Marks Scored:

KATHMANDUUNIVERSITY
End Semester Examination [C]
July, 2017

JUL 12 6 2017

Level : B.E.
Year : IV
Course : EPEG 422
Semester : I

Exam Roll No. :
Registration No.:
Time: 30 mins.
F.M. : 10
Date :

SECTION "A"
[20 Q × 0.5=10 marks]

Choose the most appropriate answer.

1. 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

2. For the resistance firing method of an SCR, the variation of firing angle, α is
   a. $\alpha > 90^0$
   b. $\alpha < 90^0$
   c. $\alpha = 90^0$
   d. $\alpha \leq 90^0$

3. For a single phase semi converter drive, the average output voltage at armature terminal is given as
   a. $\frac{V}{2\pi}(1+\cos\alpha)$
   b. $\frac{V}{\pi}(1+\cos\alpha)$
   c. $\frac{V}{\pi}(\cos\alpha)$
   d. $\frac{V}{2\pi}(\cos\alpha)$

4. A single phase full converter operates in the following mode of operation.
   a. Four quadrant
   b. One quadrant
   c. Two quadrant
   d. Three quadrant

5. For a three phase full wave converter drive, the average output voltage at armature terminal is given as
   a. $\frac{3V_{ml}}{2\pi}(1+\cos\alpha)$
   b. $\frac{3V_{ml}}{\pi}(\cos\alpha)$
   c. $\frac{V_{ml}}{3\pi}(\cos\alpha)$
   d. $\frac{3V_{ml}}{2\pi}(\cos\alpha)$

6. The firing sequence for a three phase full converter with firing angle $\alpha = 0^0$ 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. $210^0, 270^0, 330^0, 390^0, 450^0, 510^0$

7. A step down chopper is operated in the continuous conduction mode in steady state with a constant duty ratio, D. if V_o is the magnitude of the dc output voltage and V_s is the magnitude of dc input voltage, the ratio V_o/V_s is given by
   a. D/1-D
   b. 1-D
   c. 1/1-D
   d. D

8. In type D chopper
   a. The load current is always positive but the load voltage may be positive or negative.
   b. The load voltage and the load current are both positive.
   c. The load voltage is always positive but load current can be positive or negative.
   d. The load voltage and load current are both negative.

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=4×10^{-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. 10 kW
   b. 20 kW
   c. 30 kW
   d. 40 kW

10. A 208-V, 10hp, four pole, 60 Hz, Y-connected induction motor has a full-load slip of 5 percent, rotor frequency of this motor at rated load is
a. 60 Hz b. 120 Hz c. 6 Hz d. 3 Hz

11. The maximum torque developed in an induction motor is independent of
a. Rotor resistance b. Rotor reactance
c. Both rotor resistance and reactance d. Both stator resistance and reactance

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 regeneration 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 three phase squirrel cage induction motor drives a blower type load. The rotor current is maximum when motor runs at slip, s equal to
a. Zero b. One third c. One d. Half

14. The induction motor is said to be operated in field weakening mode on _____ control method of a.c. drive
a. Stator voltage b. Stator frequency
c. Stator voltage and frequency d. Stator current

15. The constant torque operation of an induction motor drive is obtained from
a. Stator voltage control b. Stator voltage and frequency control
c. Stator frequency control d. Rotor current control

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

17. The expression for the rectified voltage, V_D from the diode rectifier in static Kramer drive is
a. $2.339saV_{in}$ b. $-2.33saV_{in}$ c. Zero d. One

18. For a cylindrical rotor synchronous motor, the pull-out torque is obtained when the load angle is at
a. 45^0 b. 90^0 c. 180^0 d. 270^0

19. The developed torque from the salient pole motor is due to
a. Electromagnetic torque only
b. Reluctance torque only
c. Combination electromagnetic and reluctance torque
d. Difference of electromagnetic and reluctance torque

20. In comparison to salient pole motor permanent magnet synchronous motor has
a. Higher pull out torque b. Higher efficiency
c. Higher pull out torque and higher efficiency d. Increased losses

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Level : B.E.
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Time : 2hrs. 30 mins.

Course : EPEG 422
Semester : I
F.M. : 40

SECTION "B"
[5 Q × 8 = 40 marks]

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

Q.1

a. Explain with basic performance equation, how the speed of a separately excited dc motor can be controlled by varying field flux. [4]

b. A separately exited dc motor, operating from a single phase half controlled bridge at a speed of 1200 rpm has an input voltage of 230V and a back emf of 50V. The SCR are fired symmetrically at $\alpha = 45^0$ in every half cycle and armature has a resistance of 2.5 Ω. Calculate [2+2=4]
   i. Average armature current.
   ii. Motor torque.

Q.2

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). Derive expressions for average value of output voltage. [2+2=4]

b. A chopper used for on-off control of a dc separately excited motor has a supply voltage of 120V dc, an on time of 10ms and off time of 15ms. Calculate the average load current when the motor speed is 1000 rpm and has a voltage constant of K_v =0.5 V/rad/sec. The armature resistance is 3 Ω. [4]

Q.3

a. List out 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. For a fan-type loads, show that the rotor current in a 3-phase induction motor is maximum when the slip, s = 1/3. Consider the torque required by a blower type load is proportional to speed squared. [4]

Q.4

a. What do you mean by Slip-Power Recovery Scheme? State the major differences between Static Kramer drive and Scherbius drive with appropriate circuit diagram along with its working principles. [2+2=4]

b. Explain why it is essential to have a closed loop control of an electric drive.
A total load of 450 kVA is operating at a power factor of 0.65 lagging. An additional synchronous motor is added having an input power of 90 kW at a maximum power factor of 0.85 leading. Determine reactive power and the overall power factor after addition of synchronous motor on total load. [2+1+1=4]

Q.5

a. Prove that for a reluctance motor the pull out torque is obtained when load angle (δ) is at 45^0. Use appropriate phasor diagram and labeling. [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 80Nm, the, calculate
   i. Synchronous speed (ω_s).
   ii. Load angle (δ).
   iii. Line current (I_a).
   iv. Input power factor (θ). [1+1+1+1=4]

Q.6

a. List out the classification of various chopper configuration. Explain any one type of chopper circuit. [1+3=4]

b. Sketch the supply voltage V_s and output voltage, V_o waveform for a three phase half wave converter controlling armature side of a dc motor considering firing angle, $\alpha = 30^0$. [2+2=4]

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SECTION "A"
[20 Q × 1 =20 marks]

Attempt ALL the questions (Select and mark [X] for most appropriate answer).

1. Incorrect steering axis inclination (S.A.I.) causes
[ ] generation of a braking effect at tight corners
[ ] tendency to assume toe-out orientation
[ ] poor recovery of the steering wheel after making a turn
[ ] the vehicle to pull to the side of lesser inclination

2. It is necessary to maintain the valve clearances as they
[ ] increase the speed at which the valves move up and down
[ ] reduce the resistance to sliding that occurs between the cam and the tappet
[ ] allow for lengthening of the valves owing to the heat of combustion
[ ] make the crankshaft turn smoothly

3. In a ventilated disc brake,
[ ] caliper is covered with cooling fins
[ ] a duct directs air towards the caliper for cooling while the vehicle is moving
[ ] disc contains many small holes for optimum cooling performance
[ ] disc contains radial vanes between its rubbing surfaces for optimum cooling performance

4. The main feature of MacPherson strut suspension is that
[ ] the vertical size of the suspension can be made more compact
[ ] non-vertical external forces are supported by the suspension arms
[ ] the unsprung mass in lighter
[ ] the assembly is slightly more complicated in design

5. The aluminium alloy is used in cylinder blocks because
[ ] it is lighter and has good heat dissipation characteristics
[ ] it does not require any cylinder liners
[ ] material cost is low
[ ] the piston is also made of aluminium alloy

6. The cetane rating of Diesel fuel is in the order of
[ ] 60 [ ] 45 [ ] 25 [ ] 70

7. The anti-knock property of compression ignition engine fuel can be improved by adding
[ ] amyl nitrate [ ] tetraethyl lead [ ] trimethyl pentane [ ] hexadecane

8. The ball joints are used on the tie-rod ends, because they
[ ] reduce the amount of sliding resistance
[ ] reduce the amount of noise generated
[ ] improve the force transmission speed
[ ] can deal with movement of the suspension both vertically and in other directions

9. The crescent-shaped cavity on the piston head top surface is called as
[ ] piston oil hole [ ] snap ring [ ] valve clearance [ ] valve recess

10. The two rows of cylinders in a 'V' type engine are generally arranged at
[ ] 45° [ ] 90° [ ] 130° [ ] 60°

11. Which part of the automobile tyre is subjected to greatest flexing action?
[ ] Bead [ ] Side wall [ ] Shoulder [ ] Tread

12. The piston compression rings are made of
[ ] steel [ ] cast iron [ ] bronze [ ] aluminium

13. The power source for a brake booster is
[ ] exhaust manifold pressure
[ ] electricity
[ ] the pressure difference between the atmospheric pressure and the vacuum pressure in the intake manifold
[ ] hydraulic pump

14. Which one of the following statement correctly describes the construction of a bevel-gear type differential?
[ ] The drive shafts are splined to the differential carrier.
[ ] The left side gear and the differential carrier rotate in constant unison.
[ ] The differential carrier houses differential pinion gears and side gears, each pinion gear meshes with a different side gear.
[ ] The differential carrier houses differential pinion gears and side gears

15. The function of a proportioning control valve (PCV) in a brake system is to
[ ] ensure that equal pressure is supplied to the front and rear brakes throughout every braking operation
[ ] reduce the brake fluid pressure when the brakes approach their lockup point
[ ] cause less brake fluid pressure to act on the front brakes than on the rear brakes when the fluid pressure exceeds a predetermined level
[ ] cause less brake fluid pressure to act on the rear brakes than on the front brakes when the fluid pressure exceeds a predetermined level.

16. The formula for Iso-octane is
[ ] C8H18 [ ] C7H17 [ ] C6H18 [ ] C7H18

17. The condition that results in large quantities of HC emission is
[ ] high temperature combustion
[ ] incomplete combustion
[ ] low temperature combustion
[ ] high atmospheric temperature combustion

18. The engine oil level should be checked
[ ] immediately after the ignition switch is turned off
[ ] while the engine is running
[ ] a few minutes after the ignition switch is turned off
[ ] while the engine is running at high-idle speed

19. The order in which effort applied to the steering wheel is transferred to the front wheel is
[ ] steering wheel - steering gearbox - steering shaft - tie rod - steering knuckle - front wheels
[ ] steering wheel - steering shaft - steering gearbox - tie rod - steering kunckle -front wheels
[ ] steering wheel - steering shaft - steering gearbox - steering knuckle - tie rod - front wheels
[ ] steering wheel - tie rod - steering gearbox - steering shaft - steering knuckle - front wheels

20. The fuel pump of a programmed fuel injection (PFI) system operate for two seconds when the ignition is turned to the start position to
[ ] enable the pump's fault-diagnosis function to operate
[ ] warm up and lubricate the pump
[ ] supply a large amount of fuel and thereby create a choke effect
[ ] pressurize the fuel system before the engine is started