Total No. of printed pages = 7

CAI-501/CS/5th Sem/2017/N

# CONTROL SYSTEMS

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

1. Fill in the blanks : $10 \times 1 = 10$

(a) _____ Feedback is employed in control systems.

(b) A physical system is a collection of _____ connected together.

(c) In mechanical _____ system, motion takes place about a fixed axis.

(d) The inverse Laplace transform of $1.5/s(s+1)$ is _____.

(e) _____ is called the loop transfer function or open-loop transfer function.

[Turn over

(f) The Laplace transform of impulse function is _____.

(g) A system with two open loop poles at the origin of the s-plane is called a _____.

(h) Stability is a very important characteristic of the _____ response of the system.

(i) The frequency where M has a peak value is known as the _____.

(j) $M_r$ and $M_p$ depends only on _____.

2. Choose the correct answers : 11×1=11

(i) A synchro transmitter is used for

(a) Feedback (b) Amplification

(c) Error Detector (d) Remote sensing

(ii) In an automatic control system, which of the following elements is not used ?

(a) Error detector

(b) Final control element

(c) Sensor

(d) Oscillator.



(iii) The frictional force acts in a direction

(a) opposite to that of motion

(b) along that of motion

(c) perpendicular to that of motion

(d) towards to that of motion.

(iv) A system has the following transfer function :

$G(s) = 100(s+5)(s+50)/s^4(s+10)(s^2+3s+10)$

The type and order of the system are, respectively,

(a) 4 and 9 (b) 4 and 7

(c) 5 and 7 (d) 7 and 5

(v). For the system $C(s)/R(s) = 16/s^2+6s+16$, the nature of the time response will be

(a) Overdamped (b) Undamped

(c) Critically damped (d) Underdamped

(vi). The steady state error for a type 2 system subjected to unit ramp input is

(a) 1 (b) infinity

(c) 1/K (d) 0

(vii) Three blocks with gains of 4, 6 and 8 are connected in parallel. The total gain of the arrangement is

(a) 17 (b) 160

(c) 44 (d) 37.

(viii) The overshoot due to decrease of damping factor

(a) increases (b) decreases

(c) remains constant (d) None of the above.

(ix) The damping ratio of a system is 0.5. the value of $M_r$ is

(a) 2.308 (b) 1.54

(c) 1.01 (d) 0.5

(x) The root locus is

(a) an algebraic method

(b) a graphical method

(c) combination of graphical and algebraic methods

(d) None of these.



(xi) If the system has G(s) = 1/s(1+4s), the system is

(a) stable

(b) unstable

(c) marginally stable

(d) conditionally stable.

3. Match the following : 4×1=4

| | |
|---|---|
| (i) Overdamped | (a) Complex conjugate |
| (ii) Underdamped | (b) Real and different |
| (iii) Critically damped | (c) Purely imaginary |
| (iv) Undamped | (d) Real and equal. |

Answer any *five* questions : 5×9=45

4. Draw the equivalent signal flow graph and determine the overall gain using Mason's gain formula.

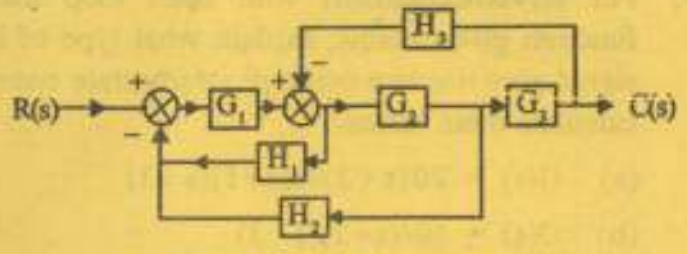


Figure 01

5. Derive the transfer function $\Theta_2(s)/T(s)$ for the given rotational mechanical system shown in below figure 02.

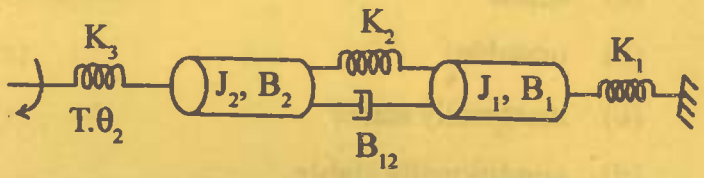


Figure 02

6. Write short notes on synchro and AC position control system.

7. The forward path transfer function of a unity feedback control system is given by $G(s) = 2/s(s+3)$, obtain an expression for unit step response of the system.

8. A unity feedback control system has an open loop transfer function, $G(s) = 12/s(s+3)$. Find the natural frequency, damping ratio, peal time, percentage overshoot and settling time for a step input of 10 units.

9. For servomechanisms with open loop transfer function given below, explain what type of input signal give rise to a constant steady state error and calculate their values.

   (a) $G(s) = 20(s+2)/s(s+1)(s+3)$

   (b) $G(s) = 10/(s+2)(s+3)$

   (c) $G(s) = 10/s^2(s+1)(s+2)$.



10. Using Routh criterion, determine the location of the roots of the following characteristic equations and comment on the stability of the systems.

    (a) $S^4 + 2s^3 + 10s^2 + 8s + 3 = 0$

    (b) $S^5 + s^4 + 24s^3 + 48s^2 - 25s - 5 = 0$.

11. Write the rules for construction of root locus ?