17644

BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – Dip.RA-2024
Course Name – Robotic Control System
Course Code - DEC30105
(Semester III)

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) Recall the definition of an open-loop control system.

a) Operates using feedback
b) Works without feedback
c) Self-correcting system
d) Real-time adaptable system

(ii) Recall which system uses sensors to regulate output.

a) Manual
b) Closed-loop
c) Open-loop
d) Isolated

(iii) Apply classification to control systems used in robotics.

a) Adaptive only
b) Open-loop only
c) Linear or Nonlinear
d) Static

(iv) Define the nature of step input in control systems.

a) Constant slope
b) Linear rise
c) Instantaneous jump
d) Sine wave

(v) Define the transient response of a second-order underdamped system.

a) Pure oscillation
b) Critically damped
c) Oscillatory with decay
d) Overdamped

(vi) Identify the type of input for velocity constant evaluation.

a) Step
b) Ramp
c) Parabolic
d) Impulse

(vii) Interpret time-domain specification related to peak time.

a) Time to zero error
b) Time to first peak
c) Time to settle
d) Time to maximum rise

(viii) Estimate steady-state error of type-1 system with unit ramp input.

a) 0
b) 1
c) ∞
d) 0.5

(ix) Classify the system as unstable if Routh array has

a) Zero in second row | b) Negative coefficient in numerator
c) Sign change in first column | d) All rows positive

(x) Outline the importance of root locus plot.

a) Time-domain representation | b) Frequency-domain output
c) Graphical method to locate root positions | d) Only for marginally stable systems

(xi) Determine location of breakaway point for poles at 0 and -3.

a) -1.5 | b) 1.5
c) 0 | d) -4

(xii) Define the purpose of Bode plots in control system analysis.

a) Show time delay | b) Show time constants
c) Show frequency response | d) Show error constants

(xiii) Interpret the term "relative stability" in frequency response.

a) System damping | b) Gain margin only
c) Distance from instability in Bode plot | d) Response to parabolic input

(xiv) Define what is represented in a logarithmic magnitude vs phase plot.

a) Time vs amplitude | b) Nyquist gain vs time
c) Frequency vs time | d) Magnitude vs phase angle

(xv) Outline how frequency response indicates stability.

a) Zero gain | b) High overshoot
c) Positive Nyquist encirclement | d) Phase and gain margins

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Define an open-loop control system with an example. (3)
3. Describe the working of a closed-loop control system. (3)
4. Explain the role of standard input signals in time domain analysis. (3)
5. Sketch the basic form of a Bode plot for a first-order system. (3)
6. Analyse the effect of damping ratio on the transient response of second-order systems. (3)

OR

Compare the time domain specifications obtained for a unit step input and a unit ramp input in a second-order system. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. Justify selection of Nyquist plot over Bode plot in certain stability analyses. (5)
8. Defend the role of frequency domain methods in modern control system design. (5)
9. State the differences between open-loop and closed-loop control systems in detail. (5)
10. Describe with diagram how a closed-loop system operates, including feedback. (5)
11. Recall the steps to derive transfer function from differential equations. (5)
12. Identify key features in a Nyquist plot and link them to system stability for different gain values. (5)

OR

Differentiate between absolute and relative stability in the context of Bode and Nyquist methods. (5)

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