PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING
END TERM EXAMINATION - JUN 2023

Semester : Semester VI - 2020
Course Code : EEE3001
Course Name : Sem VI - EEE3001 - Electrical Drives
Program : EEE

Date : 21-JUN-2023
Time : 9.30AM - 12.30PM
Max Marks : 100
Weightage : 50%

Instructions:
(i) Read all questions carefully and answer accordingly.
(ii) Question paper consists of 3 parts.
(iii) Scientific and non-programmable calculator are permitted.
(iv) Do not write any information on the question paper other than Roll Number.

PART A

ANSWER ALL THE QUESTIONS   **(10 X 3 = 30M)**

1. An induction motor is driving the conveyor belt in coal mines. Assume it is controlled by VVVF control method. It is required to control the belt at higher speeds which is greater than the base speed. Suggest the V/f ratio.

    (CO3) [Knowledge]

2. A 220V, 50A separately excited dc motor which is used in textile mill industry for rolling application and is operating at rated toque condition. Compute the value of rated armature current by taking suitable data?

    (CO2) [Knowledge]

3. A220V, 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. Compute the minimum firing angle of the converter?

    (CO2) [Knowledge]

4. A hoist is installed in an apartment is an example of electrical drive. In order to understand the conventions of motor torque, load torque and speed, as an engineer comment on the condition of weights of loaded cage, empty cage and counter weight while designing a drive system.

    (CO1) [Knowledge]

5. In a paper mill, the rate of change of moment of inertial seen by the motor during the load conditions is constant. What would be the fundamental torque equation of the drive?

    (CO1) [Knowledge]

6. In a cement industry, a primary crusher is used to crush the lime stone in to 100mm pieces.   Identify and comment on the suitable motor for the application.

(CO4) [Knowledge]

7. List out the applications of induction motor in modern Industries ?

(CO3) [Knowledge]

8. A 3-phase, 50 Hz, 4 pole induction motor runs at a speed of 1400 rpm is used as a crusher in cement mills. Compute the slip of the motor and comment on the value of slip at standstill condition.

(CO3) [Knowledge]

9. The textile mill has various processes like ginning. Spinning and looms. The ginning means the separation of seeds from cotton. The process requires standard starting torque and standard overload capacity, at constant speed. No speed control is required. The total operation is taken place at constant speed. Suggest the suitable motor for the application.

(CO4) [Knowledge]

10. 8 MW, 3-phase, 6600V, 6-pole, 50Hz , UPF, star connected synchronous motor is controlled by a line commutated inverter. Compute the the value of output power delivered by the motor when operating at half rated torque ?

(CO4) [Knowledge]

PART B

ANSWER ALL THE QUESTIONS   **(3 X 10 = 30M)**

11. A 3-phase, 400 V, 6-pole, 50 Hz, delta-connected, slip-ring induction motor has rotor resistance of 0.2 Ω and leakage reactance of 1 Ω per phase referred to stator.   Neglect stator impedance and magnetizing branch. Stator to rotor turns ratio is 2.2. The motor is used as a suction fan in cement industry and employed static Krammer Drive (Slip Power Recovery) to pump power back to the source instead of wasting in rotor resistances. While operation, due to the techical problem in fring circuit, the power can not be pumped back to the source. As an engineer, Identify the problem and compute the rated torque of the motor.

(CO3) [Comprehension]

12. The MITSUBISHI ELECTRIC Company uses Permanent magnet motor drive for Elevator applications. Two motors are shown in Fig. . 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.

For low- to middle-speed elevators

For high-speed elevators
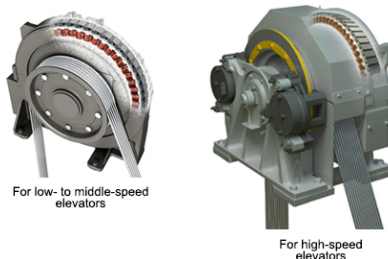
Fig. Mitsubishi Electric make PMSM traction motor for elevator applications

- If it is required to operate the elevator with good dynamic response in acceleration and deceleration, suggest the value of moment of inertia?   (3M)
- Chose the different values of moment of inertia of your interest within the range and compute the equivalent torque seen by the motor?   (4M)
- omment on the equivalent torque seen by the motor for the above results.   (3M)

(CO1) [Comprehension]

13. A Baldor make CDP 3440 model, 90V, 7.6 A, 1750rpm DC shunt motor is used in lathe machine applications . 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)

- Suggest the suitable power converter and value of firing angle to rotate the spindle at 750 rpm(6M)
- Comment on the variation of firing angle, if operating torque increases.(4M)

(CO2) [Comprehension]

PART C

ANSWER ALL THE QUESTIONS   (2 X 20 = 40M)

14. 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. . The specifications of the motor are 1370kW, 6.6kV, 50Hz, 550 rpm and 10 poles. The parameters referred to stator side are $R_s=2\Omega$, $R_r'=5\Omega$, $X_s=X_r'=5\Omega$, $X_m=80\Omega$. When driving the pump it runs at rated speed at rated voltage.

- As an engineer suggest the suitable method to control the motor and justify it?   (4M)
- Chose the stator connection as DELTA and compute the value load torque and source current at a speed of 1200 rpm.   (16M)

Fig.: MENZEL make Three phase inductor motor for water pumping application in fertilizer plant.

(CO3) [Application]

15. In present day cement industries, variable frequency drives are used in various sections such as
a. Raw mill and cement mill drives
b. Kiln drive
c. Crusher drives
d. Waste gas fan drive
e. Compressor drives etc.

- Identify the suitable electric motors at different sections in the process of manufacturing cement. (10M)
- 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. (6M)
- Comment on the electric motors used in primary crusher and suction fan (4M)

(CO4) [Application]