THE TEXTILE ASSOCIATION (INDIA)
G.M.T.A. (REVISED) EXAMINATION - 2015
SECTION - E PAPER A.5

Control Systems in Textile Machines

Date: 30/12/2015          Marks: 100          Time: 10 am to 1 pm

Instructions:
1. Attempt any six questions out of which Q1 is compulsory
2. Answer each next question on new page
3. Figure to the right indicate full marks
4. Illustrate your answers with sketches and flow chart wherever necessary
5. Use of non programmable electronic pocket calculator permissible
6. Mobile and any other communication devices are not allowed in exam hall.
7. Assume suitable data wherever necessary

1. A. Mechanical impedance is the ratio of
   a. rms force to rms velocity
   b. rms force to rms displacement
   c. rms velocity to rms displacement
   d. none of the above

2. Whether a linear system is stable or unstable that it
   a. is a property of the system only
   b. depends on the input function only
   c. both (a) and (b)
   d. either (a) or (b)

3. Assertion (A): Potentiometers cannot be used as error detectors in position control systems.
   Reason (R): The resolution of a potentiometer places an upper limit on its accuracy
   a. Both A and R are correct and R is correct explanation of A
   b. Both A and R are correct but R is not correct explanation of A
   c. A is correct but R is wrong
   d. R is correct but A is wrong

4. For a first order system having transfer function \( \frac{1}{1+st} \), the unit impulse response is
   a. \( e^{-st} \)
   b. \( T e^{-st} \)
   c. \( \frac{1}{T} e^{-st} \)
   d. \( T^2 e^{-st} \)

5. A stepper motor is
   a. a two phase induction motor
   b. is a kind of rotating amplifier
   c. is an electromagnetic transducer used to convert an angular position of shaft into electrical signal
   d. is an electromechanical device which actuates a train of step angular movements in response to a train of input pulses on one to one basis.
F. From the noise point of view, bandwidth should
   a. be large
   b. not be too large
   c. should be as large as possible
   d. should be infinite

G. For the second order system having following differential equation
   \[ \frac{d^2 \theta_2}{dt^2} + F \frac{d \theta_2}{dt} + K \theta_2 = K_2 \theta_1 \]
   (When \( \theta_2 \) and \( \theta_1 \) are output and input) the natural frequency is
   a. \( \sqrt{\frac{K}{J}} \)
   b. \( \sqrt{\frac{J}{K}} \)
   c. \( KJ \)
   d. \( \sqrt{\frac{1}{KJ}} \)

H. In a second order system, the time constant \( t \) of exponential envelopes depends
   a. only on damping factor
   b. only on natural frequency
   c. both on damping factor and natural frequency
   d. neither on damping factor nor on natural frequency

I. The current rating of dc tachogenerator is usually
   a. small
   b. high
   c. medium
   d. either (b) or (c)

J. The most commonly used devices for differencing and amplification, in control systems, are
   a. BJT amplifiers
   b. FET amplifiers
   c. operational amplifiers
   d. either (a) or (b)

2. A. A thermometer requires 1 minute to indicate 98% of its final response to a step input. If it is a first order system then calculate the time constant?

   B. In a second order system \( \omega_n = 10 \text{ rad/sec} \) and \( \zeta = 0.1 \), then calculate \( \omega_d \)?

3. A. If \( x(t) = e^t \), find \( Y(s) \).
   \[ \frac{X(s)}{s^2 + 5s + 6} = \frac{s + 1}{s^2 + 5s + 6} \]

   B. For the second order system \[ \frac{2}{dt} + \frac{4}{dt} + 8y = 8x \], calculate damping ratio?

   C. In the given figure, \( F = 3 \text{ kg force} \). Then \( X(s) = \)

4. A. For the given figure \( C(s)/R(s) \)
B. An open loop system has a forward path transfer function \(42.25y(s + 6.5)\). The unit step response of the system starting from rest will have its maximum value at what time?

C. \[ \frac{C(s)}{U(s)} = \]
   in the given figure

5. A. Explain the principle and function of LVDT?
   B. Give a brief idea of Servo potentiometer?

6. A. Examine the following statements (True/False)
   1. Air and gases are compressible.
   2. Air, gases and some liquids are compressible.
   3. Oil can function as hydraulic fluid as well as lubricator.

B. Explain DC Tachogenerator?

7. In the signal flow graph in the given figure the number of forward paths and pairs of non-touching loops are respectively

6. A. Short Note On:-
   1. Thermistors
   2. Thermocouples
   3. Solid State Sensors
   4. Quartz thermometers

B. Differences between Open-loop and Closed-loop control systems

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