III B. Tech II Semester Supplementary Examinations, April - 2021
POWER ELECTRONIC CONTROLLERS AND DRIVES
(Electrical and Electronics Engineering)

Time: 3 hours   Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**
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PART –A   (14 Marks)

1. a) What are the problems of load un-equalization?   [2M]

    b) Draw the voltage waveform of single phase full controlled converter fed dc motor for   [2M]
        firing angle 90^0.

    c) Draw the speed-torque characteristics of separately excited dc motor fed using one   [2M]
        quadrant chopper.

    d) What is meant by flux-weakening in the speed control of induction motor?   [3M]

    e) What are the advantages of static Scherbius drive system?   [3M]

    f) What are the disadvantages of separate control used for synchronous motor?   [2M]

PART –B   (56 Marks)

2. a) Describe the load torque equation and hence discuss conditions for steady state   [7M]
        stability limit.

    b) A 250 V, dc shunt motor has an armature resistance of 0.1 Ω. Under rated field   [7M]
        excitation its back e.m.f is 240 V at a speed of 1200 rpm. It is coupled to an
        overhauling load having torque of 200 N.m. Determine lowest speed at which the
        motor can hold the load by regenerative braking.

3. a) Explain the operation of a dc series motor supplied from single phase semi converter.   [7M]

    b) A dc motor is operating from single phase full controlled bridge converter with free-   [7M]
        wheeling diode at a speed of 1200 rpm. The input voltage is *220 sin(314t)* and back
        emf is 80 V. The thyristors are triggered symmetrically at α = 30^0. The armature has
        resistance of 4 Ω. Calculate average current and motor torque. What is its speed when
        it operated at α = 60^0?

4. a) Explain class-A chopper fed armature speed control of separately excited dc motor.   [7M]
        Derive the motor speed-torque relation and explain its characteristics.

    b) A 230 V, 500 rpm, 90 A separately excited dc motor has the armature resistance and   [7M]
        inductance of 0.1 Ω and 10 mH respectively. It is controlled by a c1ass-C two-
        quadrant chopper operating with a source voltage of 230 V at a frequency of 400 Hz.
        (i) Calculate the motor speed for a motoring operation at duty ratio of 0.5 with one
        fourth rated torque; (ii) What will be the motor speed when it is regenerating at a duty
        ratio of 0.6 and rated torque?

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5. a) Describe torque-speed characteristics of variable voltage control of induction motor.   [5M]

   b) A three phase 440 V, 50 Hz 6-pole, 945 rpm Y-connected induction motor has the   [9M]
      following parameters:

   $$r_1 = 0.2\ \Omega, \qquad r_2' = 0.3\ \Omega, \qquad x_1 = 0.5\ \Omega, \qquad x_2' = 1.0\ \Omega.$$

   The motor is fed from a voltage source inverter with constant V/f ratio.
   - (i) Calculate the maximum torque and corresponding speed for 50 Hz and 20 Hz frequency.
   - (ii) What is the value of V/f ratio at 20 Hz such that maximum torque at this frequency is same as 50 Hz?

6. a) Describe static Scherbius drive operation of slip-power recovery scheme used for   [7M]
      induction motor.

   b) The rotor of a 6-pole, 50 Hz, slip-ring induction motor has a resistance of 0.2 Ω per   [7M]
      phase and runs at 960 rpm on full load. Calculate the resistance per phase to be
      inserted in series with rotor circuit to reduce the rotor speed to 800 rpm, such that
      torque being: (i) same as before; (ii) proportional to square of speed.

7. a) Explain how braking of synchronous motor is done using VSI?   [7M]

   b) What are the different methods of variable frequency control of synchronous motor?   [7M]
      Describe them.

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