phase 440V, 50Hz,1250 HP,6 pole, 720 rpm Slip ring Induction motor is used in cement industry for suction fan to separate the cement powder which is having less than 32 microns as shown in Fig.3. The parameters referred to the are Rs=0.1ohms, .  The stator to rotor turns ratio is 2. The dc link inductor has a resistance of 0.01Ω. The motor is controlled by Static kramer drive and designed for slip power  recovery for a speed range of 25% below speed. In order to control the speed of the drive with respect to bed thickness in crusher section, it is observed that drive could not pump the **power back to the source** even though the rectifier section and transformer are in perfect operating condition.   1. Identify the problem in inverter section(range of firing angle) (3M) 2. Assume the necessary data and obtain the transformer turns ratio. (3M) 3. Torque for a speed of 600 rpm and firing angle of 140 degrees(4M)   Selection of AC induction motors for cement plant applications - EE  Publishers  **Fig.3:Three phase induction motor drive in cement Industry** | (CO 3) | [Knowledge] |
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| 10 | 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.   * 1. As an engineer suggest the suitable method to control the motor and justify it?(4M)   2. Chose the stator connection of your choice and compute the value load torque at a speed of 450rpm.(6M)   https://www.menzel-motors.com/fileadmin/_processed_/e/f/csm_6600V_squierrel_cage_motor_MEBKSD500_2_63054ff98a.jpg  **Fig. 4: MENZEL make Three phase inductor motor for water pumping application in fertilizer plant.** | (CO 3) | [Knowledge] |
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| 11 | 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=15 Ω,Rs=0 Ω. 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. (4M) 2. Compute the current drawn by the motor at half rated torque and field current, UPF. (6M)   Types of Fans: A Look at the Industrial Blower Fan  **Fig. 5: Blower driven by Synchronous motor drive in paper mill application** | (CO 4) | [Knowledge] |
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| 12 | 1. HITAHI make(CLW) traction motor of TYPE HS15250A used to haul passenger train for Indian railways as shown in Fig.6. The specifications of the traction motor are 750V DC, 900A, 895rpm, 630kW and Armature resistance is 0.05 ohms. Assume a step down chopper with an input voltage of 800V DC is used to control the speed of the motor. 2. It is observed that due to some technical problem the controlling switch lasts the control action. What would be the speed of the motor? (4M) 3. The duty ratio of the chopper at full rated torque at 450rpm.(6M)   Welcome to CLW Official Website !  **Fig.6. Traction motor in WAP4 model (Indian Railways)** | (CO 3) | [Knowledge] |
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| 13 | A Y connected squirrel cage induction motor has following parameters 400V, 50Hz, 4pole, 1370rpm Rs=2ohms, Motor speed is controlled by VVVF control. Compute the motor breakdown torque for a frequency of 60Hz . | (CO 3) | [Knowledge] |
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| **PART C** | | | |
| **ANSWER ANY 2 QUESTIONS 2Q X 15M=30M** | | | |
| 14 | 1. A 30A, 470V and 875rpm Crompton DC shunt motor is used in sheet roll forming operation as shown in Fig.7(a)&(b). This motor is controlled by three phase fully controlled converter. The value of armature winding resistance is 1Ω and inductance is 1mH. The supply specifications are 3-ϕ, 440V, 50 Hz supply.   Assume the required data and compute the ideal no load speed of drive in continuous mode. (4M)  Suggest the firing angle of the converter to run the motor at the rated speed.  At the time of rolling operation, it is required to operate at full rated torque and to rotate the spindle at 600rpm, compute the firing angle of the converter. (6M)  Suggest the firing angle of the converter(5M)  Roll Forming Machine - Sheet Roll Forming Machine Manufacturer from  Ghaziabad  **Fig.7(a). Sheet roll forming process**  **Fig. 7(b). Closer view of Crompton make DC motor**  Crompton DC Motor for Steel Rolling and Wire Rod Mills, Voltage: 201-500 V,  | ID: 4750658588 | (CO 2) | [Knowledge] |
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| 15 | 1. HITAHI make(CLW) dc series motor is used as a traction motor in WAP4 engine in Indian railways as shown in Fig.8. The specifications of the traction motor are 750V DC, 900A, 750V DC, 900A, 895rpm, 630kW. Armature and field windings are 0.005 ohms each. Assume linear magnetic circuit. 2. Identify the suitable Electrical braking method. (4M) 3. Compute the value of braking resistor to be inserted in order to operate the motor under dynamic braking at twice the rated torque and 800rpm. (6M) 4. Comment on the value of braking resistance, if it is braked at rated toque and 800rpm. (5M)   Itarsi WAP-4 22914.jpg  Welcome to CLW Official Website !  **Fig.8(b) Hitachi make DC series motor in WAP4 Engine** | (CO 2) | [Knowledge] |
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| 16 | 1. In a chemical industry, three phase star connected squirrel cage induction motor is used to pump the chemical liquid as shown in Fig. 9. The specifications of the motor are 400V, 50Hz, 4pole, 1370rpm, Rs=2ohms, Motor speed is controlled by variable voltage variable frequency(VVVF) control. 2. Comment on the torque and power of the motor, if it is controlled in above base frequency(4M) 3. Assume the drive operating at constant V/f ratio up to 50 Hz and with constant terminal voltage at above 50 Hz. What would be the motor breakdown torque for a frequency of 60Hz as a ratio of its value at 50Hz ? (6M) 4. Compute the pull-out torque of the drive at 70Hz? (5M)   Image 1. Using VFDs to operate pumps and blowers at lower speeds decreases energy consumption significantly, extends motor life and reduces required maintenance. All graphics courtesy of AutomationDirect  **Fig.9. Variable frequency Drive fed with Induction motor for pumping the liquid** | (CO 4) | [Knowledge] |
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