Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination [C]
June, 2018

Level : B.E.
Year : IV
Course : EPEG 422
Semester: I
Exam Roll No. :
Time: 30 mins.
F. M. : 10
Registration No. :
Date : JUN 14 2018

SECTION "A"
[20 Q × 0.5=10 marks]

Choose the most appropriate answer.

1. The basic elements of a electric drive system are
   a. Electric motor
   b. Control System
   c. Electric motor and control system
   d. Electrical source and load

2. An electric car is required to operate in
   a. One quadrant only.
   b. Two quadrants.
   c. Three quadrants.
   d. Four quadrants.

3. In a dc motor speed below base speed are obtained by
   a. Armature voltage control.
   b. Armature current control.
   c. Field flux control.
   d. Field voltage control.

4. A single phase half wave converter drive feeding a dc motor armature offers .....drive and limited to .....power level.
   a. One quadrant and 0.5 kW.
   b. Two quadrant and 15 kW.
   c. One quadrant and 15 kW.
   d. Four quadrant and 0.5 kW.

5. For a regenerative braking on a single phase full converter drives the back emf must be reversed and the delay angle of full converter in field circuit should be
   a. Less than 90^0.
   b. Equal to 90^0.
   c. More than 90^0.
   d. Equal to 0^0.

6. For a three phase DC drives, which of the following offers four quadrant operation
   a. Half wave converter drives.
   b. Semi converter drives.
   c. Full converter drives.
   d. Dual converter drives.

7. The firing sequence for a three phase full converter with firing angle $\alpha = 60^0$ is
   a. $60^0, 120^0, 180^0, 240^0, 300^0, 360^0$
   b. $120^0, 180^0, 240^0, 300^0, 360^0, 420^0$
   c. $150^0, 210^0, 270^0, 330^0, 390^0, 450^0$
   d. $210^0, 270^0, 330^0, 390^0, 450^0, 510^0$

8. A dual converter used for the speed control of dc motors, will have two bridges
   a. Two rectifiers
   b. Two inverters
   c. One rectifier and one inverter
   d. Two rectifiers and two inverters

9. A dc series motor is fed from 400V dc source through a chopper. The dc motor has following parameters: r_a=0.04 Ω, r_s=0.06 Ω, k=4 x 10^{-3} Nm/amp^2. The average armature current of 100A is ripple free. For a chopper duty cycle of 50%, the input power to motor is
   a. 10kW.
   b. 20kW.
   c. 30kW.
   d. 40kW.

10. Which of the following system is preferred for chopper drives?
    a. Constant frequency system
    b. Variable frequency system
    c. Constant voltage system
    d. Variable voltage system

11. In an a.c. motor control, the ratio of voltage to frequency is maintained at constant value to
    a. Make maximum use of magnetic circuit.
    b. Make minimum use of magnetic circuit.
    c. Maximize the current from the supply to provide torque.
    d. Minimize the current drawn from the supply to provide torque.

12. A three phase induction motor develops a torque as a function of slip when supplied from a fixed voltage at constant frequency and operates in motoring region of operation for the following value of slip
    a. $0 \leq s \leq 1$.
    b. $s < 0$.
    c. $1 \leq s \leq 2$.
    d. $s > 2$.

13. A 3 phase, 11.2 kW, 1750 rpm, 460 V, 60 Hz, four pole, star connected induction motor has following parameters: R_s=0, R_r=0.38Ω, X_s=1.14Ω, X_r=1.71Ω and X_m=33.2Ω. The motor is controlled by varying the supply frequency. If the breakdown torque requirement is 35 Nm, the synchronous speed equals
    a. 498.01 rad/s
    b. 447.711 rad/s
    c. 996 rad/s
    d. 377 rad/s

14. The Ward Leonard characteristic for speed control can be obtained from
    a. Three phase synchronous motor.
    b. Both three phase synchronous motor and induction motor.
    c. Three phase induction motor.
    d. Both DC motor and three phase induction motor.

15. The slip power recovery scheme for the speed control of induction motor
    a. Increase the efficiency.
    b. Decrease the efficiency.
    c. Improves the power factor.
    d. Decreases the power factor

16. The static Scherbius drive system offers speed control
    a. Above synchronous speed
    b. Both above and below synchronous speed
    c. Below synchronous speed
    d. Only at synchronous speed

17. Synchronous Condenser are often installed in Power system for
    a. Power Factor Correction
    b. Frequency control
    c. Speed control of the generators
    d. Load balancing

18. Reluctance motor is equivalent to a
    a. Salient pole motor with no armature current
    b. Salient pole motor with no field current
    c. Cylindrical motor with no field current
    d. Cylindrical motor with no armature current

19. In supersynchronous speed control
    a. The additional power is fed into the rotor circuit above the slip frequency
    b. The power is taken from the rotor circuit at slip frequency
    c. The additional power is fed into the rotor circuit at the slip frequency
    d. The additional power is fed into the rotor circuit below the slip frequency

20. For a three phase induction motor, slip at maximum torque and value of maximum torque are
    a. dependent and independent on the rotor resistance respectively
    b. independent on the rotor resistance
    c. independent and dependent on the rotor resistance respectively
    d. dependent on the rotor resistance

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SECTION "B"
[5 Q × 8 = 40 marks]

*Attempt **ANY FIVE** questions.Assume any suitable data if required.*

1.
a. Describe how the speed of a separately-excited dc motor is controlled through the use of two 3-phase full converters (one in the armature and other in the field). Discuss how two-quadrant drive can be obtained from this scheme. [2+2=4]
b. Derive expressions for rms values of source and thyristor currents for a three phase full converter in Question no. 1 showing the voltage and current waveforms required. State all the assumptions made. [2+2=4]

2.
a. The speed of a 50kW, 500V, 120A, 1500 rpm separately excited dc motor is controlled by a three-phase full converter fed from 400 V, 50 Hz supply. Motor armature resistance is 0.1 Ω. Find the range of firing angle required to obtain speeds between 1000 rpm and (-1000) rpm at rated torque. [2+2=4]
b. Describe how the speed of a dc series motor can be controlled by means of a dc chopper for power control. Obtain the expression between duty cycle of the chopper and speed of the dc motor. [2+2=4]

3.
a. Enumerate the various methods of speed control of a 3-phase induction motor. Describe stator-voltage control technique for the speed control of a 3-phase induction motor. [1+3=4]
b. Discuss how volts/hertz control for a 3-phase induction motor is similar to armature voltage control of a dc motor. [4]

4.
a. Describe static Kramer drive for the speed control of a 3-phase SRIM and show that the steady state torque is not influenced by whether a transformer is used or not. [4]
b. Derive appropriate expressions to obtain speed-torque characteristics of static Kramer drive for open loop system with different firing angles. [4]

5.

a. Derive an expressions for power developed for cylindrical rotor synchronous motor in terms of excitation voltage, load angle. Plot the variation of pull out torque and pull out power with frequency for a cylindrical rotor motor.

[3+1=4]

b. A three phase, 400V, 50 Hz, 4 pole, star connected reluctance motor with negligible armature resistance, has $X_d = 8\Omega$ and $X_q = 2\Omega$. For a load torque of 80 Nm, Calculate

i. Load angle (δ)
ii. Line current (I_a)
iii. Input power factor (θ)

[1+2+1=4]

6.

a. List out the different types of power factor correction employed. Mention the benefits of power factor correction. Explain any one type of power factor correction method.

[1+1+2=4]

b. Explain class B or resonant pulse commutation of a thyristor circuit with suitable waveforms.

[4]