بســـم الله الرحمن الرحيم

جامعة طنطا - كلية الهندسة امتحان الفصل الدراسي الثاني يونيو 2007

السنة الثالثة قسم هندسة القوى والالات الكهربية اسم المادة : تصميم الالات الكهربية التاريخ : يونيو 2007

الزمن : 3 ساعات عدد الصفحات : 1 الدرجة : 100

Answer ALL Questions : *[Make suitable assumptions if necessary]*

[1] A 40 kW, 230-V, 1000 rpm, dc shunt motor having the following data:

Specific magnetic loading = 0.65 Wb/m^2, specific electric loading = 30000 ac/m, ratio of pole arc / pole pitch = 0.7, length of machine = pole arc, internal drop in armature circuit = 10 V, field current = 2.5 A, field mmf =130 % armature mmf, mmf required for air gap = 60 % armature mmf, gap contraction factor =1.15 , full-load efficiency = 90 %, the current density for brushes = 7 A/cm^2, and the current carried by each brush should not exceed 70 A.

Calculate:

(a) Main dimensions and number of poles ; (b) Number of armature conductors and type of winding; (c) Number of slots and no. of conductors per slot;
(d) Armature mmf per pole; (e) Field mmf per pole; (f) Length of air gap;
(g) Length of commutator.

[2] A 750 kW, 500 V, 8-pole, 3-phase, star-connected, squirrel-cage induction motor has the following data:

Stator winding: single layer, 4 slot per pole per phase, 4 conductor per slot.

Rotor winding: 67 slots, cross section of each bar is 11 mm diameter x 29 cm long, cross section of each end ring is 15 x 15 mm^2 , the mean diameter of end ring is 48.5 cm .

Full load efficiency and power factor may be taken as 0.92 and 0.89 respectively. Mechanical losses are 750 W. Take resistivity of copper as 0.02 ohm per m per mm^2. The air gap contraction factor is 1.2. Assume the mmf required for the iron parts to be 30 % of the air gap mmf.

Calculate:

(a) The motor speed;
(b) The magnetizing current per phase.

[3] A 1250 kVA, 3300 V, 300 rpm, 50-Hz, 3-phase star-connected alternator of salient pole type has the following data :

Bore diameter = 1.9 m ; core length = 0.335 m ; pole arc/pole pitch = 0.66; ampere conductors per metre are 32500 ; turns per phase = 150, single layer concentric winding with 5 conductors per slot, short circuit ratio = 1.2. Assume that the distribution of gap flux is rectangular under the pole arc with zero values in the interpolar region; mmf required for air gap is 88 % of no load field mmf and the gap contraction factor is 1.15. The current density in damper bars is 2.5 A/mm^2 .

Calculate:

(a) Specific magnetic loading; (b) Armature mmf per pole;
(c) Gap flux density over pole arc;
(d) Air gap length; (e) Number of damper windings per pole, and diameter of each damper winding.

[4] Determine the dimensions of the core, the number of turns, and the cross-sectional area of conductors in the primary and secondary windings of a 100 kVA, 2200/480 V, single-phase core type transformer to operate at a frequency of a 50-Hz , assuming the following data: approximate voltage per turn = 7.5 V, maximum flux density= 1.2 Wb./m^2 , ratio of effective cross-sectional area of core to square of diameter of circumscribing circle=0.6, ratio of height to width of window = 2, window space factor = 0.28, current density =2.5 A/ mm^2 .

TANTA UNIVERSITY
Faculty Of Engineering
Electrical Power and Machines Engineering Department

Course : Power Electronics — Time : 3 hours

Year : 3rd year(Power&Machines). — Date : 27/5/2007

Answer All The Questions

#Clarify your answer with the suitable sketches as you can

The first question

a) Derive an expression for the commutation angle in 3-ϕ controlled rectifier

b) Explain the function of the Freewheeling diode.

c) Explain how the chopper can be used to transfer energy from one source to another source describing the required condition for this transfer .

d) Compare between the boost and buck regulators w.r.t. connection diagram , v_o , I_o, the rating of the devices and filter elements .

The second question .

A highly inductive load of resistance 40 Ω is supplied from 3- ϕ Y connected supply with phase voltage 220 v via 3- ϕ half controlled bridge without Freewheeling diode across the load . Determine the firing angle (α) to feed the load with power of 2.6Kw , then find the following:

a) rms and average load currents.

b) rms and average thyristor currents.

c) input power factor (pf)

d) the transformer utilization factor (TUF) .

e) Sketch considering commutation the waveforms of v_o , i_a , i_{D2} ,v_{D4}

بقية الأسئلة الصفحة الثانية

The third question.

An inductive load of (R=20, L=37mH) is supplied from ac source 220 v, 50 Hz via bidirectional switch(two thyristors). The switch is controlled by On-Off control method for 50 cycles On & 30 cycles Off .Calculate:

(a) the firing angle of each thyristor.

(b) the flicker frequency .

(c) the load power.

(d) the input power factor.

(e) the rating of each thyristor.

The fourth question

a)1--ϕ bridge inverter is supplied from a 800 v dc source and supply an inductive load of (R=30 Ω ,L =94.5 mH, f_o =50 Hz). Find:

(i) the useful power (ii) the rating of the switch

b) Power transistor(BJT)has β=10, R_C=5Ω,V_{cc}=100v&input voltage to base circuit is V_B=8V.

If $V_{CE(sat)}$ =2.5V&$V_{BE(sat)}$=1.75V find:

(i)the value of R_B that will resulting saturation with an overdrive factor of 2

(ii) the forced β (iii)the power loss in transistor

The fifth question

a) Explain using the 1--ϕ full converter

(i) How to reverse the direction of rotation of DC motor?

(ii) Control the speed of 1-ϕ ac motor.

b) Compare between the power transistor and the thyristor.

c) Sketch the different forms of the bidirectional switch.

Good Luck .

Tanta University Faculty of Engineering Department of Electric Power and Machines Engineering	Year : Third Year Subject : Digital Control Systems Date : 13 / 6/ 2007 Time allowed: Three hours

Answer the following questions

[1] (a) Drive the transfer function of a zero order hold device. Then plot its frequency characteristics (amplitude and phase).

(b) For the transfer function $G(s) = \frac{1}{s+1}$,

- Obtain the discrete transfer function using matched pole zero method with a sampling period T = 0.1 second.
- Obtain the difference equation and the unity step response.

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[2] Figure 1 shows a digital control system. When the controller gain K is unity and the sampling time is 0.5 seconds, determine:

a) The closed loop pulse transfer function

b) The steady-state value of the system output

c) Find the value of the digital compensator gain K to make the system just unstable.

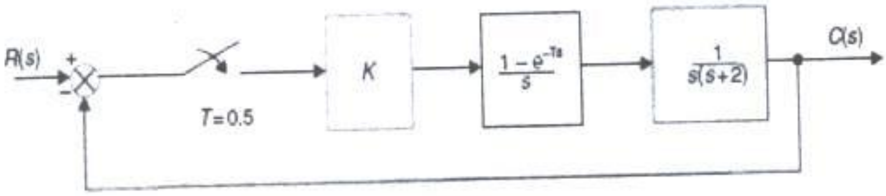

Figure 1

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[3] Given the block diagram of a sampled data system as shown in figure 2, where the sampling period T = 0.5 second and $H(s) = \frac{e^{-sT}}{1+2.24s}$:

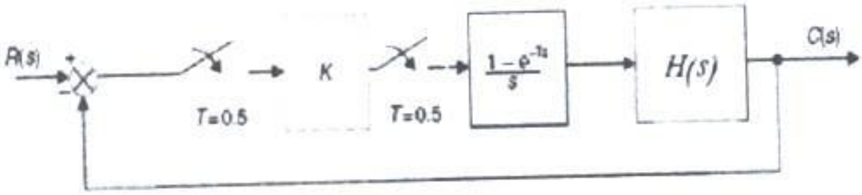

Figure 2

a) Determine the z transformed transfer function of the open loop system
b) Determine the positive values of K for which the system is unstable
c) Calculate the values of K so that the settling time $t_s(5\%) = 5$ sec.
d) Determine the overshoot in the step response found for K in (c).
e) Assume the system to be set so that no overshoot occurs; then determine the value of K and calculate $t_s(5\%)$.

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[4] **(a)** Write down the steps of designing a digital PID controller using pole placement method.

(b) Given an open loop transfer function $G(s) = \frac{1}{s(s+2)}$, design a digital PID controller using the pole placement method assuming sampling time of 1 sec. The desired characteristic equation is: $T(z^{-1}) = 1 - 1.1z^{-1} + 0.3z^{-2}$

Best wishes ...

University of Tanta **Faculty of Engineering** Third Year

Department of Electrical Power and Machines

2006-2007 **Electrical Testing and measurements** Time: Three Hours

Attempt ALL questions:

Question 1.

I. With zero field current, the generated voltage of a driven d.c. generator is V1. Then, On ampere of d.c. is passed in the normal direction and later on the field circuit is switche off. What will be the generated voltage then? Justify your answer by giving reasons.

II. What is the advantage of using a diverter resistance across the series field winding of d.c machines.

III. Aided with illustration(s) explain the effect of variation of the field circuit resistance o the voltage build up of d.c. shunt generator.

IV. A d.c. shunt generator builds up at 1500 rpm, but does not build up at 1200 rpm Comment.

V. A cumulatively compounded d.c. generator is first run at its rated speed and at no load. I develops a voltage of 220 volts, then it is operated as a differentially compounded generator at the same speed and at no load also. Will it build up? If yes, what will be the voltage at no load.

VI. The output voltage of d.c. shunt generator driven at a constant speed is to be kep constant at different loads. Will the generator field copper loss remain constant? Verify Your answer..

VII. A d.c. machine has a no load loss of 400 W. Its total losses at ¾ the of the its rating is 800 W. In which of the above two conditions, will the efficiency be higher. Verify.

VIII. A differentially compounded generator is delivering full load. Its shunt field circuit is opened, comment on he its terminal voltage

IX. Draw the detailed connection diagram of an experiment to determine the external characteristic of a cumulatively compounded d.c. generator including the details of the driving mover. Design a table that you use to enter your experimental data and required calculations and sketch the expected results. Is it required to keep the speed constant all over the test? Comment

Question 2.

I. A 250 V, 10 kW, d.c. motor has an armature resistance of 0.125 ohm. What should be the value of starting resistance and its current rating if the starting current is to be limited to full load current

II. If the starting resistance of a d.c. motor is high, what will be its effect? Verify your answer.

III. A d.c. motor is fed from a 230 V, d.c. supply. It runs at 1200 rpm, when its field current is 0.9 A. Comment on its speed variation when a suitable resistance is added to its field circuit.

IV. When loading a d.c. motor with a d.c. generator, how does the motor adjust itself automatically to meet the new conditions?

V. With reasoning, name one application of d.c. series motor.

VI. The series winding of differential compounded d.c. motor is short circuited. What would happen to its speed?

VII. Draw the detailed connection diagram of an experiment to determine the efficiency of a d.c. shunt motor that derives a dc generator. Design a table that you use to enter your experimental data and required calculations and sketch the expected results.

Question 3.

I. Explain in details what will happen if the high voltage side of a 230/115 V, 50 Hz transformer is connected to 230 V, 25 Hz supply?

II. List the different losses in a transformer and state the condition for maximum efficiency.

III. Does the user prefer a high voltage transformer? Verify your answer. What are the various causes of transformer voltage regulation?

IV. In an experiment on the load test of a single-phase transformer, it is noted that the wattmeter connected to the primary side reads some power even after the load is disconnected. Comment.

V. Draw the detailed connection diagram of an experiment to determine the variation, with supply voltage, of both the iron losses of a single phase transformer and one element in the equivalent circuit that account for this type of losses. Design a table that you use to enter your experimental data and required calculations and sketch the expected results.

Question 4.

I. Some people use the term "Short-circuit test of three-phase induction motor." Comment.

II. Can an induction motor draw a supply current with a leading power factor? Verify your answer.

III. List the different losses in squirrel-cage induction motors.

IV. Draw the detailed connection diagram of an experiment to determine the efficiency of a squirrel-cage induction motor that is loaded with an eddy-current brake. Design a table that you use to enter your experimental data and required calculations and sketch the expected results. What is the maximum number of torque/slip curves you can obtain from the test?

Question 5.

I. What are the various causes of voltage regulation of three-phase alternators? Could it have a negative value? Verify your answer.

II. Draw the detailed connection diagram of an experiment to determine the synchronous impedance of a three-phase synchronous alternator including the details of the driving mover. Design a table that you use to enter your experimental data and required calculations and sketch the expected results. Is it required to keep the speed constant all over the test? Comment.

مادة التحكم في الآلات الكهربية – سنة ثالثة قسم هندسة القوى والآلات الكهربية للطلاب المقيدين من الخارج فقط

Tanta University, Faculty of Engineering
Department of Electrical Power and Machines
Academic Year 2006/2007

Course: *Control of Electrical Machines*
Marks: *120*

Time Allowed: *Three Hours*
Date: 6/6/2007

Answer the Following Six Questions:

Question (1)

Figure (1) shows three different alternative methods to control the speed of an electric motor through a power electronic converter with a voltage gain G.

(a) State the main advantages and disadvantages of each controller.

(b) Show the main steps to decide whether a speed control is necessary for the motor.

(c) Define a suitable controller and converter in the case of a dc motor.

(d) Repeat part (c) in the case of an induction motor.

(e) Show how to use the adaptive control to overcome the main disadvantage of linear analog controllers.

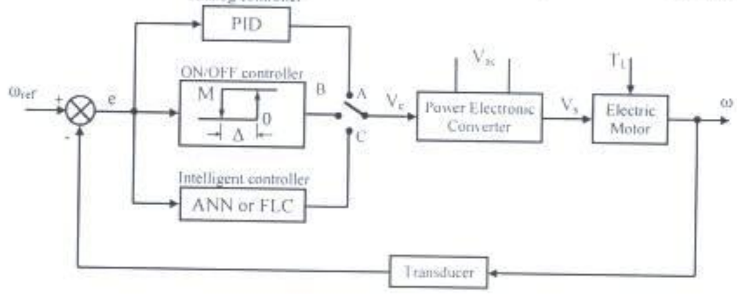

Figure (1)

Question (2)

It is required to control the speed of a separately excited dc motor fed from a single-phase thyristor bridge.

(a) Write the motor equations for transient operation and sketch its block diagram.

(b) Show why it is necessary to control its speed,

(c) Write the closed loop transfer function of the system $\frac{\omega(s)}{\omega_{ref}(s)}$.

(d) Design a speed controller as a function of the motor parameters to satisfy the following requirements:
   (i) Fast motor speed response.
   (ii) An overshoot less than 20% for step change in speed reference.
   (iii) Zero steady state error.

(e) For the controller designed in step (d), explain with the aid of sketch, the speed and current responses due to step change in single phase voltage supply.

Numerical data: 10 kw, 200 v, dc separately excited motor. The electrical time constant =20 ms, the equivalent armature resistance = 2 Ω, the back emf constant = 2 v/rad/sec, the inertia of the rotating parts = 0.2 kg.m^2, the equivalent gain of the thyristor bridge and its firing circuit = 100.

Continued, next page

Question (3)

In Figure (1) position (A), a separately-excited dc motor having a slotted disc with perimeter 36 slots as a transducer to measure the shaft speed and a divide by three counter is used in the feedback path:

i) Calculate the reference frequency if shaft speed of the motor is 1250 rpm.

ii) with the aid of sketches, explain the operation of this motor drive.

Question (4)

Describe how to design a feed-forward Artificial Neural Network (ANN) to act as intelligent controller for the system shown in Figure (1) position (C) to control the speed of a three phase induction motor.

Question (5)

Describe how to design a fuzzy logic controller to act as intelligent controller for the system shown in Figure (1) position (C) to control the speed of a three phase induction motor.

Question (6)

Draw the schematic of simple PID controller using OP-AMP and calculate all component values to meet the following transfer function:

$$\frac{V_c(s)}{E(s)} = \frac{12s^2 + 7s + 2}{s}$$

End of Exam Questions, Good Luck

Tanta University Faculty of Engineering Department of Electric Power and Machines Engineering		Year : Third Year Subject : Digital Control Systems Date : 13 / 6/ 2007 Time allowed: Three hours

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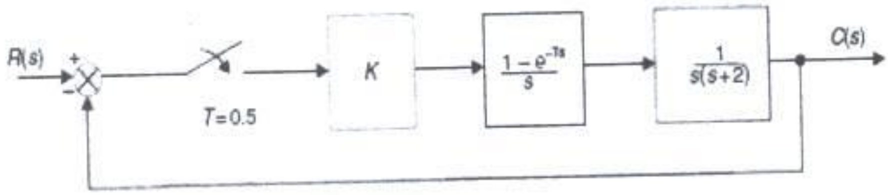

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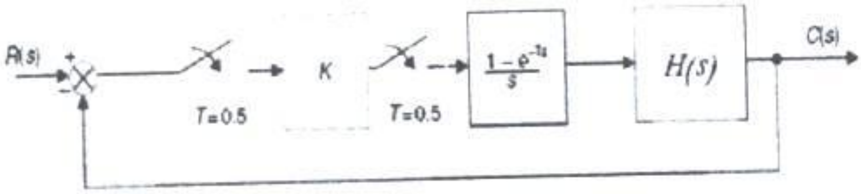

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