d) How the slip-power is recovered using static Scherbius drive and draw the speed torque characteristics.

OR

A 3-phase, 415V, 50 Hz, 1470 rpm, star connected slip ring induction motor has the following per phase parameters referred to stator.

$r_1 = 0.12\Omega$, $r_2 = 0.1\Omega$, $x_1 = x_2 = 0.4\Omega$, $x_m = 10\Omega$.

Per phase turn ratio from rotor to stator =0.8

Speed of this motor is controlled by rotor ON-OFF control. For a speed of 1200 rpm the inductor current is 100A and chopper resistance is 1.8 Ω calculate.

i) The value of chopper duty cycle.

ii) Efficiency for a power output of 25kW and for negligible no-load losses.

iii) The input power factor.

5. a) Write the application and advantages of synchronous motor.

b) Draw the block diagram of closed loop operation of synchronous motor drives.

c) A 3300V, delta connected synchronous motor has a synchronous reactance per phase (delta) of 18 Ω. It operates at a leading power factor of 0.707 when drawing 800 kW from the mains. Calculate its excitation emf.

d) A 3 phase, 230V, 60 Hz, 40 kW, 8 Pole star connected salient pole synchronous motor has X_d=2.5 Ω and X_q=0.4 Ω the armature resistance is negligible. If the motor operates with an input power of 25kW at a leading pf of 0.86. Determine

i) The torque angle

ii) The excitation voltage V_f

iii) The torque T_d

OR

How is the output-voltage of a VSI improved by PWM techniques? Explain how you will use this converter for speed control of a synchronous motor.

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Roll No .....

EX - 702

B.E. VII Semester

Examination, December 2015

Electrical Drives

Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max.50 words) carry 2 marks, part C (Max.100 words) carry 3 marks, part D (Max.400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

1. a) Write the main components of an electric drive.

b) Write the difference and application of semi-converter and full converter.

c) Explain the concept of constant-torque control and constant power control.

d) A 220 V, 1000 rpm, 10A separately excited d.c. motor is fed from a single phase full converter with a.c source voltage of 250V, 50 Hz. Armature circuit resistance is 1 ohm. Armature current is continuous calculate firing angle for:

i) Rated motor torque at 500 rpm

ii) Half the rated motor torque at (–500) rpm.

OR

The speed of a separately excited d.c motor is controlled by means of a 3 phase semi converter from a 3 phase, 415 V, 50 Hz supply. The motor constants are inductance 10 mH, resistance 0.9 ohm and armature constant

1.5V/rad/sec (Nm/A). Calculate the speed of this motor at a torque of 50 N-m. When the converter is fired at 45°. Neglect losses in the converter.

2. a) Explain the operation of dual converter in all four quadrants (in short)
   b) How chopper is used to control the speed of D.C motor.
   c) Draw the block diagram of closed loop operation of a four quadrant dc. drive.
   d) A 220V, 1500 rpm, 50 A separately excited DC motor with armature resistance of 0.5 Ω is fed from a circulating current dual converter with 3 ϕ ac source voltage of 165V (line). Determine converter firing angles for the following operating points.
      i) Motoring operation at rated motor torque and 1000 rpm.
      ii) Braking operation at rated motor torque and 1000 rpm.

OR

A 230V, 1200 rpm, 15A separately excited dc motor has an armature resistance of 1.2 Ω. Motor is operated under dynamic braking with chopper control. Braking resistance has a value of 20Ω.

   i) Calculate duty ratio of chopper for motor speed of 1000 rpm and braking torque equal to 1.5 times rated motor torque.
   ii) What will be the motor speed for duty ratio of 0.5 and motor torque equal to its rated torque?

3. a) Write the methods of speed control of Induction motor which one is applicable to slip ring induction motors.
   b) Explain the operation of four quadrant Ac voltage controllers.

   c) Draw the speed torque characteristics which are obtained by stator voltage variation of 3 phase Induction motor.
   d) A Y connected squirrel cage induction motor has the following ratings and parameters. 400V, 50 Hz, 4 Pole, 1370 rpm $R_s = 2\Omega$, $R_r^1 = 3\Omega$, $X_s = X_r^1 = 3.5\Omega$. Motor is controlled by a voltage source inverter at constant V/f ratio calculated approximate values of the following
      i) Speed for a frequency of 30 Hz and 80% of full load torque.
      ii) Frequency for a speed of 1000 rpm and full load torque.
      iii) Torque for a frequency of 40 Hz and speed of 1100 rpm.

OR

A 440V, 3 ϕ, 50 Hz, 6 Pole, 945 rpm delta connected induction motor has the following parameters referred to stator.

$R_s = 2.0\Omega$, $R_r = 2.0\Omega$, $X_s = 3\Omega$, $X_r = 4\Omega$

When driving a fan load at rated voltage it runs at rated speed. The motor speed is controlled by stator voltage control. Determine the motor terminal voltage, current and torque at 800 rpm.

4. a) What are the advantages and disadvantages of wound rotor IM.
   b) Write short note on Regenerative braking of IM.
   c) A 15 kW, six-Pole 50 Hz, three phase slip-ring induction motor runs at 975 rpm on full load. With a rotor current per phase of 25 A. Allowing 200 W for copper loss in short-circuiting gear and 1.5 kW for friction and windage losses. Calculate the resistance per phase of the three phase rotor winding.