MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL

EE-503

CONTROL SYSTEM – I

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.

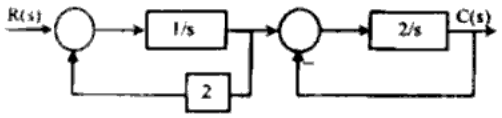
GROUP A
(Multiple Choice Type Questions)

1. Answer any *ten* questions. $10 \times 1 = 10$

(i) A servomechanism is

(A) an automatic regulating system
(B) a position control system
(C) a process control system
(D) a closed-loop system

(ii) The transfer function of a system shown in the block-diagram is



(A) $\frac{2}{(s+2)^2}$ (B) $\frac{1}{s^2(s+2)}$ (C) $\frac{2}{s^2+2}$ (D) $\frac{s}{s^2+2}$

HTTP://WWW.MAKAUT.COM

HTTP://WWW.MAKAUT.COM

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

(iii) A second-order feedback system has two closed loop poles at the same location in the S-plane and has no finite zeros. The nature of unit step response of the system is

(A) under damped (B) over damped
(C) critically damped (D) oscillatory

(iv) A negative feedback control system has open loop transfer function $G(s)H(s)=\frac{k}{s^2(s+a)}$. The closed loop system is

(A) unstable (B) stable
(C) marginally stable (D) conditionally stable

(v) A signal flow graph is used to determine the

(A) steady state error in the system
(B) stability of the system
(C) transfer function of the system
(D) dynamic error co-efficient

(vi) As compared to an open loop system, a closed loop system is

(A) more stable and more accurate
(B) more stable and less accurate
(C) less stable and more accurate
(D) less stable and less accurate

(vii) The Nyquist plot of a system encloses the point (–1, 0). The gain margin of the system is

(A) less than zero (B) greater than zero
(C) zero (D) infinite

(viii) The unit step response of a second-order system is

$$C(t) = 1 - 1.125\, e^{-3t} \sin(4t - 0.927).$$

The damping ratio and the damped frequency in rad/s are respectively

(A) 0.5, 3 (B) 0.5, 4
(C) 0.6, 5 (D) none of these

HTTP://WWW.MAKAUT.COM

HTTP://WWW.MAKAUT.COM

(ix) The addition of a PD controller in cascade with the plant

(A) improves damping
(B) reduces the steady state error
(C) increases undamped frequency
(D) increase the order of the system

(x) The transfer function of a phase-load compensator is $G_c(s)=\frac{1+Ts}{1+0.333Ts}$.

The maximum phase contribution from the compensator is

(A) 20° (B) 30°
(C) 45° (D) 60°

(xi) The gain margin in dB for a system with open-loop transfer function $G(s)=\frac{2\sqrt{2}}{s(s+2)^2}$ is

(A) 0 (B) 6 dB
(C) 9 dB (D) 12 dB

(xii) The open-loop transfer function of a negative feedback system is $G(s)H(s)=\frac{k}{s(s+1)(s+2)}$. The root crosses the imaginary axis when the value of k is

(A) 8 (B) 6
(C) 4 (D) 2

HTTP://WWW.MAKAUT.COM

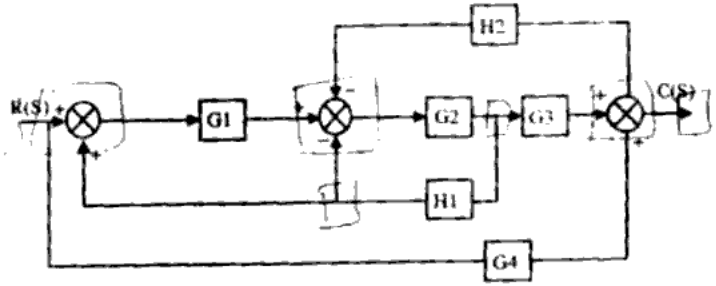
HTTP://WWW.MAKAUT.COM

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

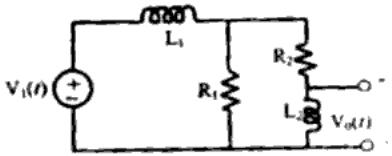
GROUP B
(Short Answer Type Questions)

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

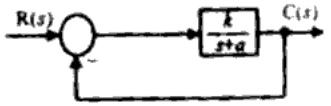
2. Obtain the transfer function C/R of the block diagram shown using Mason's Gain Formula.



3. Draw a block diagram representation for the system shown below, representing every element by a block. Also find the transfer function $\frac{V_0(s)}{V_i(s)}$.



4. For a first order system shown below, find the time constant, rise time and setting time for step response, given $k = 12$ and $a = 4$



HTTP://WWW.MAKAUT.COM

5. A unity feedback control system has the open loop transfer function

$$G(s)=\frac{k}{s(s^2+4s+20)}$$

Specify the type of the system.
Find the static error constants and the corresponding steady state errors.
Assume that the system is stable.

6. The characteristic equation of a feedback system is

$$s^4+4s^3+16s^2+16s+48=0$$

Check whether the response is oscillatory or not. If so, determine the frequency of oscillation.

GROUP C
(Long Answer Type Questions)

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

7. The forward path and feedback path transfer functions of a negative feedback system are $G(s)=\frac{5}{s^2(s+2)}$ and $H(s)=(s+a)$ respectively. Sketch the root contour for the system with respect to the parametera. For what range of value of 'a' does the system remain stable?

8.(a) A second order system is described by the differential equation. 5

$$\frac{d^2y(t)}{dt^2}+0.8\frac{dy(t)}{dt}+y(t)=x(t).$$

When $x(t)$ is the input and $y(t)$ is the output. Determine resonance frequency, peck resonance, cut off frequency and band width.

(b) Sketch the polar plot of 10

$$G(s)=\frac{32}{(s+4)(s^2+4s+8)}$$

And find its points of intersection with real and imaginary axes.

9. Construct the Bodo plots for a unity feedback system whose open loop transfer function is given by $G(s)=\frac{10}{s(s+1)(1+0.025)}$. From the Bodo plot determine :
   (i) Gain and phase cross over frequencies
   (ii) Gain margin and phase margin
   (iii) Stability of the closed loop system.

10. A feedback control system has forward path gain $G(s)=\frac{2}{s(s-1)}$ and feedback path gain $H(s)=(s+1)$.
Draw the Nyquist diagram for the system and assess the stability of the closed loop system.

11. Write short notes on any *three* of the following: 3×5
   (a) PID controller
   (b) Position encoders
   (c) Servo motors
   (d) Syncros
   (e) Block diagram of speed control of dc motor.