Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (BME)/SEP.SUPPLE/SEM-7/BME-703/2012

2012

POWER & CONTROL SYSTEM

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) The characteristics equation of a closed loop second order system is given as $s^2 + 4s + 16 = 0$ the resonant frequency in radian/sec of the system is

a) 2 b) $2\sqrt{3}$

c) 4 d) $2\sqrt{2}$.

ii) The unit step response of a network is $\left(1-e^{-at}\right)$ then the unit impulse response will be

a) ae^{-at} b) $ae^{-\frac{t}{a}}$

c) $\frac{1}{ae^{-at}}$ d) $(1-a)ae^{-at}$.

iii) The Routh array of a characteristic equation is given below :

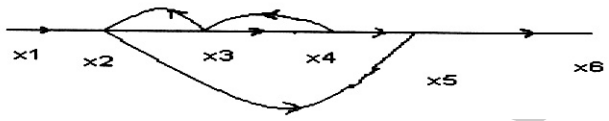
S^4	8
S^3	7
S^2	–3
S^1	2
S^0	1

The number of roots lying on the right hand side of *s*-plane is

a) 1 b) 2

c) 3 d) 4.

iv) The signal flow graph of a system is shown in the figure below. The number of forward path is



a) 2 b) 3

c) 4 d) 5.

v) For a unit step input, a system with forward path transfer function $G(s) = 20/s^2$ and feedback transfer function $H(s) = (s+5)$ has a steady state output of

a) 0 b) 5

c) 0·2 d) 10.

vi) When the gain K of a system becomes zero, the roots of the loci

a) move away from the poles

b) move away from the zeros

c) coincide with the poles

d) coincide with the zeros.

vii) When cathode is more positive with respect to anode for a thyristor, the number of blocked PN junction is

a) 1 b) 2

c) 3 d) 4.

viii) A thyristor may be termed as

a) DC switch b) AC switch

c) either (a) or (b) d) square wave switch.

ix) $\frac{di}{dt}$ protection for an SCR is achieved by

a) R in series with SCR b) L in series with SCR

c) R across SCR d) L across SCR.

x) Most suitable solid state devices for audio, VHF/UHF and microwave amplifiers is

a) IGBT b) S.I.T.

c) MOSFET d) P.U.T.

xi) For a continuous conduction freewheeling diode conducts in a single semi converter for

a) α b) $\beta - \Pi$

c) $\alpha + \Pi$ d) β.

xii) For a continuous conduction in a single phase semi converter each SCR conducts for

a) α b) Π

c) $\alpha + \Pi$ d) $\alpha - \Pi$.

xiii) In a single phase full converter, if output voltage has peak and average value of 325V and 133V respectively, then the firing angle is

a) 40° b) 140°

c) 50° d) 130°.

xiv) Each diode of a 3-phase half wave diode rectifier conducts for

a) 60° b) 120°

c) 180° d) 90°.

xv) In a single phase full converter, the number of SCRs conducting during overlap is

a) 1 b) 2

c) 3 d) 4.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

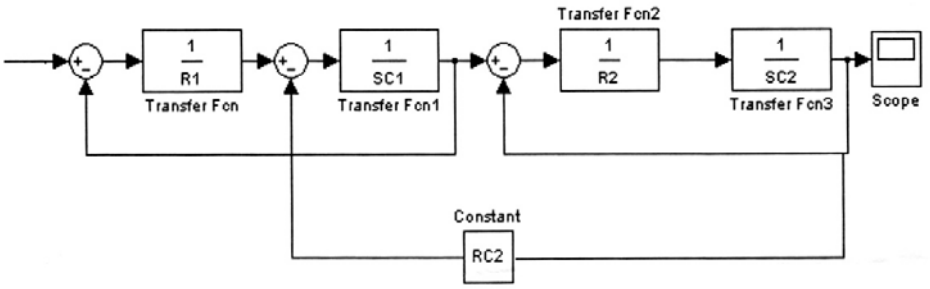
2. Write short note on any *one* of the following :

   i) Tachogenerator

   ii) Error detector

   iii) Synchro.

3. Find the overall transfer function of the system shown below :



   Use block diagram reduction method.

4. State Nyquist stability criterion & define gain margin, phase margin from the nyquist plot.

5. Draw the Static characteristics of a SCR, along with proper labelling. Also explain the different operating regions.

6. What are the applications of rectifier ?

7. Explain the function of a step down chopper.

GROUP – C
(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

8. A unity feedback control system has open loop transfer function $G(s) = \frac{k}{s(s+2)(s+5)}$. Sketch the root locus & show

   a) Line for $\zeta = 0 \cdot 5$ and value of k for this damping ratio.

   b) The frequency at which the root locus crosses the imaginary axis and the corresponding value of k.

   8 + 4 + 3

9. a) Draw the unit step response of 2nd order underdamped system & define the following term :

   Rise time, peak time, maximum peak overshoot, delay time, settling time.

   b) The open loop transfer function of a unity feedback system is $G(s) = \frac{k}{s(10+s)}$. Determine the gain of k so that the system will have a damping ratio of 0·5. For this value of k determine settling time, peak time & peak overshoot.

c) Obtain the unit impulse response & step response of a unity feedback system whose open loop transfer function is $G(s)=\frac{(2s+1)}{s \wedge 2}$. 5 + 5 + 5

10. a) Define the term 'gain margin' & 'phase margin'.

b) A unit feedback control system has open loop transfer function $G(s)=\frac{200(s+5)}{s(s+5)(s+20)}$. Sketch the bode plot & show the gain margin, phase margin, gain crossover frequency & phase cross over frequency. 4 + 7 + 4

11. a) Explain the two transistor analogy of a tyristor and derive an expression for the anode current using this analogy.

b) Explain briefly different communication process of SCR.

c) What is G.T.O. ?

d) Define holding and latching current of SCR.

7 + 5 + 1 + 2

12. Explain the principle of Chopper operation. Discuss the control strategies of chopper. What are the applications of chopper ? Classify choppers. 5 + 5 + 5

13. What is inverter ? What is a rectifier ? Explain the function of a single phase half controlled rectifier using inductive load. What do you mean by free-wheeling diode ? What happens if a free-wheeling diode is connected to the circuit of single phase half controlled rectifier having inductive load ?

1 + 1 + 1 + 5 + 1 + 6

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