BRAINWARE UNIVERSITY

Term End Examination 2023-2024
Programme – Dip.RA-2022
Course Name – Robotic Control System
Course Code - ECPC403
(Semester IV)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Select the appropriate one for an open-loop control system.

a) Output is independent of control input
b) Output is dependent on control input
c) Only system parameters have effect on the control output
d) None of the option

(ii) For the open control system, select which of the following statements is incorrect.

a) Less expensive
b) Re-calibration is not required for maintaining the required quality of the output
c) Construction is simple and maintenance easy
d) Errors are caused by disturbances

(iii) Indicate the control system in which the control action is somehow dependent on the output.

a) Closed loop system
b) Semiclosed loop system
c) Open system
d) None of the option

(iv) Predict the physical mean if the initial conditions for a system are inherently zero.

a) The system is at rest but stores energy
b) The system is working but does not store energy
c) The system is at rest or no energy is stored in any of its part
d) The system is working with zero reference input

(v) Select from the following: an open-loop control system.

a) Field controlled D.C. motor
b) Ward leonard control
c) Metadyne
d) Stroboscope

(vi) In an open-loop system, select from the following:

a) the control action depends on the size of the system
b) the control action depends on system variables
c) the control action depends on the input signal
d) the control action is independent of the output

(vii) Given a unity feedback system with $G(s) = K/[s(s+4)]$, indicate the value of K for a damping ratio of 0.5.

a) 1
b) 16
c) 4
d) 2

(viii) A closed-loop system is distinguished from an open-loop system; select the appropriate one.

a) Servomechanism
b) Feedback
c) Output pattern
d) Input pattern

(ix) Examine the band width of a feedback amplifier.

a) remains unaffected
b) decreases by the same amount as the gain increase
c) increases by the same as the gain decrease
d) decreases by the same amount as the gain decrease

(x) Determine which matrix in the state space representation describes the dynamics of the system.

a) State matrix
b) Input matrix
c) Output matrix
d) Direct transmission matrix

(xi) Determine which of the following methods can be used to obtain a state space representation from a transfer function.

a) Pole-zero cancellation
b) Bode plot analysis
c) Eigenvalue analysis
d) Partial fraction expansion

(xii) Show that the transfer function of a system is used to calculate which of the following:

a) The order of the system
b) The time constant
c) The output for any given input
d) The steady state gain

(xiii) Examine what the term "controllability" refers to in state space analysis.

a) The ability to observe all state variables.
b) The ability to control all state variables.
c) The ability to stabilize the system.
d) The ability to transform the system into canonical form.

(xiv) In block diagram algebra, select the purpose of a block diagram reduction.

a) To make the diagram more complex
b) To simplify the diagram for analysis
c) To add more blocks to the diagram
d) To color the diagram for clarity

(xv) Choose which of the following statements is true regarding complex conjugate poles in the root locus plot.

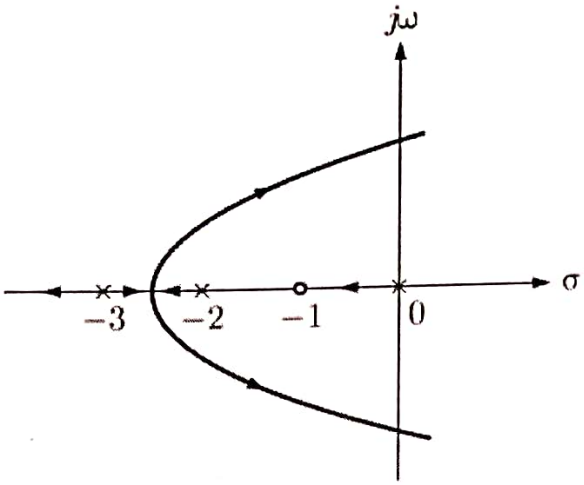
a) They always lie on the real axis.
b) They move towards each other as the gain increases.
c) They move away from each other as the gain increases.
d) They remain stationary regardless of the gain.

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Describe any three frequency response specifications used for the design of the control system. (3)

3. The root locus plot for a system is given below. Calculate the open-loop transfer function (3)



corresponding to this plot.

4. Construct the pole-zero map of the following transfer function. (3)

$$G(s) = \frac{(s-2)(s+2+j4)(s+2-j4)}{(s-3)(s-4)(s-5)(s+1+j5)(s+1-j5)}$$

5. Define feedback and non-feedback control systems. (3)

6. For frequency response analysis, write the frequency domain specifications. (3)

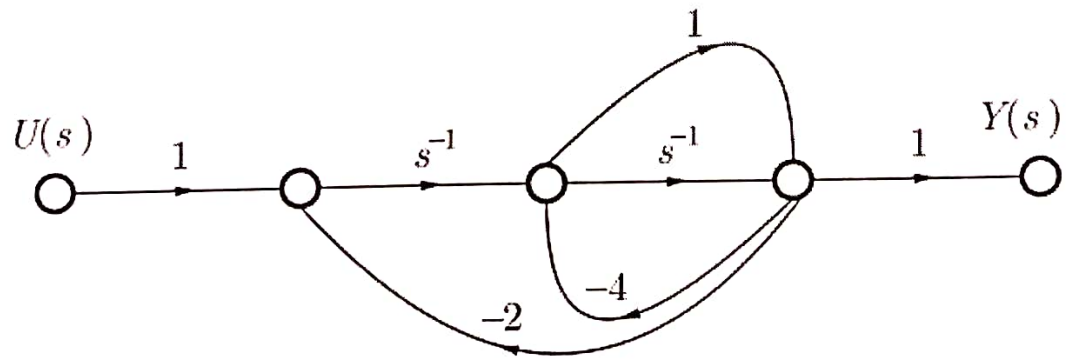
OR

Write about the advantages of frequency domain analysis. (3)

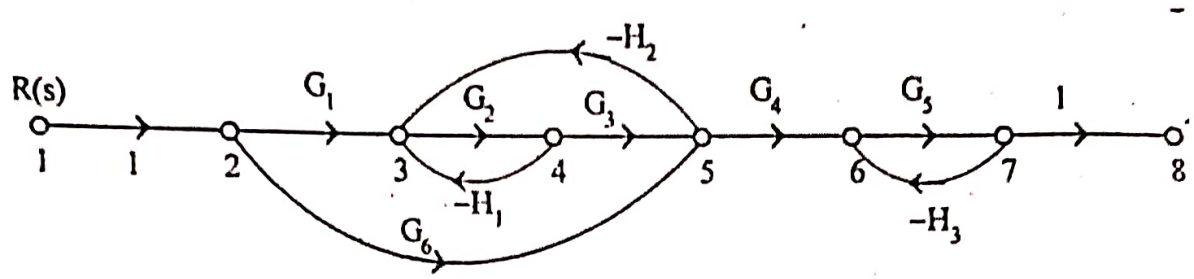
Group-C

(Long Answer Type Questions) 5 x 6=30

7. The signal flow graph for a system is given below. Evaluate the transfer function U(s)/Y(s) for this system. (5)



8. Indicate the overall transfer function of the system whose signal flow graph is shown in Fig. (5)



9. Define degenerative and regenerative feedback control systems. (5)

10. Draw the Bode magnitude and phase plot of the following open-loop transfer function and solve for the gain margin, (5)

$$G(s)H(s) = \frac{1}{s(s+2)(s+4))}$$

phase margin, and absolute stability.

11. Describe the ramp response of a first-order system. (5)

12. Explain the differential equation modeling of translational mechanical systems. (5)

OR

Explain the differential equation modeling of rotational mechanical systems. (5)

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