Reg. No. : | | | | | | | | | | | | |

Question Paper Code : X10384

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020
Seventh Semester
Electrical and Electronics Engineering
EE8009 – CONTROL OF ELECTRICAL DRIVES
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. List the advantage of closed loop control of electric drives.
2. Show the variation of power during the variable torque operation of DC drive.
3. Name the features of current source inverter fed induction motor drive.
4. Compare variable frequency drive with (v/f) drive.
5. List the factors affecting the torque angle of synchronous motor.
6. How the power factor of synchronous motor drive is controlled ?
7. What do you mean by reluctance principle ?
8. Why it is called sinusoidal BLDC motor ?
9. Write the significance of phase locked loop.
10. Name the feedback elements used in the electric drive.

PART – B **(5×13=65 Marks)**

11. a) i) Develop a block diagram and transfer function for DC motor. **(8)**

    ii) Step by step, design a speed controller for DC motor drive. **(5)**

    (OR)

    b) i) Explain the combined field and armature control method suitable for DC motor. From this, also explain the constant torque and power operation. **(8)**

    ii) Write a note on the PI controllers and also list its features. **(5)**

12. a) i) With neat control circuit, explain the working of (v/f) based induction motor drive. **(8)**

ii) Explain the working of closed loop variable frequency drive with dynamic braking. **(5)**

(OR)

b) i) Write and explain the concept of vector control. **(8)**

ii) Elucidate the operation of modified Kramer drive. **(5)**

13. a) i) What is self control of synchronous motor and how the synchronous motor is controlled using this technique ? **(8)**

ii) Write a technical note on the brushless excitation in synchronous motor drive. **(5)**

(OR)

b) i) List and explain the methods to control the torque of synchronous motor. **(8)**

ii) Why the closed loop control is used for synchronous motor drive ? Explain. **(5)**

14. a) i) Show the variation of inductance of coil per phase during the operation of Switched Reluctance Motor with neat waveforms. **(8)**

ii) What is the step angle of a three phase switched Reluctance Motor having 12 stator poles and 8 rotor poles ? What is the commutation frequency in each phase at a speed of 6000 rpm ? **(5)**

(OR)

b) i) With neat circuit diagram, explain the three phase Unipolar driven Permanent Magnet Brushless DC Motor. **(8)**

ii) A PMBLDC motor has torque constant of 0.12 Nm/A referred to the DC supply. (i) Estimate it's no load speed in rpm when connected to a 48 V DC supply. (ii) If the armature resistance is 0.15 Ohm per phase and the total voltage drop in the controller transistors is 2 V, determine the starting current and the starting torque. **(5)**

15. a) With necessary control circuit arrangement, explain any one microcontroller based DC drive. Also draw the relevant flow for the control technique. **(13)**

(OR)

b) Write a technical note on the following :

i) Speed detecting element **(8)**

ii) Current sensing circuit. **(5)**

PART – C **(1×15=15 Marks)**

16. a) A 460 V, 60 bHz, 6 pole, 1180 rpm star connected squirrel-cage induction motor has the following parameters peer phase referred to the stator R_s = 0.19 Ω, R_r' = 0.07 Ω, X_s = 0.07 Ω, X_r' = 0.67 Ω and X_m = 20 Ω. **(15)**

The motor is fed by 6-step inverter, which in turn is fed by a 6-pulse fully controlled rectifier.

1) If the Rectifier is fed by an ac source 460 V and 60 Hz, what should the rectifier firing angle be to get the rated fundamental voltage across the motor ?
2) Calculate the percent increase in copper loss of the machine at 60 Hz compared to the value when fed by a sinusoidal supply neglect skin effect.
3) If the machine is operated at a constant flux.
   a) Calculate the inverter frequency at 600 rpm and rated torque.
   b) Calculate the inverter frequency at 500 rpm and half the rated torque, also calculate the motor current.

Neglect the de-rating due to harmonics and use approximate equivalent circuit with referred to stator.

(OR)

b) A 500 kW, three phase, 3.3 kV, 50 Hz, 0.8 (lagging) power factor, 4 pole, star connected synchronous motor has following parameters, R_s = 0 (zero) Ω, X_s = 15 Ω Rated field current is 10 A. Calculate (i) Armature current and power factor at half the rated torque and rated field current. (ii) Field current to get unity power factor at the rated torque, (iii) Torque for unity power factor operation at field current of 12.5 A. **(15)**

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