TECHNICAL UNIVERSITY OF MOMBASA

UNIVERSITY EXAMINATION FOR:

DIPLOMA IN TECHNOLOGY IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEP2304: ELECTRICAL MACHINE DRIVES

END OF SEMESTER EXAMINATION

SERIES: AUGUST 2019

TIME: 2 HOURS

DATE: Pick DateSelect MonthPick Year

Instructions to Candidates
You should have the following for this examination
-Answer Booklet, examination pass and student ID
This paper consists of **five** Questions; Question ONE is compulsory. In addition attempt any Other TWO Questions.
Do not write on the question paper.

Question ONE

a)
  i.   State any THREE good characteristics of Insulated Gate Bipolar Transistors (IGBT's) over other electronic devices applied in electrical drives
  ii. Sketch a Current Source Inverter Circuit(VSI) for a 3-φ synchronous motor, and explain the function of each section

  (9 Marks)

b) A $150V_{l-n}$, 10A, 40Hz, 1- φ, 0.85pf motor is fed via a four step inverter circuit from a 3- φ, 240 V_{l-n} supply. Calculate:
  i.   The DC section voltage and current
  ii. The source side fundamental current and power factor
  iii. The source side fundamental current and power factor if source is replaced by $415V_{ll}$, 3- φ supply

  (11 Marks)

Question TWO

a)
   i. List any FOUR parameters considered in a dynamic model for electrical drives
   ii. State FOUR advantages of space phasor models over dynamic models in electrical drives

   (8 Marks)

b) Two phase quadrature currents displaced from fixed reference frame by θ=30º and each having peak value of 200 A are fed to a three phase machine with balanced supply. Sketch the layout of such a drive system and determine:
   i. **αβo** component output with **dqo** input
   ii. **abc** component output from **αβo** block
   iii. the layout sketch corresponding to drive in b(i) and b(ii) above

   (12 Marks)

Question THREE

a)
   i. Sketch a classification chart for various kinds of electric drives
   ii. Highlight any SIX factors to consider while selecting an electric drive for a certain application

   (8 Marks)

b)
   i. With the aid of a sketch explain the functioning of Field controlled DC servo motor
   ii. Show that the transfer function of a Field Controlled Servo Motor is given by:

$$\frac{\theta_o(s)}{V_F(s)} = \frac{K_F K_m / L_F J_m}{s(s + D_m/J_m)(s + R_f/L_f)}$$

   iii. Determine the steady state angular displacement for the motor in b(i) above when supplied with a 100V step input. The parameters of the machine are:
   $L_f= 100H$, $R_f=0.5k\Omega$, $K_f =10$, $J_m=0.01Kgm^2s^{-2}$, $D_m=0.04N/ms^{-1}$, $K_m=50$

   (12 Marks)

Question FOUR

a)
   i. State THREE Advantages of DC Chopper drives over DC Silicon Controlled Rectifier(SCR)
   ii. Sketch bock diagram of DC SCR drive system and explain how it functions

   (9 Marks)

a) A 210V, 20A, 500r.p.m. separately excited DC motor having armature resistance of 0.5Ω is to be connected via a SCR drive. Determine transformer ratio applied and the firing angle required for:
   i. forward motoring operation at 500rpm
   ii. forward braking at 300rpm

   (11 Marks)

Question FIVE

a)
   i. With the aid of a diagram explain how a Cyclo-converter drive functions
   ii. State ONE advantage and ONE disadvantage of the circuit above over variable voltage constant frequency SCR circuits

   (9 Marks)

b) Sketch the equivalent circuit of an Induction motor derive the relationship between torque and frequency and:
   i. determine the toque output for 15hp,415V, 730rpm,50Hz induction motor when the control signal k=0.25, 0.5 and when k=0.65 and 1 respectively:
   ii. Sketch the Torque speed characteristic above assuming the motor was of NEMA class D

   (11Marks)