Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech.**
PEL6J003

6th Semester Regular Examination 2017-18
ELECTRICAL DRIVES
BRANCH : EEE
Time : 3 Hours
Max Marks : 100
Q.CODE : C440

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1. Answer the following questions: *multiple type or dash fill up type :* **(2 x 10)**

a) A motor has a thermal heating time constant of 50 mm. When the motor runs continuous of full scale, its final temperature rise is 80° C, what would be the temperature rise after 1 hour, if the motor runs continuously on full load?
(i) 54 ^{0}C (ii) 55.9 ^{0}C
(iii) 58.1 ^{0}C (iv) none of these

b) The concept of V/f control of inverters driving induction motors resuls in
(i) Constant torque operation (ii) Speed Reversal
(iii) reduced magnetic loss (iv) harmonic elimination

c) Polarity of supply voltage is reversed in which type of braking?
(i) Regenerative braking. (ii) Dynamic braking.
(iii) Plugging. (iv) None of these.

d) Which speed control method preferred for constant torque drive?
(i) Field control. (ii) Armature voltage control.
(iii) Mechanical loading system (iv) None of above.

e) Which braking is not possible in series motor?
(i) Regenerative braking. (ii) Dynamic braking.
(iii) Plugging. (iv) None of these

f) For an IM to operate in braking region slip should be always
(i) less than zero (ii) greater than 1.
(iii) Equal to 1 (iv) None of these

g) Which of the following motors are best for rolling mills?
(i) Synchronous motors (ii) squirrel cage induction motor
(iii) Slip ring induction motor (iv) D.C. motors

h) A separately excited dc motor, when fed from a single phase full converter with firing angle 60^0 runs at 1000 rpm. If this motor is connected to 1-phase semiconverter with the same firing angle of 60^0, the motor would now run at
(i) 2000rpm (ii) 1500rpm
(iii) 1450rpm (iv) 1000rpm

i) The coefficient of adhesion is highest when
(i) the rails are dry (ii) the rails are oiled
(iii) the rails ark wet with dew (iv) the rails are dusty.

j) A schedule speed of 45 km, per hour is required between two stops 1.5 km apart. The duration of stop is 20 seconds. The acceleration is 2.4 kmphps and retardation is 3.2 kmphps. For a simplified trapezoidal curve, the maximum speed will be

(i) 40 km per hour (ii) 48 km per hour

(iii) 74 km per hour (iv) 90 km per hour

Q2. **Answer the following questions: *Short answer type :*** **(2 x 10)**

a) What are the components of electrical drive? Show with suitable block diagram.

b) Calculate the starting time of a drive with following parameters: J=10 kg-m^2 , T=15+0.5ω_m and T_L=5+0.6ω_m

c) Draw the steady state load torque speed curves for High speed hoist and Traction load.

d) The temperature rise of amotor when operating for 25 min on full load is 25^0C and becomes 40^0C when motor operates for another 25 min on the same load. Determine Heating time constant.

e) Differentiate between short time duty and intermittent periodic duty with suitable examples.

f) What are the advantages and disadvantages of Plugging?

g) Why stator voltage control is suitable for speed control of induction motors in fan and pump drives?

h) Why current source inverter-fed induction motor drive is operated at a constant rated flux?

i) What are the advantages of static rotor resistance control over conventional methods of rotor resistance control of induction motor?

j) Why a train driven by a separately excited dc motor has better adhesion than a train driven by series dc motors?

Part – B (Answer any four questions)

Q3. **a)** Load diagram of a shearing machine shows a periodic fluctuation of torque with 10000 N-m required for 10 sec and 1000 N-m for 20 sec. The combined moment of inertia of motor and flywheel referred to the motor shaft is 1000kg-m^2. Calculate maximum and minimum values of torque and speed. The motor speed torque characteristic is a straight line given by the equation T=20000-20N, N-m, where N is the speed in rpm. **(10)**

b) What is steady state stability of an electrical drive? Derive the condition of steady state stability by perturbation approach mathematically. **(5)**

Q4. **a)** A thyristor converter fed dc motor has the following specifications: Rated armature current=500 A, Armature Resistance=0.01 ohm. The drive operates on following duty cycle: **(10)**

(i) Acceleration at twice the rated armature current for 10 sec.

(ii) Running at full load for 10 sec.

(iii) Deceleration at twice the rated armature current for 10 sec.

(iv) Idling interval.

The core loss is constant at 1 kW. If β has a value of 0.5, determine the maximum frequency of drive operation.

b) What are the different classes of motor duty? Derive the expression for overloading factor 'K' for intermittent periodic duty. **(5)**

Q5. **a)** The rheostatic braking was applied to bring a separately excited dc motor to rest from its initial speed of 1050 rpm along with a load torque equal to 15% of the rated value. The rating plate of the motor has the data: 35kW, 220V, 175A, 1000rpm. Further, the test results show that: R_a=0.08 Ω, L_a=0.12 H, (M.I. of motor-load) J= 8 kg-m^2. **(10)**

(i) Calculate braking resistance value so as to limit the braking current to twice the rated value while neglecting the effect of inductance.

(ii) Obtain the expression for the transient values of speed and current including the effect of armature inductance, with the motor field flux at the rated value.

b) Explain different types of electrical braking of DC series motor with suitable diagram and draw the speed torque characteristics under braking. **(5)**

Q6. **a)** A 3-phase, 400V, 50 Hz,6-pole star connected slip ring induction motor has the following parameters referred to stator R_s=0.4 Ω, $R_r^/$= 0.6 Ω X_s= $X_r^/$= 1.4 Ω. The motor drives a fan load at 960 rpm. The stator to rotor turns ratio is 2. **(10)**

(i) What resistance must be connected in each phase of the rotor circuit to reduce the speed to 800 rpm?

(ii) When the motor is controlled by static rotor resistance control, calculate the value of external resistance so that motor runs at 800 rpm for a duty ratio of 0.5.

b) Draw and explain Static Kramer drive with suitable diagram. How it is different from Static Scherbius drive? **(5)**

Q7. **a)** A 3-phase 400V, 50 Hz, 4 pole, 1400 rpm, Y-connected wound rotor induction motor has the following parameters referred to stator R_s=2 Ω, $R_r^/$= 3 Ω X_s= $X_r^/$= 3.5 Ω. The stator to rotor turns ratio is 2. The motor speed is controlled by the Static Scherbius drive. The inverter is directly connected to the source. Determine (i) the speed range of the drive when $\alpha_{max}=165^0$ (ii) the firing angle for 0.4 times the rated motor torque and a speed of 1200 rpm (ii) torque for a speed of 1050 rpm and $\alpha= 95^0$. **(10)**

b) Explain the variable frequency control of multiple synchronous motors with suitable diagram and differentiate between true synchronous mode and self-controlled mode. **(5)**

Q8. **a)** A 80 tonne locomotive is employed to drive a train weighing 400 tonnes. The locomotive is driven by 4 DC motors, each geared to a driving axle through a reduction gear with a=0.3. the train has 48 wheels(including the wheels of locomotive), each with aradius of 0.5 m and aweight of 450 kg. The mass of each motor is 5 tonnes and the average diameter of the armature core is 1.0m. The train resistance is 30N/tonne. Inertia of the rotating parts other than wheels and motors can be neglected. Calculate the coupling torque per motor required to accelerate the train at 1kmphps on a up gradient with G=10. Transmission efficiency is 95%. **(10)**

b) Define coefficient of adhesion. How it is different from coefficient of friction? Explain in details the factors affecting coefficient of adhesion. **(5)**

Q9. **a)** Write a short note on drives used in cement mills and paper mills. **(10)**

b) What are the application areas and functions of microprocessor in electrical drives? **(5)**