

Indian Maritime University

(A Central University, Govt. Of India)

M.Tech(MEM)

Semester II

June 2022 End Semester Examinations

Instrumentation, Automation & Control Systems

(PG13T1202)

Time: 3 Hours

Max Marks: 60

Date: 21.06.2022

Pass Marks: 30

Part A - 10 MCQs (10 X 01 Mark)

(1) LDVT can be used for -

- a) Angular Velocity measurement of a column
- b) Load measurement
- c) Vibration measurement
- d) Force measurement in a beam

(2) A pair of active transducers

- a) Thermocouple, Thermistor
- b) Thermistor, solar cell
- c) Thermocouple, solar cell
- d) Solar cell, LDVT

(3) The transducers that convert the input signal into the output signal, a continuous function of time, are known as

- a) Analog
- b) Digital
- c) Active
- d) Passive

(4) A turbine flowmeter produces an output in the form of pulses. The total number of pulses is:

- a) Inversely proportional to flow
- b) Directly proportional to total flow
- c) Proportional to the square root of flow
- d) (Proportional to the square of flow

(5) For the measurement of high pressure with high accuracy the device used is

- a) Manganin wire pressure
- b) Ionization gauge
- c) Dead weight gauge
- d) Bourdon tubes

(6) Consider the following transducers

- i) LDVT, ii) Piezoelectric, iii) Thermocouple iv) Photo voltaic Cell v) Strain Guage

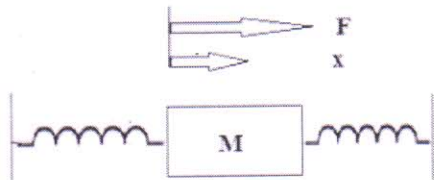
Which of the following are active transducers

- a) 2,3, & 5
 b) 1,3, & 4
 c) 1,2, & 5
 d) 2,3, & 4

(7) The output of the feedback control system must be a function of _____

- a) Output and feedback signal
 b) Input and feedback signal
 c) Reference input
 d) Reference output

(8) Consider a simple mass spring friction system as given in the figure K_1 , K_2 are spring constants f -friction, M -Mass, F -Force, x -Displacement. The transfer function $X(s)/F(s)$ of the given system will be :

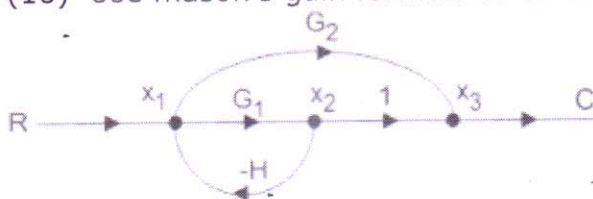


- a) $1/(Ms^2+fs+K1.K2)$
 b) $1/(Ms^2+fs+K1+K2)$
 c) $1/(Ms^2+fs+K1.K2/K1+K2)$
 d) $K2/(Ms^2+fs+K1)$

(9) If the initial conditions for a system are inherently zero, what does it physically mean?

- 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

(10) Use mason's gain formula to calculate the transfer function of given figure:



- a) $G1/1+G2H$
 b) $G1+G2/1+G1H$
 c) $G2/1+G1H$
 d) None of the mentioned

Part B – 5 Short Questions (05 X 02 Marks)

(11) What is a MEMs Pressure Sensor

(12) Define Quadrature encoder and state its use

(13) A system generated by $\frac{dy}{dx} + 2y = 4tu(t)$. The ramp component in the forced response will be:

(14) Find the initial and final values of the following function:

$$F(s) = \frac{12(s+1)}{s(s+2)^2(s+3)}$$

(15) The characteristic equation of a system is given as $s^3+25s^2+10s+50=0$. What is the number of the roots in the right half s-plane and the imaginary axis respectively?

Part C – 7 Long Questions-Answer Any 5 (05 X 8 Marks)

(16) a) Describe with sketch Mechanical Accelerator and prove that a steady state displacement is a measure of constant input acceleration [4]

b) Derive a linear constant coefficient differential equation for mechanical rotatable disc (polar moment of Inertia "J") attached to shaft and the disc rotates in a viscous medium of coefficient "D". [4]

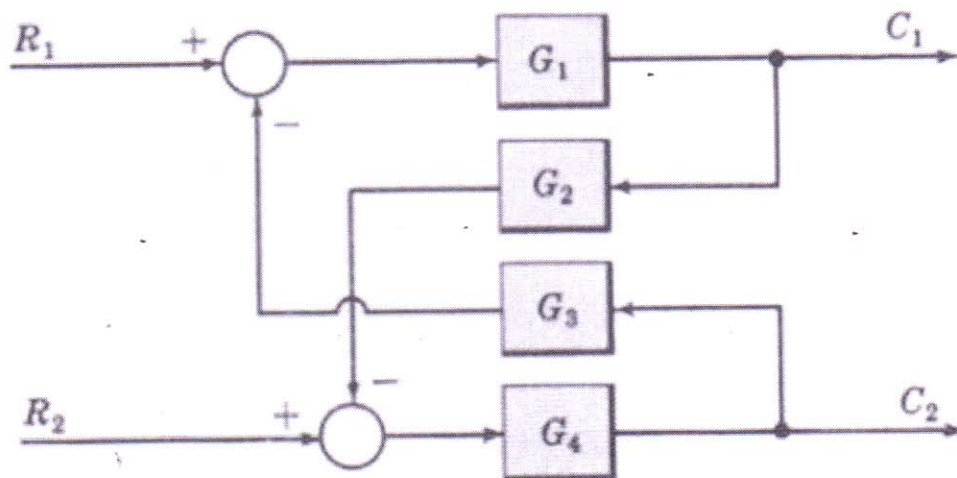
(17) a) Discuss the working principle of LDVT [4]

b) Describe a Hall effect Transducer [4]

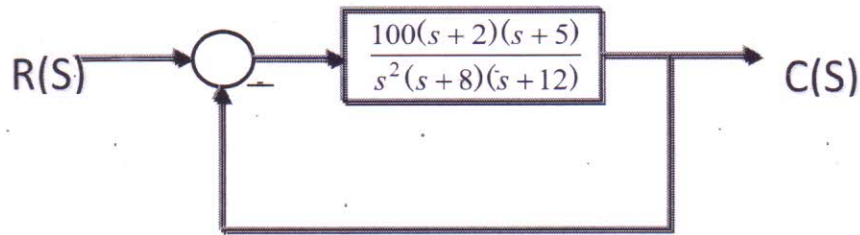
(18) a) Describe a Pirani Gauge with materials used and also temperature ranges [4]

b) Discuss a Turbine flow meter with working details [4]

(19) Obtain the closed loop transfer function $C(S)/R(S)$ of the system whose block is shown in fig. [8]



(20) a) For the system shown in figure below evaluate the static error constants and find the expected steady state errors for the standard step, ramp and parabolic inputs. [5]



b) Difference between Accelerometer and Gyroscope sensors. [3]

(21) a) Determine the range of K such that feedback system having characteristic equation $s^4 + 5s^3 + 5s^2 + 4s + K = 0$ [4]

b) Prove that the Bode Magnitude plot for $(j\omega)^l$ is a straight line. [4]

(22) A unity feedback system has open loop transfer function $G(s) = K(s+5)s(s+2); K \geq 0$

(a) Draw a rough sketch of the root locus plot; given that the complex roots of the characteristic equation move along a circle.

(b) As K increases, does the system become less stable? Justify your answer.

(c) Find the value of K (if it exists) so that the damping ξ of the complex closed loop poles is 0.3 [8]