MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

EC-503

CONTROL SYSTEM

Time Allotted: 3 Hours | Full Marks: 70

The questions are of equal value.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
All symbols are of usual significance.

GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. 10×1 = 10

(i) If the maximum overshoot is 100%, the damping ratio is
(A) 1 (B) 0 (C) 0.5 (D) ∞

(ii) The transfer function of an integral compensator is given by
(A) $\frac{1}{s}$ (B) $\frac{1}{s^2}$ (C) $\frac{k}{s}$ (D) ks

(iii) Additional of a pole to the close loop transfer function
(A) increases rise time (B) decreases rise time
(C) increases overshoot (D) has no effect

(iv) The root locus is symmetrical w.r.t.
(A) negative real axis (B) positive real axis
(C) imaginary axis (D) positive and negative real axis

(v) A feedback control system is basically
(A) high pass filter (B) band pass filter
(C) low pass filter (D) none of these

(vi) If the phase margin in negative, it indicates the system is
(A) highly stable (B) unstable
(C) oscillatory (D) it has nothing to do with stability

(vii) The initial slope of bode plot for a transfer function having single pole at origin is
(A) 20 dB/decade (B) – 40 db/decade
(C) 40 db/decade (D) – 20 db/decade

(viii) By increasing the gain k of the system the steady error of the system
(A) increases (B) decreases
(C) remain unaltered (D) none of these

(ix) Transfer function of a simple integrator where a=1/RC is given by
(A) $\frac{1}{s-a}$ (B) $\frac{1}{s+a}$ (C) $\frac{a}{s-a}$ (D) none of these

(x) If the poles of a control system lie on the imaginary axis in s plane the system will be
(A) unstable (B) stable
(C) conditionally stable (D) marginally stable

(xi) The poles of a system lie on -4 and -20 the system is
(A) overdamped (B) under damped
(C) critically damped (D) undamped

(xii) The settling time of a second order liner system is
(A) 4 times the time constant of the system
(B) 3 times the time constant of the system
(C) ¼ times the time constant of the system
(D) none of these

GROUP B
(Short Answer Type Questions)

Answer any *three* questions. 3×5 = 15

2. Distinguish between an open loop and a closed loop system. Determine the transfer function of a simple closed loop system. 3+2

3. State Mason's Gain formula. What is the difference between block diagram and signal flow graph? 2+3

4. Find the stability of the system whose characteristic equation is given by 5
$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

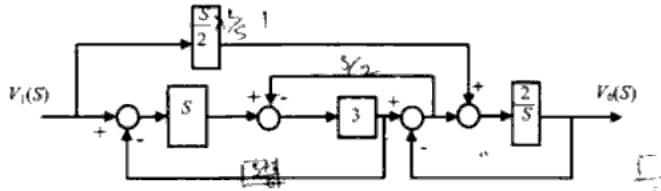
5. Write down the advantage and disadvantage of state space technique. 5

6. Design a lag compensator using R-C network. 5

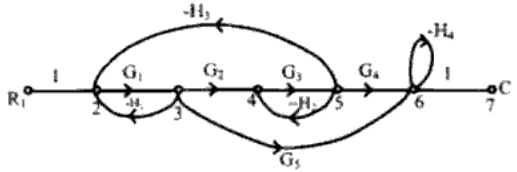
GROUP C
(Long Answer Type Questions)

Answer any *three* questions. 3×15 = 45

7. (a) Construct the equivalent signal flow graph for the block diagram shown in below and evaluate the transfer function using Mason's gain formula.



(b) Obtain the transfer function C/R form the given SFG. 9+6



8. (a) Define the following terms, Steady state error, Settling time, Peak Overshoot, Type and Order of a Control system. 5

(b) Sketch the transient response of a 2nd order system and derive the expression for rise time and peak overshoot. 5

CS/B.Tech/ECE/Odd/Sem -5th/EC-503/2015-16

(c) The forward path transfer function of a unity feedback control system is given by G(S) = 2/[S(S + 3)]. Obtain the expression for unit step response of the system. 5

9. (a) What are the difficulties that may arise in applying Routh stability criterion? What is relative stability? 3

(b) For the unity feedback system whose open loop transfer function is 12
$$G(s) = \frac{k}{s(s+1)(s+2)(s+5)}$$
(i) Find the range of k for stability of the system.
(ii) Find the value of k if the system is marginally stable.
(iii) Find the actual location of the closed loop poles when the system is marginally stable.

10. (a) Sketch the root locus for the open loop transfer function of a unity feedback control system given below and determine, (i) the value of K for $\xi = 0.5$, (ii) the value of K for marginal stability. 7
$$G(s) = \frac{K}{s(s+1)(s+3)}$$

(b) The open loop transfer function of an unity feedback system, 8
$G(s) = \frac{10(s+3)}{s(s+2)(s^2+4s+100)}$ Draw the Bode Polt and determine (i) gain crossover frequency (ii) phase crossover frequency (iii) gain margin (iv) phase margin.

11. (a) Using Nyquist criterion investigate the closed loop stability of a system whose open-loop T.F. $G(s)H(s) = \frac{K(s+1)}{(s+0.5)(s-2)}$. 10

(b) Write a short note on Relative and absolute stability of a control system. 5

12. Write short notes on any *three* of the following: 3×5
(a) Eigen value and Eigen vectors
(b) PID controller
(c) Polar plot
(d) Lead-Lag compensation
(e) Servo motors
(f) Kalman's Test.