Total Pages—6

2015

PG

(Set-1)

M.Tech-2nd
Machine Drives

Full Marks : 70

Time : 3 hours

Answer any six questions including Q.No.1 which is compulsory

The figures in the right-hand margin indicate marks

1. Answer the following : 2 × 10

   (*a*) Why half wave converter is not used for supply to the field circuit of a d.c motor ?

   (*b*) What is the relationship of V_{dc} and V_{ac} in terms of firing angle for a fully controlled converter ? $V_{dc} = \frac{2V_m}{\pi}\cos\alpha \Rightarrow V_{dc} = V_{dm}\cos\alpha$

   (*c*) State two advantages of current source inverter.

→ Commutation ckt. is simple as it contains only C.
→ do not require feedback diodes
→ O/p current does not depend on the load.
→ are robust & reliable
→ used in high power a.c. motor.

(*d*) What is the range of firing angle of a fully controlled line commutated converter to operate as an inverter ? $90° \leq \alpha \leq 180°$

(*e*) What are the most suitable converters for operation of a d.c. motor in the first quadrant only ?

(*f*) In which mode of operation of a variable speed induction motor drive, the *v*/*f* ratio is kept constant over a wide range of it's frequency variation. Constant torque mode

(*g*) If a 3 phase induction motor is fed from a balanced three phase supply on the rotor side, short circuiting the stator terminals, then what is the speed of the rotating magnetic field ?

(*h*) A 3-phase induction motor is fed by a voltage source inverter of *f* Hz and operates at a slop of 'S' p.u. The interaction of the fundamental air gap mmf with 5th harmonic of rotor mmf will produce how much frequency ? (6 th harmonics of frequency)

(*i*) Why a synchronous motor operated on a force commutated inverter, operated at unity power factor ?

(*j*) What is the advantage of a variable frequency synchronous motor over an induction motor ?

2. (*a*) Discuss on different important considerations in matching power Electronic converter and the motor. 5

(*b*) What are the different components required for a Power Electronics Drive ? Explain with a neat block diagram. 5

3. (*a*) Derive the transfer function of a field controlled DC motor. 5

(*b*) The speed of a 7·5 kW, 220V, 1200 rpm separately excited d.c. motor is controlled by a 1-phase full converter. The rated armature current is 40A. The armature

resistance $r_a = 0{\cdot}2\ \Omega$ and armature inductance $L_a = 10$ mH. The a.c. source voltage is 260 V. The motor voltage constant = 0·18 V/rpm. Assume the motor current is continuous and ripple free. For a firing angle $\alpha = 30^\circ$ and the rated current. Find out the speed, torque and power input to motor. 5

4. (*a*) Distinguish between Half-Controlled and Fully-Controlled converters. Compare their advantages and disadvantages while feeding a separately excited d.c. motor. 5

(*b*) A constant frequency strategy is used to control the speed of a d.c. motor from a 220V supply. The combined armature and field resistance is 0·25 Ω. The average current in the chopper is 30A and the chopper frequency is 200 Hz. Determine the pulse width of the average value of back emf is 100 V. 5

5. (*a*) State the factor favouring induction motor having slip energy recovery scheme for speed control. 5

(*b*) Discuss on field weakening method of operation of synchronous motor. 5

6. (*a*) What are the limitations of square wave inverter over a PWM inverter while feeding a.c. motors ? 5

(*b*) A 3-phase 1460 rpm, 415 V, 50 Hz four pole star connected induction motor has the following parameters : $r_1 = 0{\cdot}6\ \Omega$, $r_2' = 0{\cdot}3\ \Omega$, $x_1 = 0{\cdot}9\ \Omega$, $x_2' = 1{\cdot}4\ \Omega$, $x_m = 25\ \Omega$. The speed of motor is controlled by varying the stator voltage and frequency voltage to frequency ratio at the rated condition is kept constant determine the maximum torque and speed at which it occurs for stator frequencies of 50 Hz and 25 Hz. 5

7. (*a*) Explain the operation of self controlled synchronous motor drive fed from a current source inverter. 5

(*b*) State the limitations of load commutation with reference to the speed control of synchronous motors. 5

8. Write short notes on any *two* : 5 × 2

(*i*) Criteria for selection of drive components

(*ii*) Comparison of converter fed and chopper fed d.c. drives

(*iii*) Soft start of induction motor

(*iv*) Vector control of 3-phase squirrel cage motors.
