

Indian Maritime University
(A Central University, Govt of India)
End Semester Examinations – December 2022
Programme Name: M. Tech(MEM)
Semester: II
Subject Code: PG13T1202

FN

Subject Name: Instrumentation, Automation & Control Systems

Date: 25.11.2022

Max Marks: 60

Duration: 03 Hrs

Pass Marks: 30

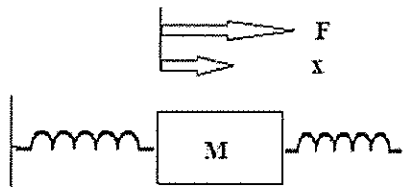
General Instructions

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

Section A

Attempt all multiple choice questions/ fill in the blanks of 01 marks each and choose the correct answer as applicable
[10x1= 10]

1. Consider a simple mass spring friction system as given in the figure K1, K2 are spring constants f-friction, M-Mass, F-Force, x-Displacement. The transfer function $X(s)/F(s)$ of the given system will be :



- a. $1/(Ms^2+fs+K1.K2)$
- b. $1/(Ms^2+fs+K1+K2)$
- c. $1/(Ms^2+fs+K1.K2/K1+K2)$
- d. $K2/(Ms^2+fs+K1)$

2. Pressure can be measured directly by

- a. Rotameter
- b. LVDT
- c. Bourdon Tube
- d. Strain

3. The ratio of maximum displacement deviation to full scale deviation of the instrument is called
 - a. Static Sensitivity
 - b. Dynamic Deviation
 - c. Linearity
 - d. Precision or Accuracy

4. Sound waves are
 - a. Voltage Signal
 - b. Pressure Waves
 - c. Current
 - d. Radiation

5. The overall transfer function of two blocks in parallel are:
 - a. Sum of individual gain
 - b. Product of individual gain
 - c. Difference of individual gain
 - d. Division of individual gain

6. Transfer function of the system is defined as the ratio of Laplace output to Laplace input considering initial conditions
 - a. 1
 - b. 2
 - c. ∞
 - d. 0

7. Oscillations in output response is due to:
 - a. Positive feedback
 - b. Negative feedback
 - c. No feedback
 - d. None of the mentioned

8. A node having only outgoing branches.
 - a. Input node
 - b. Output node
 - c. Incoming node
 - d. Outgoing node

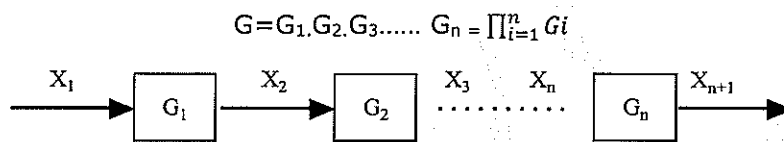
9. Strain gauge, LVDT and thermocouple are examples of
 - a. Active transducers
 - b. Passive transducers
 - c. Analogue transducers
 - d. Primary transducers

10. Reference junction compensation is necessary in thermocouple-based temperature instruments because:
 - a. Copper extension wire has a tendency to corrode
 - b. Thermocouples are inherently nonlinear
 - c. The reference junction generates a temperature-dependent voltage
 - d. The junction's electrical resistance varies with temperature

Section B

Answer all the five questions of 2 marks each [5x2=10 marks]

11. On what principle the Thermocouple sensor works for temperature measurement?
12. Sketch an IP Converter (Electronic to Pneumatic Transducer).
13. Difference between Accelerometer and Gyroscope sensors.
14. The characteristics equation of system is $S^4+6S^3+11S^2+6S+K=0$, what restriction must be placed upon the parameter k in order to insure that the system is stable.
15. Prove that for a causal block the transfer function is given by



Section C

(Answer any five questions of 8 marks each) [5x8 Marks= 40 Marks]

Seven Questions of 08 Marks each of which any 05 questions to be answered.

16. (a) Sketch and describe an electronic to pneumatic signal transducer (IP Converter).
(b) Explain with a sketch the purpose of a Valve Positioner in a pneumatic valve actuator.
17. (a) Explaining the principle of variable area flowmeter show the working of any type of a flowmeter based on this principle.
(b) Describe with a sketch the working of a Position Motor(ac) Synchro.
18. (a) Sketch and explain a Capacitive Level Sensor.
(b) Sketch and describe an Electromagnetic Flowmeter.
19. (a) What is a Negative Feed Back Amplifier? How it ensures (i) Gain Stability, (ii) Reduction in distortion, (iii) Improvement in Circuit Stability.
(b) Sketch and explain an Aux. Boiler automatic Combustion Control.
20. a) How the furnace temperature is sensed by an Optical Radiation Pyrometer – show with a sketch
b) What is Hall Effect? Describe a Hall Effect Transducer

21. Plot the root locus pattern of a system whose forward path transfer function

$$G(s) = \frac{k}{s(s+2)(s+3)}$$

22. (a) The characteristic equation of a control system is given below, the number of the roots of the equation which lie on the imaginary axis of s-plane is

$$s^6 + 2s^5 + 8s^4 + 12s^3 + 20s^2 + 16s + 16 = 0$$

(b) A unity feedback control system has the open loop transfer function. If the input to the system is a unit ramp, find the steady state error

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

