

Reg. No. : .....

Name : .....

**VI Semester B.Tech. (Reg./Sup./Imp.–Including–Part Time) Degree**  
**Examination, July 2011**  
**PT2K6/2K6EE602**  
**POWER ELECTRONICS**  
**(2007 Admn.)**

Time : 3 Hours

Max. Marks : 100

*Instructions: 1) Answer all questions.*

*2) Any missing data may be suitably assumed.*

- I. a) List different types of power diodes and explain their salient features. 5
- b) Explain the peripheral effects of power electronics equipment. 5
- c) Explain PWM technique. 5
- d) Discuss the role of freewheeling diode in a converter circuit. 5
- e) Explain the principle of operation of cycloconverter. 5
- f) Discuss the principle of operation of a step up chopper. 5
- g) Explain the principle of operation of Half-wave A.C. voltage regulator. 5
- h) List the merits and demerits of boost regulator. 5
- II. a) Explain the working principle of SCR with the help of V-I characteristics. 8
- b) Explain with neat sketch the working principle of enhancement MOSFET. 7
- OR
- c) Draw and explain the circuit diagram for the synchronized UJT triggering, also draw the voltage waveforms. 9
- d) Give the comparison b/w TRIAC and SCR. 6

P.T.O.



- III. a) Explain the working principle of 1 phase half-wave controlled converter with resistive load. Draw the voltage a/c the load waveform and derive the average load voltage and current expressions. **15**

OR

- b) Explain the operation of single -phase, half controlled bridge converter with resistive load with associated waveforms.  
Derive the expression for average load voltage and RMS load voltage. **15**

- IV. a) What is the principle of chopper ? Give the classification of chopper. **8**

- b) A d.c. chopper circuit connected to a 100 V D.C. source supplies an inductive load having 40 mH in series with a resistance of  $5\ \Omega$  . A free wheeling diode is placed across the load. The load current varies between the limits of 10A and 12A. Determine the time ratio of the chopper. **7**

OR

- c) With neat circuit diagram a relevant waveforms explain the working of single phase full-wave A.C. voltage regulator. **9**

- d) A single phase a.c. voltage regulator with R-L load has the details :

Supply voltage = 230 V, 50 Hz.

$R = 4\ \Omega$  and  $WL = 3\ \Omega$  calculate

i) the control range of firing angle.

ii) the maximum value of RMS current.

iii) the maximum power and power factor. **6**

- V. a) With the neat circuit and waveforms, explain a Buck converter circuit. **9**

- b) Explain any one arrangement of UPS. **6**

OR

- c) With the block schematic explain the off-line high frequency SMPS. **9**

- d) Write a technical note on reliability of UPS system. **6**

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**PT2K6/2K6 EE603 – POWER SYSTEMS – II**

Time : 3 Hours

Max. Marks : 100

*Instructions : 1) Answer all questions.  
2) Missing data may be assumed suitably.*

- I. a) Show that per unit reactance of transformer is same on either side of L.V. or H.V. side. 5
- b) Write a note on formation of  $Y_{BUS}$  by inspection method. 5
- c) Derive an expression for 3 phase power in terms of symmetrical components. 5
- d) Explain the sequence networks of synchronous machine. 5
- e) What is economic load sharing of generators ? Derive the necessary expression. 5
- f) With a block schematic explain the turbine speed governing system. 5
- g) What is swing equation ? Obtain swing equation for a multimachine system. 5
- h) Define the terms transient stability and dynamic stability. 5
- II. a) List the advantages of per unit calculations. 3
- b) Write a technical note on
- i) One line diagram
  - ii) Impedance diagram
  - iii) Reactance diagram
- for a sample power system selected. 12

OR

P.T.O.

c) Draw the per unit reactance diagram for the sample power system shown in fig. (1). Choose a base of 30 MVA and 6.6 KV in generator  $G_1$  ckt.

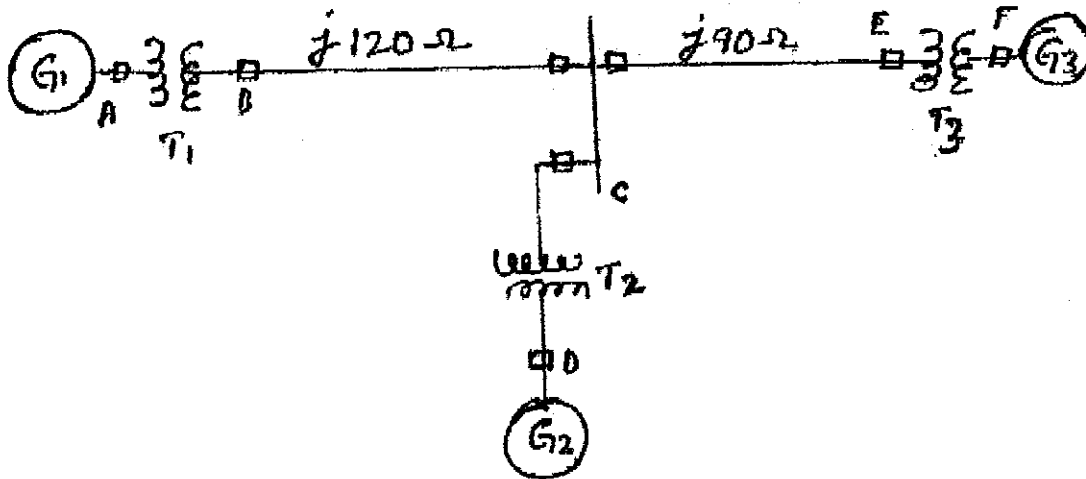


Fig. (1)

$G_1 = 25 \text{ MVA, } 6.6 \text{ KV and } X'' = 20\%$

$G_2 = 15 \text{ MVA, } 6.6 \text{ KV and } X'' = 15\%$

$G_3 = 30 \text{ MVA, } 13.2 \text{ KV and } X'' = 15\%$

Transformer 1 : 30 MVA, 6.6  $\Delta$  - 115 Y KV,  $X = 10\%$

Transformer 2 : 15 MVA, 6.6  $\Delta$  - 115 Y KV, with  $X = 10\%$

Transformer 3 : Single phase units, each rated 10 MVA, 6.9/69 KV, with  $X = 10\%$

15

III. a) Explain how the unbalanced phasor is drawn using three symmetrical components.

7

b) A single line to ground fault occurs at the terminals of an unloaded generator. Derive the expression for the fault current.

8

OR

c) A double line to ground fault occurs at the terminals of unloaded generator whose neutral is grounded through reactance. Draw the sequence n/ws and sequence components of currents.

15



IV. a) What are the assumptions made in evaluating incremental transmission loss rate and also determine the B-coefficients ? **15**

OR

b) With the block schematic explain automatic load dispatch in power systems. **15**

V. a) Obtain the power angle curve of a synchronous machine connected to infinite bus. **9**

b) A 50 Hz, 4-pole turbo-generator rated 100 MVA, 11 KV bus has an inertia constant of 8.0 MJ/MVA.

i) Find the stored energy in the rotor at synchronous speed.

ii) If the mechanical input is suddenly raised to 80 MW for an electrical load of 50 MW, find rotor acceleration neglecting mechanical and electrical losses. **6**

OR

c) Explain how the system stability is improved. **6**

d) A generator operating at 50 Hz delivers 1 p.u. power to an infinite bus through a transmission circuit in which resistance is ignored. A fault takes place reducing the maximum power transferrable to 0.5 p.u. whereas before the fault this power was 2.0 p.u. and after the clearance of the fault it is 1.5 p.u. By the use of equal area criterion determine the critical clearing angle. **9**

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**VI Semester B.Tech. (Reg. / Sup. / Imp. - Including Part Time) Degree  
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PT2K6/2K6EE604 – CONTROL SYSTEMS – I**

Time : 3 Hours

Max. Marks : 100

*Instructions : 1) Answer all the questions.  
2) Missing data can be suitably assumed.*

- 1. a) What do you mean by a block diagram ? What are the advantages ?
  - b) Name the analogous electrical elements in torque current and torque voltage analogy for the elements of mechanical rotational system.
  - c) Distinguish between type and order of a control system.
  - d) Write the block diagram of armature controlled dc motor.
  - e) Write a short note on constant M and N circles.
  - f) Discuss the advantages and disadvantages of the Bode plot compared to the Nyquist plot.
  - g) Give the steps involved in determining the pulse transfer function  $G(z)$  from  $G(s)$ .
  - h) Define one sided and two sided z-transform. (5×8=40)
2. a) Write the differential equations governing the behaviour of the mechanical system shown in Fig. 2 (a). Also obtain the analog electrical circuits based on (a) Force current analogy and (b) Force - Voltage analogy. 15

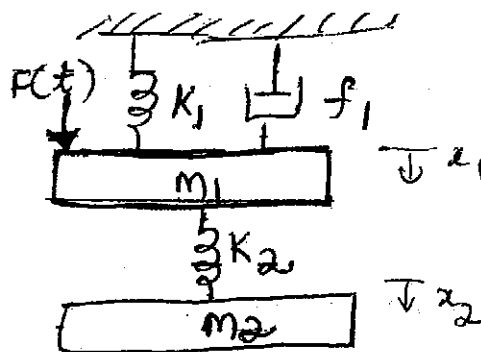


Fig. 2 (a)

OR

P.T.O.



- b) Obtain the transfer function of the feedback control system shown in Fig. 2 (b) by (i) block diagram reduction technique (ii) signal flow graph method. 15

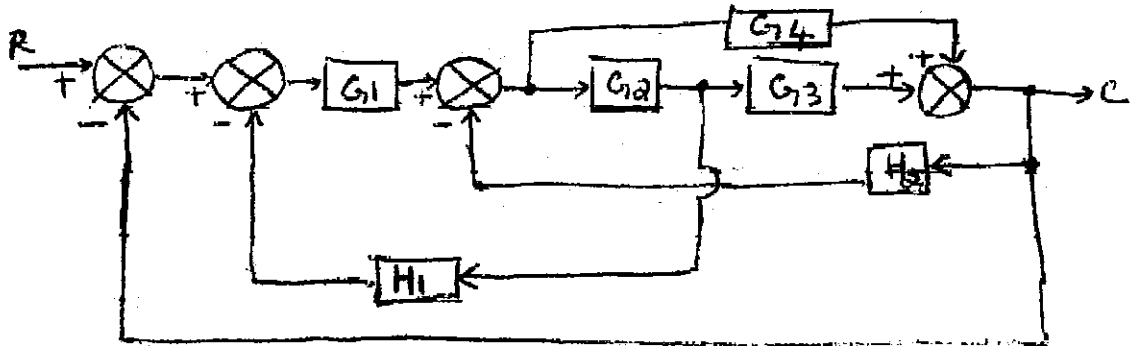


Fig. 2 (b)

3. a) Derive the transfer function of the armature controlled DC machine. (DC motor). 8  
 b) A unity feedback system is characterized by an open-loop transfer function.

$G(s) = \frac{k}{s(s+10)}$ . Determine the gain K so that the system will have a damping ratio of 0.5. For this value of K determine the settling time, peak overshoot and peak time for a unit step input. 7

OR

- c) Sketch the root locus for  $0 < k < \infty$ , for the system with the open-loop transfer function

$$G(s)H(s) = \frac{k}{s(s+2)(s^2+2s+2)}$$
15

4. a) Sketch the bode plots showing the magnitude in dB and phase angle in degrees as a function of log frequency for the transfer function

$$G(s)H(s) = \frac{2000}{s(s+2)(s+100)}$$

Determine the gain cross over frequency, phase cross over frequency, gain margin and phase margin. Also determine the value of k and the corresponding phase margin for a gain cross over frequency of (a) 10 rad/s (b) 1 rad/s. 15

OR



- b) Sketch the Nyquist plot and therefrom determine the stability of the closed loop system whose open loop transfer function is given by

$$G(s)H(s) = \frac{K}{s(s^2 + 12s + 20)} \quad 15$$

5. a) Find the one sided z-transform of the discrete sequences generated by mathematically sampling following continuous time functions.

- a)  $t^2$                       b)  $\sin \omega t$                       c)  $e^{-at} \cos \omega t$                       15

OR

- b) Explain the pulse transfer function briefly.                      9

- c) Describe the process of sampling in frequency domain.                      6
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**PT2K6 / 2K6 EE 605 : ELECTRICAL ENGINEERING DRAWING**

Time: 3 Hours

Max. Marks: 100

*Instruction : Answer all questions.*

1. a) Design and draw the developed winding diagram for an A.C. motor having the following details :
- No. of phase = 3  
No. of slots = 12  
No. of poles = 4  
Double layer full pitch wave with star connections. 18
1. b) Draw a neat single line of a 33 kV/11 kV substation with following equipment :
- i) One 33 kV incoming line connected to 33 kV bus bar.  
ii) Two 3 winding transformers rated 2 MVA and 1MVA of 33 kV/11 kV each terminating respectively at bus-bar 1 and bus-bar 2 of 11 kV each.  
iii) Two 11kV OCB's connected on LT side.  
iv) Three 33 kV GOS units.  
v) Four 11 kV outgoing feeders from bus-bar 1 and bus-bar 2. Provide lighting arrestors, isolators, circuits breakers, CT's and PT's wherever required. 12

OR

2. a) Design and draw the developed single layer lap winding of DC armature with 24 conductors and 4 poles. Also show the direction current in the coils and brush position. 18
2. b) Draw line diagram of a 11 kV sub-station with indicating transformer, L.A., CB etc. 12
3. a) Draw a neat proportionate longitudinal cross section of one limb of a three phase oil cooled power transformer with the following details showing the HV and LV windings.

P.T.O.



Core = 2 stepped

Diameter of the circumscribing circle = 22.6 cm diameter of the LV winding  
in 2 concentric layers = 25 cm (inside)

Outside diameter of LV winding = 28.1 cm

Inside diameter of HV winding = 32 cm

Outside diameter of HV winding = 36.8 cm

Height of LV winding = 41.2 cm

Height of HV winding = 40 cm.

The LV winding is 12 sections with insulation between them and the HV winding is in 09 sections with insulation between them. Show the complete details of the coil and insulation, duct if any between LV and HV coils by assuming any missing data.

15

3. b) Draw to  $\frac{1}{4}$ <sup>th</sup> scale the sectional end view, (right half in section) of a 50 kW dc generator dimensions :

- i) Thickness of yoke = 5 cms
- ii) No. of main poles = 4
- iii) Total height of pole = 14 cms (including pole shoe)
- iv) Width of main pole = 12 cms
- v) Main pole winding = 7 cm × 3 cm
- vi) No. of interpoles = 4
- vii) Interpole section = 10 cm × 4 cm
- viii) Air gap = 0.4 cm
- ix) Pole arc = 63% of pole pitch
- x) External diameter of armature stampings = 38 cms
- xi) Internal diameter of armature stampings = 20 cms
- xii) Size of slots = 3.5 cm × 1.5 cm
- xiii) No. of slots = 32
- xiv) Shaft dia = 6 cms
- xv) Interpole winding = 6 cm × 2 cm.

Armature stampings are mounted on the cast iron spider of external diameter 20 cms. Show few slots on the armature.

20

OR



4. a) Draw the front elevation left half in section, sectional plan and end view of a transformer with the dimensions given below. Scale 1/2 full size. Single phase core type 15 kVA, 50 Hz distribution type transformer. Cross section of core = 63 mm × 91.6 mm.

Window = 298.5 mm × 114.5 mm

Yoke Height = 63.5 mm

LT windings section of conductor = 2.79 mm × 10.6 mm one coil per leg

HV windings cross section of wire = 2.59 mm diameter

Air space around core = 1.66 mm

Insulation between core and LT = 1.6 mm

Insulation on HT = 3 mm

Insulation at the top and bottom of winding

Insulation between layer = 0.35 mm.

18

4. b) Following are the design details of an armature used for small D.C. motor :  
Diameter of the shaft = 5.4 cm; Coller diameter = 6.3 cm; Length of the hub = 24.75 cm; Outer dia. of armature core = 39.6 cm; Inner dia. armature core = 20.5 cm; Outer dia. of end ring = 34.2 cm; Thickness of the end ring = 1.35 cm; Thickness of the flange = 0.67 cm; Axial length of core = 24.75 cm; Number of armature slot = 48 cm; Area of parallel slot = 2.4 × 1.04 cm.

Draw to  $\frac{1}{4}$ <sup>th</sup> full size, assembled

i) Half sectional front elevation

ii) Half sectional end view.

Other missing data should be suitably assumed.

17

5. a) Draw the half sectionual end-view of a 25 kVA 400 V, 1500 rpm, 50 Hz, 3-phase alternator. The rotor is of salient pole type. The dimensions are given below :

Outside diameter of stator stamping : 40

Inside diameter of stator stamping : 29

External diameter of stator frame = 49

Number of slots : 48 (open type); Slot dimensions : 3.2 × 1.2; Air gap : 0.2;

Width of the pole = 7; Height of pole with shoe : 7.5; Pole shoe height = 1.8;

Diameter of shaft at centre : 7.0; Diameter of shaft at bearing : 5.5.

Alternator is housed on a base plate of 48 cm width. All dimensions are in cms.

Appropriate scale may be used. Missing data may be assumed.

17



5. b) A box type yoke of a squirrel cage induction motor is made of cast iron. The stator core is fixed to the yoke by dovetail joint between the rectangular type ventilating holes. The rotor is directly mounted over the shaft. There is a rectangular type ventilating hole above the shaft in the rotor core in each quadrant. The shaft is supported by end shield bearing. Draw the top sectional end view of the above assembly with the following main dimensions :
- i) Radial thickness of yoke – 7 cms
  - ii) Dia. of the shaft below rotor core – 2.54 cms
  - iii) Outer diameter of the rotor core – 15 cms
  - iv) Rotor has 30 slots of size (rectangular type) –  $1 \times 0.5$  cms
  - v) Air gap – 0.1 cm
  - vi) Stator slots – 36
  - vii) Depth of the taper type stator slots – 2.4 cms
  - viii) Width of teeth of parallel side – 0.6 cms
  - ix) Scale =  $\frac{1}{2}$  size.

18

OR

5. a) Draw the half sectional end view (with top half in section) of a 6 poles alternator with following dimensions. Show clearly the method of fixing the pole with rotor spider and stator core with the frame.

Air gap dia. of stator = 39.72

Outer dia. of stator = 56.61

Outer dia. of rotor = 38.48

Coil winding in 3 steps of width = 4.89, 3.47 and 1.53 each of 2.56 in height

Width of the pole = 7.68

Height of the pole = 7.68 with shoe

Pole arc = 15

No. of poles = 6

All dimensions are in cms, missing data may be suitably assumed.

17

6. b) Draw the half section end view and half section elevation of the squirrel cage rotor directly mounted over the shaft. Show clearly the method of fixing the rotor with the shaft. Diameter of rotor = 17.88 cm, length of rotor = 13.5 cm, one radial cooling duct = 1 cm wide, rotor conductor diameter = 0.9 cm, distance between ring and core = 0.5 cm, diameter of shaft below rotor core = 3.5 cm. Six vanes are fixed to the rotor and plates to help cooling.

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PT2K6/2K6EE606 (A) : ELECTRICAL SYSTEM DESIGN AND  
ESTIMATION**

Time: 3 Hours

Max. Marks: 100

*Instruction : Answer all questions. Missing data may be assumed suitably.*

- |      |  |    |
|------|--|----|
| I.   | a) List the code of practice for power installation.   | 5  |
|      | b) What are the factors considered for the choice of wiring system ?   | 5  |
|      | c) Explain the purpose or importance of estimation.  | 5  |
|      | d) Explain the single line diagram of wiring of a motor along with the actual motor wiring.                        | 5  |
|      | e) Explain briefly the requirements of good lighting.  | 5  |
|      | f) Write a note on LED lighting.   | 5  |
|      | g) What is a substation ? Name the factors that should be taken care of while designing and erecting a substation. | 5  |
|      | h) Write a note on comparison b/w indoor and outdoor substation.   | 5  |
| II.  | a) List the different systems of wiring. Explain the CTS or TRS wiring scheme.                                     | 8  |
|      | b) Explain what are the data required for estimation.  | 7  |
| OR   |  |    |
|      | c) Explain the load calculation and wire size selection for wiring.  | 5  |
|      | d) List the wiring materials for power circuits and their approximate costs.                                       | 10 |
| III. | a) Explain the estimation of wiring for pump sets and submersible pump sets is done.                               | 8  |
|      | b) Explain clearly the power installation for a theatre.   | 7  |

OR

P.T.O.

- c) A 10 H.P., 415 volt, 3  $\phi$ , 50 Hz squirrel cage induction motor is to be installed in a flour mill, the plan of which is shown in Fig. (i) Q. III. (c). Show the wiring diagram of the layout and estimate the quantity of materials required. Cost not necessary.

15

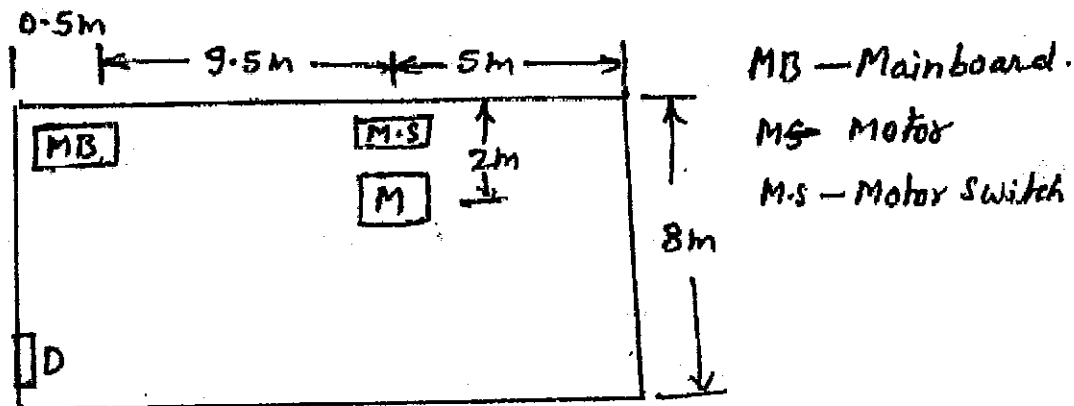


Fig. (i) Q. III. (c)

- IV. a) With a neat sketch explain the working of sodium vapour lamp. 9
- b) With neat sketches explain the asymmetrical light fittings. 6
- OR
- c) Explain the working principle of electric discharge lamps. 8
- d) Write a note on polar curves. 7
- V. a) With a neat one line sketch explain the operation of single bus-bar system with sectionalisation. 15
- OR
- b) With a neat one line key diagram of 11 kV/400 V indoor substation explain the operation. Justify the use of transformer ratings and C.B. ratings. 15