EE706

M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)
BANGALORE – 560 054

SEMESTER END EXAMINATIONS – JANUARY 2016

Course & Branch : **B.E.- Electrical & Electronics Engg.**   Semester : **VII**
Subject   : **Electric Drives**   Max. Marks : 100
Subject Code   : **EE706**   Duration : 3 Hrs

Instructions to the Candidates:
- Answer one full question from each unit.
- Missing data, if any, may be suitably assumed.
- Answer all questions at one place

UNIT – I

1. a) Discuss about the structure of an electric drive system with suitable diagram.   CO1 (08)

    b) A motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with gear ratio of 0.1 and efficiency of 90%. The load has a moment of inertia of 10kg-m2 and torque of 10N-m. Other load has translational motion and consists of 1000kg weight to be lifted up at an uniform speed of 1.5m/s. Coupling between this load and the motor has an efficiency of 85%. Motor has an inertia of 0.2kg-m2 and runs at a constant speed of 1420 rpm. Determine the equivalent inertia referred to the motor shaft and equivalent torque developed by the motor.   CO1 (06)

    c) Draw the speed-torque characteristics of the following loads: CO1 (06)
       (i) Traction loads
       (ii) Constant power loads
       (iii) Air compressor type loads

2   a) Using four quadrant diagrams, analyze the multiquadrant operation of an elevator drive system. State the speed-torque conventions used and assumptions made.   CO2 (10)

    b) Discuss about the different components of load torques. Also draw the speed-torque characteristics of each component.   CO1 (08)

    c) List out some of the factors that can be used for classifying drive systems.   CO1 (02)

UNIT – II

3. a) Discuss about dynamic braking of dc motors in detail.   CO2 (07)

    b) A 220V, 1500rpm, 11.6A, separately excited motor is controlled by a 1-phase fully controlled rectifier with an ac source voltage of 230V, 50Hz. The rectifier operates in continuous current conduction mode. The armature resistance is 2Ω.   CO2 (06)
       (i) What should be the value of the firing angle to get the rated torque at 1000 rpm?

   (ii) Find the firing angle for the rated braking torque at speed 1500rpm.
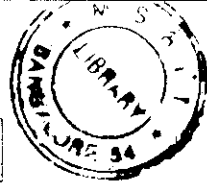
c) Which kind of chopper would you suggest to operate a dc motor in forward motoring and forward braking quadrant? Justify your suggestion. CO3 (07)

4. a) Derive a relation for relating speed and torque of a separately excited dc motor and plot the characteristics. CO2 (07)

b) A 230V, 500rpm, 100A, separately excited dc motor has an armature resistance of 0.1Ω. The motor is driving, under rated conditions, a load whose torque is constant and independent of speed. The speeds below the rated speed are obtained with armature voltage control and the speeds above the rated speed are obtained by field control. CO2 (08)

(i) Calculate the motor terminal voltage when the sped is 400rpm.

(ii) By what amount should the flux be reduced to get a motor speed of 800 rpm?

c) Briefly explain the operation of a half-controlled rectifier fed dc motor. CO2 (05)

UNIT – III

5. a) With regard to induction motors, explain the dc dynamic braking method. CO2 (07)

b) V/f method of induction motor speed control is better than stator voltage control and stator frequency control method.
Mention whether the above statement is TRUE or FALSE. Explain elaborately why you think so. CO2 (07)

c) A 400V, star connected, 3-phase, 6-pole, 50Hz induction motor has the following parameters referred to the stator: Rs=Rr'=1 ohm, Xs=Xr'=2 ohm. For regenerative braking operation of this motor determine the maximum overhauling torque it can hold and range of speed for safe operation. CO2 (06)

6. a) With a neat diagram, explain the operation of star-delta starter used for starting three phase induction motor. CO2 (07)

b) A 2200V, 2600kW, 735rpm, 50Hz, 8-pole, 3-phase squirrel cage induction motor has the following parameters referred to the stator: Rs=0.075Ω, Rr'=0.1Ω, Xs=0.45Ω, Xr'=0.55Ω. Stator winding in delta connected and consists of two sections connected in parallel. Calculate starting torque and maximum torque as a ratio of rated torque, if the motor is started by star-delta switching. What is the maximum value of line current during starting? CO2 (07)

c) Discuss about the operation of cycloconverter fed induction motors. CO2 (06)

UNIT – IV

7. a) Draw the circuit diagram of a voltage source inverter fed BLDC motor drive and explain its operation. CO3 (07)

b) What is meant by pulsed mode operation in synchronous motors? Explain. CO2 (05)

c) Write short notes on the different types of synchronous motors. CO2 (05)

d) Mention some of the advantages of BLDC motors over induction motors. CO2 (03)

8. a) Describe the construction of a BLDC motor with a neat diagram. CO3 (07)

b) Derive an expression for the torque produced by a cylindrical rotor wound field motor and draw the speed-torque characteristics. CO3 (07)

c) Briefly discuss about the pull-in process of synchronous motors. CO3 (04)

d) What is meant by Hall effect? CO2 (02)

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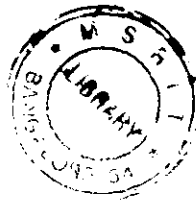
UNIT – V

9. a) A four-phase, 4/2 pole variable reluctance stepper motor need to be operated continuously so that it has a step angle of 45°. What kind of stepping operation will you suggest for this requirement? Explain your answer with excitation table.   CO3 (06)

   b) Define 'ramping' and 'slew range'.   CO3 (04)

   c) A motor operates on a periodic duty cycle in which it is clutched to its load for 20minutes and declutched to run on no-load for 10minutes. Maximum temperature rise is 60°C. Heating and cooling time constants are 50 and 70 minutes respectively. When load is declutched continuously the temperature rise is 10°C. Determine,   CO3 (06)
      (i) Maximum temperature during the duty cycle
      (ii) Temperature when the load is clutched continuously

   d) Mention some of the important features of stepper motors.   CO3 (04)

10. a) Draw the circuit diagram of an efficient unipolar drive used for stepper motors and explain its operation.   CO3 (06)

   b) An electric drive has the following specifications.   CO4 (08)
      (i) The system should be capable of being operated on a 3-phase, 440 VAC, 50 Hz supply

      (ii) The drive need to have variable speed operation with speeds varying from 50 % to 100 % of the rated speed

      (iii) The modulation strategy should be as simple as possible

      (iv) After the user has SET the speed, the motor should run at the same speed regardless of load variations

      Select appropriate motor, power electronic converter, control strategy to be used for this application. Also draw the abstract block diagram of the system layout you would suggest for this application.

   c) Explain the half-step operation of a stepper motor with suitable aid.   CO3 (06)

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