M.Sc. 3rd Semester Examination, 2024

ELECTRONICS

(*Control System & Instrumentation*)

PAPER — ELC-303

Full Marks : 50

Time : 2 hours

Answer **all** questions

The figures in the right hand margin indicate marks

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

GROUP — A

Answer any **four** questions :   2 × 4

1. Differentiate between open loop transfer function and closed loop transfer function.   2

2. Open loop transfer function of a control system is given by

$$G(s) = \frac{5}{(S+2)(S+3)} \text{ and } H(s) = 1.$$

Determine its characteristic equation.   2

3. What information does the phase margin of a system provide ?   2

4. Draw the polar plot for the system

$$G(s) = \frac{K}{(1+ST_1)(1+ST_2)(1+ST_3)}.$$ 2

5. Write two applications of cathode ray oscilloscope.   2
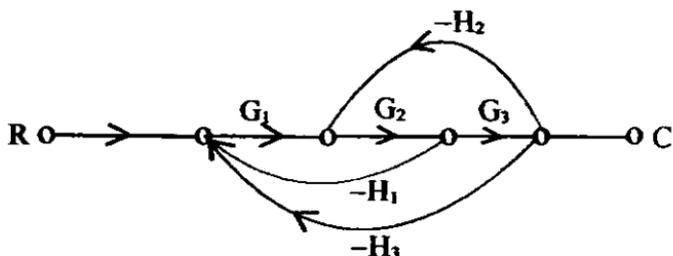
6. Differentiate between active transducer and passive transducer.   2

GROUP — B

Answer any **four** questions :   4 × 4

(*Continued*)

7. The signal flow graph of a control system is given by   4

Determine the overall transfer function.

8. The open loop transfer function of a control system with unity feedback is given by

$$G(S) = \frac{10}{(S+2)(S+5)}$$

Determine the damping ratio, undamped natural frequency of oscillation. What is the percentage overshoot of the response to a unit step input.   1 + 1 + 2

(**4**)

9. Determine the stability of the system whose characteristic equation is given by
$$S^5 + 2S^4 + 3S^3 + 6S^2 + 5S + 3.$$ 4

10. For a unity feedback control system the forward path transfer function is given by

$$G(S) = \frac{20}{S(S+2)(S^2+2S+20)}$$

Determine the steady state error of the system. when the inputs are

(i) 5

(ii) $5t$

(iii) $\frac{3t^2}{2}$ $1 + 2 + 2$

11. Write working principle of piezo-electric transducer.   4

12. What is the slope of the line for a transfer function of $\frac{1}{(s+a)}$ in a Bode plot. What do you mean by corner frequency in a Bode plot ? $2 + 2$

(5)

Answer any **two** questions : 8×2

13. The characteristic equation of a control system is given below

 $S^4 + 25S^3 + 15S^2 + 20S + K = 0$

    Determine the range of k for stability. Determine the value of k so that the system is marginally stable and find the frequency of sustained oscillation. $2 + 2 + 2 + 2$

14. For the system shown in figure (a,b) below, sketch the Nyquist plot for k = 2 and use the Nyquist criterion to determine whether the closed loop system is stable for this gain. Find the range of k for the system to be stable
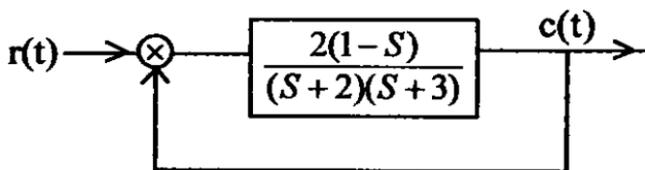
(a) System
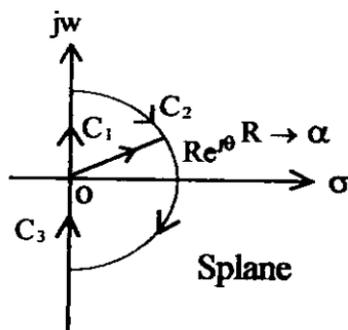
$6 + 2$

(b) Nyquist contour

15. A unity feedback control system has an open loop transfer function

$$G(S) = \frac{K}{S(S^2 + 4S + 13)}$$

sketch the root locus plot of the system by determining the following

(a) Centroid, number and angle of asymptotes

(b) Angle of departure of root locii from the poles

(Continued)

(c) Breakaway point if any

(d) The value of K and the frequency at which the root lociis cross jw axis.

$$2 + 2 + 2 + 2$$

16. Using block diagram explain a signal generator.

[Internal Assessment — 10 Marks]

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