Exam No: _____

GANPAT UNIVERSITY

B. TECH SEM- VI (ELECTRICAL ENGINEERING)

REGULAR EXAMINATION APRIL-JUNE 2016

2EE604: Electrical Drives

TIME: 3 HRS **TOTAL MARKS: 70**

Instructions: (1) This Question paper has two sections. Attempt each section in separate answer book.
(2) Figures on right indicate marks.
(3) Be precise and to the point in answering the descriptive questions.

SECTION: I

Q.1

(A) Derive the expression for torque of a salient pole wound field motor with the help of equivalent circuit and neat phasor diagram. **(06)**

(B) A 500 kW, 3-phase, 3.3kV, 50 Hz, 0.8 (lagging) power factor, 4 pole, star connected synchronous motor has following data: X_S=15 Ω, R_S=0. Rated field current is 10 A. Calculate **(06)**

a) Armature current and power factor at half the rated torque and rated current.
b) Field current to get unity power factor at the rated torque.

OR

Q. 1

(A) Draw and explain the block diagram of Electric Drive. **(06)**

(B) An electrical motor has a rotational load directly connected to its shaft. The torque speed characteristics of motor and load are **(06)**

$$T = 0.6 + 1.9\omega_m$$
$$T_L = 2.8\sqrt{\omega_m}$$

Find the operating speed ω_m and discuss if the system has steady state stability.

Q.2

(A) Explain what do you understand by the steady-state stability? What is the main assumption? **(06)**

(B) A motor running at speed N rpm is driving a rotational load L_1 directly coupled to its shaft and another load L_2 through a gear to reduce its speed by a factor K. The inertia of motor and loads L_1, L_2, are J_m, J_1 and J_2 respectively. The load torque of L_1 and L_2 are T_1 and T_2. Find expression for effective inertia and torque on the motor **(05)**

OR

Q.2

(A) With the help of construction, circuit diagram and waveforms, explain the working of a trapezoidal permanent magnet synchronous motor drive. **(06)**

(B) How can loads be classified as per Speed-Torque curves with examples. **(05)**

Q.3 **Attempt any three** **(12)**

(A) Explain Classification of Electrical Drives with examples.

(B) What is meant by multi-quadrant operation? Explain using suitable diagrams.

(C) What is the basic difference between true synchronous mode and self-control mode for variable frequency control of synchronous motor?

(D) What are the factors influencing the choice of electric drives?

SECTION : II

Q.4

(A) Which type of chopper is suitable to drive a lift (elevator)? Illustrate the working of the same chopper. (06)

(B) A 220 V, 200 A, 750 rpm separately excited motor has an armature resistance of 0.05 Ω. It is driving a load whose torque has an expression $T_L = 500 - 0.25N$ N-m, where N is the speed in rpm. Speeds below rated are obtained by armature voltage control (with full field) and speeds above rated are obtained by field control (with rated armature voltage). (06)

i) Calculate motor terminal voltage and armature current when the speed is 400 rpm.

ii) Calculate value of flux as a percent of rated flux when the speed is 1500 rpm.

OR

Q.4

(A) Explain the operation of single phase fully controlled rectifier with RLE load and derive the equation of average output voltage. Sketch the waveforms of supply voltage, supply current, output voltage, and output current. Assume continuous current conduction. (06)

(B) A 230 V, 1200 rpm, 15 A separately excited motor has an armature resistance of 1.2 Ω. Motor is operated under dynamic braking with chopper control. Braking resistance has a value of 20 Ω. (06)

i) Calculate duty ratio of chopper for motor speed of 1000 rpm and braking torque equal to 1.5 times rated motor torque.

ii) What will be the motor speed for duty ratio of 0.5 and motor torque equal to its rated torque?

Q.5

(A) Discuss the concept of stator voltage control. Explain stator voltage control using ac voltage controller. (05)

(B) A 440 V, 3 phase, 50 Hz, 6 poles, 945 rpm delta connected induction motor has following parameters referred to stator. $R_s = R_r' = 2\ \Omega$; $X_s = 3\ \Omega$; $X_r' = 4\ \Omega$ (06)
When driving a fan load at rated voltage it runs at rated speed. The motor speed is controlled by stator voltage control. Determine

i) Motor terminal voltage, current and torque at 800 rpm.

ii) Motor speed, current and torque for motor terminal voltage of 280 V.

OR

Q.5

(A) Explain the idea behind variable voltage variable frequency control method. Draw the curves showing the variations of speed, torque and power with respect to frequency. (05)

(B) A 3 phase, 440 V, 50 Hz, 6 pole, Y-connected induction motor has following parameters referred to stator : $R_s = 0.5\ \Omega$; $R_r' = 0.6\ \Omega$; $X_s = X_r' = 1\ \Omega$. (06)
Stator to rotors turns ratio is 2. If the motor is used for the regenerative braking, determine

i) Maximum overhauling torque it can hold and the range of speed in which it can safely operate.

ii) The speed at which it will hold a load with a load torque of 160 Nm.

Q.6 **Attempt any three.** (12)

(A) Write a short note on i) speed sensing ii) current sensing

(B) Draw and explain a block diagram of current limit closed loop control system.

(C) Discuss static scherbius drive with necessary diagrams.

(D) Speed of a dc series motor coupled to a fan load is controlled by variation of armature voltage. When armature voltage is 400 V, motor takes 20 A and the fan speed is 250 rpm, The combined resistance of armature and field is 1Ω. Calculate motor armature voltage for the fan speed of 350 rpm.

----------END OF PAPER----------