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Total Number of Pages: 02

M.Tech
Pepc103

1st Semester Back Examination 2017-18

Electric Drives - I

BRANCH: POWER ELECTRO,

POWER ELECTRO & DRIVES, POWER ELECTRO AND ELECTRICAL DRIVES

Time: 3 Hours

Max Marks: 70

Q.CODE: B740

Answer Question No.1 which is compulsory and any five from the rest.

The figures in the right hand margin indicate marks.

- Q1** Answer the following questions: (2 x 10)
- a) Why thermal modeling is required for motor-drive systems ? What are the important components of a modern drive systems?
 - b) How the switching frequency of power converter and the motor inductance are chosen for selecting the drive components in modern drives.
 - c) What are the types of electrical braking? Draw the torque-speed characteristics for each of them for separately excited dc motor.
 - d) Give the comparison between the field controlled and armature controlled of a DC motor used in drive purposes.
 - e) Why fan type of load operates at wide speed range compared to constant load for stator voltage control of induction motor?
 - f) Why V/f ratio is maintained constant during stator frequency control for speed control of induction motor.
 - g) What Why boosting of voltage is required at low frequency of induction motor ?
 - h) What are the different causes for discontinuous of armature current in DC motor and how it can be avoided ?
 - i) Why is the duty cycle usually changed by varying the on-time rather than the chopping frequency?
 - j) The phase controlled converter is a harmonic generator. Justify the comment.
- Q2** a) What do you mean by steady-state stability of a motor-load system ? Derive the necessary condition for the steady-state stability. (5)
- b) What are the different types of electrical braking ? Explain in details each of the electrical braking with torque – speed characteristics. (5)
- Q3** a) The field and the armature of a dc motor are being controlled by single phase fully controlled converter and the field current is set to its maximum value. Single phase AC supply of 440V, 60 Hz is given to both armature and field where $R_a = 0.25\Omega$, $R_f = 175\Omega$. The motor voltage constant is $K_v = 1.4V / \text{Arad} / \text{sec}$. The armature current corresponding to load demand is $I_a = 45\text{Amp}$. The Viscous friction and no-load losses are negligible. The motor is continuous mode and ripple free. If delay angle $\alpha_a = 60^\circ$ and $I_a = 45\text{Amp}$, (i) the torque developed by the motor (ii) speed (iii) Input power factor (5)
- b) Derive the transfer function for both Armature voltage control method. What is the significance of electrical time constants and mechanical time constant from the obtained transfer function model.

- Q4** **a)** A 230V, 960 rpm and 200 amp separately excited dc motor has an armature resistance of 0.02 ohm. The motor is fed from a chopper which provides both motoring and braking operations. The source has a voltage of 230V. Assuming continuous conduction (5)
- i) Calculate duty ratio of chopper for motoring operation at rated torque and 350 rpm.
- ii) Calculate duty ratio of chopper for braking operation at rated torque and 350 rpm.
- b)** What do you mean by torque pulsation in three phase induction motor ? How it will be overcome ? (5)
- Q5** **a)** With complete schematic diagram, explain how the slip is being controlled by firing angle of three phase inverter in Kramer's method of arrangement. (5)
- b)** Explain the DC-DC Chopper controlled converter for speed control of DC separately excited motor. Draw the torque-speed characteristics both for continuous mode and discontinuous mode. (5)
- Q6** **a)** The switching frequency of the chopper is 2 kHz. The source voltage is 80V and the duty ratio is 30%. The load resistance is 4 ohm. Assume that the inductance and capacitance are ideal and large enough to sustain the load current and load voltage with little ripple. Calculate (5)
- i) On time and switching period
- ii) Average voltage across the load
- b)** With the help of a diagram show the regions of forward motoring, plugging, and regeneration in the torque-speed plane of an induction motor. (5)
- Q7** **a)** Draw the circuit diagram for speed control of an induction motor without feed back using PWM-VSI technique with its control circuit. (5)
- b)** Why thermal modeling is required for motor-drive systems ? Derive the thermal modeling for heating curve ? (5)
- Q8** **Write short answer on any two:** (5 x 2)
- a)** Short time duty motor operation.
- b)** True synchronous mode of operation
- c)** Load Equalisation
- d)** V/f control of induction motor