Indian Maritime University

(A Central University, Govt. Of India)

B Tech (Marine Engineering)

Supplementary Examinations – March/April 2025

ADVANCED MARINE CONTROL ENGINEERING & AUTOMATION

UG11T3702

Time: 3 Hours	**Max Marks: 70**
Date: 15.03.2025	**Pass Marks: 35**

Part A – 10 MCQs (compulsory) (10 X 01 Mark)

1.(I). Which of the following is the input to a controller?

A. Servo signal.
B. Desired variable value.
C. Error signal.
D. Sensed signal.

(II). Which mechanism in control engineering implies an ability to measure the state by taking measurements at output?

A. Controllability.
B. Observability.
C. Differentiability.
D. Adaptability.

(III). Which one is not an input to the auto pilot system?

A. Main engine RPM.
B. Ship's speed.
C. Rate of turn.
D. Turn radius.

(IV). When does master controller in a boiler automatic combustion control system comes into action?

A. When there is variation in steam flow rate.
B. When there is variation in fuel supply.
C. When there is variation in draught.
D. When there is variation in steam pressure.

(V). If the trajectory path x (t) approaches the origin, irrespective of the disturbance applied near the origin or far from the origin, then the system is

D. Unstable.

(VI). The polar plot of a transfer function passes through the critical point (-1, 0). Gain margin is

A. -1dB.
B. 1dB.
C. Infinity.
D. Zero.

(VII). What is the number of the root locus segments which do not terminate on zeroes?

A. The number of poles.
B. The difference between the number of poles and zeroes.
C. The number of zeroes.
D. The sum of the number of poles and the number of the zeroes.

(VIII). A system has a single pole at the origin. Its impulse response will be

A. Constant.
B. Ramp.
C. Decaying exponential.
D. Oscillatory.

(IX). The overall transfer function from block diagram reduction for cascaded blocks is

A. Sum of individual gain.
B. Product of individual gain.
C. Difference of individual gain.
D. Division of individual gain.

(X). In pneumatic control systems the control valve used as the final control element converts

A. Position change to pressure signal.
B. Electric signal to pressure signal.
C. Pressure signal to electric signal.
D. Pressure signal to position change.

Part B – Short Questions (compulsory) (5 X 02 Marks)

2.(I) What are the UMS requirements pertaining to automatic fire detection and alarm system? (2

(III). A unity feedback system has,

$$G(s) = \frac{k}{s(s+2)(s^2+2s+5)}$$

For a unit ramp input it is desired $e_{ss} \leq 0.2$. Find k. (2 marks)

(IV). What do you mean by transfer function? (2 marks)

(V). What is Mason's gain formula in the signal flow graph? (2 marks)

Part C – Long Questions (Answer Any 5) (5 X 10 Marks)

3. Sketch and explain cargo handling crane operation control system. What are the various safety devices fitted on a crane? (10 marks)

4. Sketch and explain the operation of steering gear control system with auto pilot. (10 marks)

5. For a unity feedback system, process transfer function is given by

$$G(s) = \frac{6}{(2s+1)(4s+1)(6s+1)}$$

Design a PID controller for the above system using ultimate cycle tuning method as per the table given below.

Type of Controller	K_p	T_i	T_d
P	$0.5K_u$	∞	0
PI	$0.45K_u$	$\frac{1}{1.2}P_u$	0
PID	$0.6K_u$	$0.5P_u$	$0.125P_u$

(10 marks)

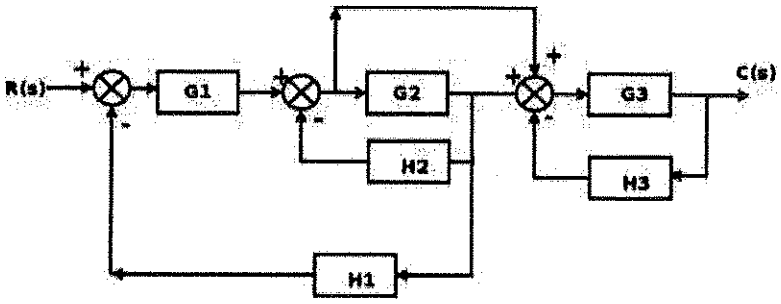
6. Consider a system described by the state model.

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U \qquad Y = [1 \quad 0]X$$

Comment on the controllability and the observability of the system. (10 marks)

7.

(i) Use block diagram reduction technique to find out the overall transfer function of the system shown in figure.



(5 marks)

(ii) Find the transfer function of the given system having input 'x' and output 'y' is represented by

$$6\frac{d^3y}{dt^3}+3\frac{d^2y}{dt^2}+2\frac{dy}{dt}+y(t)=4\frac{d^2x}{dt^2}+9\frac{dx}{dt}+x(t)$$

(5 marks)

8.

(i) Derive the expression of Time Response for a second-order system considering critically damped performance: $\xi=1$ with unit step input.

(5 marks)

(ii) Given feedback system is having $G(s)H(s)=\frac{k}{s(s+2)}$. Check whether points s=-1+j and s=-2+j lies on its root locus.

(5 marks)

9. Draw the Nyquist plot for given control system. Comment on the stability of the system.

$$G(s)H(s)=\frac{1}{(s^2+3s+2)}$$

(10 marks)

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