Registration No :

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B.Tech.
PEE6I101

6ᵗʰ Semester Regular Examination 2017-18
ELECTRICAL DRIVES
BRANCH : ELECTRICAL
Time : 3 Hours
Max Marks : 100
Q.CODE : C150
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) An equilibrium point is stable when ------- in speed causes load torque to ------ the motor torque.

  b) In case of Intermittent periodic duty running period is less than --------- time constant and rest period is less than -------------- time constant.

  c) For a single phase fully controlled rectifier fed separately excited DC motor --------- and ---------- quadrant of operation is possible.

  d) For a separately excited DC motor under Armature voltage control maximum allowable -------- is constant and under field control maximum allowable ------------ is constant.

  e) For a DC series motor under dynamic braking --------- connection is interchanged and for plugging ------------ connection is interchanged.

  f) Active load torque usually ----------- their sign and passive load torque -------- their sign when direction of the drive rotation is changed.

  g) In variable frequency control for above base speed operation ------------ is maintained constant and below base speed operation ----------- is maintained constant.

  h) Pole changing method is applicable to ----------- type induction motor and slip power recovery scheme is applicable to --------- type induction motor.

  i) VSI fed induction motor drive can be applied to ----------- motors and CSI fed induction motor drive is applicable to ----------- motors.

  j) Coefficient of adhesion ------------ with increase in speed and ------------ with decrease in speed regulation.

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

  a) What are the advantages of electrical drive?

  b) What are the components of load torque?

  c) What is steady state stability for an electric drive?

  d) What are the requirements of closed loop control of electric drives?

  e) Why a motor of smaller rating can be selected for a short time duty?

  f) What is regenerative braking?

  g) Differentiate between VSI and CSI fed induction motor drive.

h) What is the difference between static Kramer drive and static scherbius drive?

i) What is the difference between true synchronous mode and self-control mode for a synchronous motor?

j) What is coefficient of adhesion?

<u>**Part – B (Answer any four questions)**</u>

Q3. **a)** A motor has heating time constant of 60 min and a cooling time constant of 90 min. Calculate the motor rating for the following duty cycles: **(10)**

    (i) Short-time periodic duty cycle consisting of 100kW load for 10 minutes followed by no load period long enough for the motor to cool down.

    (ii) Intermittent periodic duty consisting of 100kW loadperiod of 10 min and no load period of 10 min.

Assume loss to be proportional to $(power)^2$.

b) Explain the four quadrant operation of a low speed Hoist with suitable diagrams. **(5)**

Q4. **a)** What is load equalisation in an electrical drive? Derive the Expression for moment of inertia of the flywheel required for load equalisation. **(10)**

b) A motor equipped with a flywheel has to supply a load torque of 600N-m for 10 sec followed by a no load period long enough for the flywheel to regain its full speed, It is desired to limit the motor torque to 450 N-m. What should be the moment of inertia of the flywheel? The no load speed of the motor is 600 rpm and it has a slip of 8% at torque of 400 N-m. Assume the motor speed torque characteristic to be a straight line in the range of operation. Motor has an inertia of 10 kg-m^2. **(5)**

Q5. **a)** A 220 V, 970 rpm,100A dc separately excited motor has an armature resistance of 0.05 Ω. It is braked by plugging from an initial speed of 1000 rpm. Calculate **(10)**

    (i) resistance to be placed in armature circuit to limit braking current to twice the full load value

    (ii) braking torque and

    (iii) torque when speed has fallen to zero.

b) Derive the expression for motor speed and armature current for a separately excited DC motor with armature control under transient operation of starting. **(5)**

Q6. **a)** Explain the variable frequency control of an induction motor drive with suitable diagram and what is slip speed control? **(10)**

b) A 2.8 kW 400V, 1370 rpm, 50 Hz, delta connected squirrel cage induction motor has the following parameters referred to stator R_s=2 Ω, $R_r^/$= 5 Ω X_s= $X_r^/$= 5 Ω. The motor speed is controlled by the stator voltage control. When driving a fan load it runs at rated speed at rated voltage. Calculate motor terminal voltage, current and torque at 1200 rpm. **(5)**

Q7. **a)** What is slip power Recovery scheme? Explain static scherbius drive operation with suitable diagram and derive the expression of motor torque. **(10)**

b) A 3-phase 440V, 6 pole, 970 rpm, 50 Hz, Y-connected induction motor has the following parameters referred to stator $R_s=0.2$ Ω, $R_r^{/}= 0.15$ Ω $X_s= X_r^{/}= 0.4$ Ω. The stator to rotor turns ratio is 3.5. The motor speed is controlled by the static scherbius drive. The drive is designed for aspeed range of 30% below the synchronous speed. The maximum value of firing angle is 170^0. Calculate (i) turns ratio of the transformer and (ii) torque for a speed of 750 rpm and α= 140^0. **(5)**

Q8. a) An electric train weighing 500 tonnes climbs up-gradient with G=8 and following speed-time curve: **(10)**
- (i) uniform acceleration of 2.5 km/hr/sec for 60sec
- (ii) constant speed for 5min
- (iii) coasting for 3 min
- (iv) Dynamic braking at 3 km/hr/sec to rest

The train resistance is 25 N/tonne, rotational effect 10% and combined efficiency of transmission and motor is 80%. Calculate specific energy consumption.

b) Derive the expression for Tractive Effort and torque per motor for an electric train. **(5)**

Q9. a) Explain the different operation carried out in a textile mill and what are the electrical drives used for these operations? **(10)**

b) Write a short note on Steel Rolling Mill. **(5)**