Indian Maritime University

(A Central University, Govt of India)

End Semester Examinations – June 2026

Programme Name: B Tech (ME)

Semester: IV

Subject Code: UG11T5405

Subject Name: Control Engineering and Marine Automation

Date: 15.06.2026	Max Marks: 70
Duration: 03 Hrs	Pass Marks: 35

General Instructions

(i) All Sections (A, B & C) are to be attempted.
(ii) Options, if any, are specified in respective section.

Section A

All questions are compulsory (10 x 1 = 10 Marks)

1. For a type one system, the steady state error due to step input is equal to

A) Infinite

B) Zero

C) 0.25

D) 0.5

2. Effect of small hysteresis in On-Off Control is

(A) Improved accuracy

(B) Reduced frequency of oscillations

(C) Increased amplitude of oscillations

(D) None of the above

3. Rate control means

(A) Derivative Control

(B) Integral Control

(C) Proportional Control

(D) On-Off Control

4. The value of damping ratio ζ for an under damped system, is

(A) $\zeta = 0$

(B) $\zeta > 1$

(C) $0 < \zeta < 1$

(D) $\zeta = 1$

5. Transfer Function in control system is defined as

(A) Ratio of Laplace Transform of output to Laplace Transform of input

(B) Ratio of output by input

(C) Ratio of Input by output

(D) Ratio of Z-Transform of output to Z-Transform of input

6. For a linear time-invariant system to be stable, all closed loop poles must lie

(A) On imaginary axis

(B) In right half-plane

(C) At origin

(D) In left half-plane

7. The Closed Loop Transfer Function of a system is given by

$G(s) = 100 (s +1) / s(10s^2+5s+3)$. The Type Number of this system is

(A) 0

(B) 1

(C) 2

(D) 3

8. Rise-time decides

(A) Accuracy

(B) Speed

(C) Stability

(D) Offset

9. If controllability matrix rank < n, then system is:

(A) Stable

(B) Not Controllable and not Observable

(C) Not controllable

(D) Marginally stable

10. A lag compensator primarily improves:

(A) Stability

(B) Transient response

(C) Overshoot

(D) Steady-state accuracy

Section B

All questions are compulsory **(5 x 2 = 10 Marks)**

11. Define various types of input signals commonly used in control system.

12. For a first order system with Transfer Function G(s) = 2/(s+5), find the DC Gain and Time Constant. Also write the expression for it's response for unit step.

13. Comment on accuracy and reliability of sensor.

14. What are the standard signal levels for Pneumatic transmitters and Electrical transmitters?

15. Define Controllability and Observability.

Section C

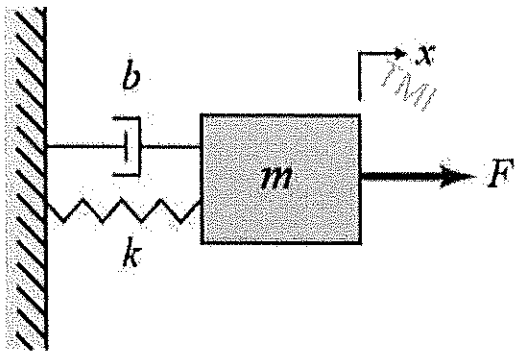
Answer any 5 questions **(5 x 10 = 50 Marks)**

16. (a) Compare Closed loop systems and Open loop systems with one example each. (5)

(b) Obtain the Mathematical Model for the system shown below.

m=Mass, k=Spring constant, b= Viscous friction,

x=Position output, F= Force input (5)



17. (a) Explain On-Off Control with hysteresis. (5)

(b) Explain Cascade Control. (5)

18. (a) Why PID tuning is required .Explain Ziegler Nicholas method of PID tuning. (5)

(b) The open loop transfer function of a unity feedback system is given as

$$G(s)H(s)=\frac{5(s+20)(s+50)}{(s+10)(s+100)}$$

Draw the bode magnitude plot. (5)

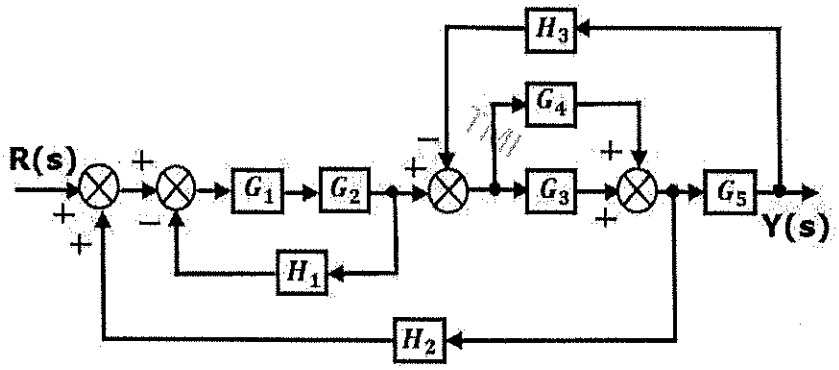
19. (a) For a unity feedback system given below, find the error coefficients and steady state errors for step, ramp and parabola inputs.

$G(s) = (s+1) / (s^2+7s+3)$ (5)

(b) Find the stability using Routh-Hurwitz criteria for the system with the following characteristic equation.

$S^6 + s^5 + 3s^4 + 2s^3 + s^2 + 2s + 1 = 0$ (5)

20. (a) Predict the Transfer Function of the following Block Diagram (5)



(b) The open loop transfer function of a unity negative feedback system is given by $k / [s(s+1)(s+2)]$. Draw an approximate Root Locus as the value of k varies from zero to infinity. Show the asymptotes, centroid and breakaway points (5)

21. (a) Obtain the transfer function of a system described by the following state equations

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -2 & 1 \\ 1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(5)

(b) Explain the alarms and safety interlocks in the Main Engine Control system. (5)

22. Explain Boiler automatic cross loop combustion with a diagram (10)

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