USN | | | | | | | | | | **18BT61**

Sixth Semester B.E. Degree Examination, Jan./Feb. 2023
Process Control and Automation

Time: 3 hrs.   Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*

Module-1

1. a. Explain with a neat diagram, the working principle of Venturimeter and Orifice meter.
   (10 Marks)
   b. Explain in detail the Online and offline methods of Analysis. **(10 Marks)**

OR

2. a. Explain with a neat diagram, the working principle of Thermocouples and Resistance Thermometers. **(10 Marks)**
   b. Briefly outline the principle and working mode of any one pressure measuring device.
   (05 Marks)
   c. Why a Bioreactor requires Instrumentation. **(05 Marks)**

Module-2

3. a. Derive the transfer function for a two tank interacting system in terms of liquid level in 2nd tank and input flow rate to 1st tank. **(10 Marks)**
   b. A thermometer having a time constant of 0.1 min is at steady state temperature of 90°C. At time t = 0, the thermometer is placed in a temperature bath maintained at 100°C. Determine the time needed for the thermometer to read 98°C. **(10 Marks)**

OR

4. a. Derive the transfer function for three tank non – interacting system. **(10 Marks)**
   b. Derive the transfer function to show mercury in glass thermometer follows the first order system with suitable assumptions. **(10 Marks)**

Module-3

5. a. Derive a step response for the Second Order system. **(10 Marks)**
   b. Define the following terms with mathematical equations for an under damped system :
   i) Overshoot   ii) Rise time   iii) Rise time   iv) Period of Oscillation
   v) Transportation lag. **(10 Marks)**

OR

6. a. Derive the transfer function to show that U – tube manometer follows the Second Order system and state all the assumptions. **(10 Marks)**
   b. A control system having transfer function.

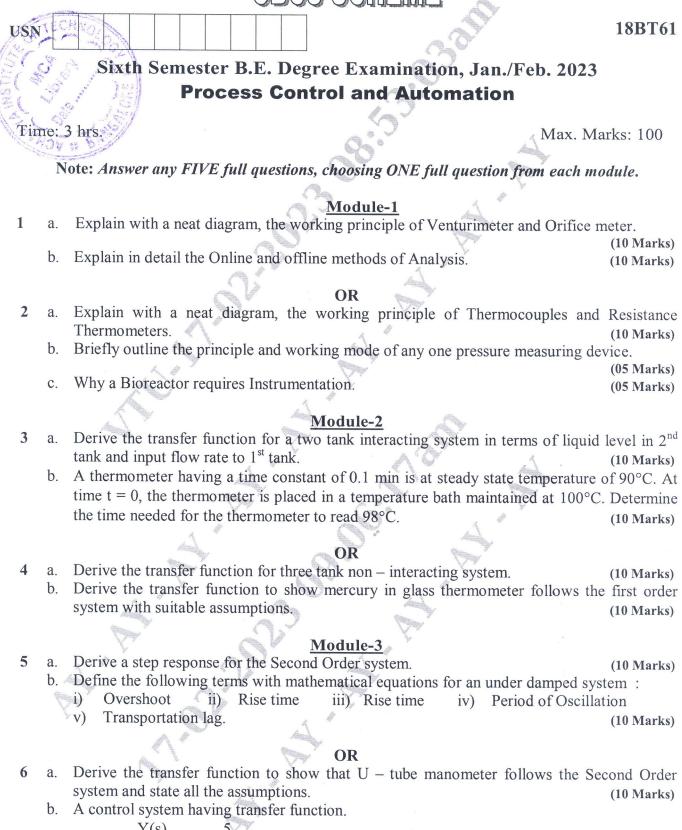 $$G(s) = \frac{Y(s)}{X(s)} = \frac{5}{1.8s^2 + 3s + 5}$$

   Control system is subjected to a step change of magnitude Y(t). Find :
   i) Y(t) at t = 0.5 , 1, 1.5, 3, 5 min   ii) Overshoot   iii) Radian frequency.
   (10 Marks)

Module-4

7   a.   What do you mean by Servo problems and Regulatory problems? Derive the general transfer function of Servo and Regulatory mechanism control problem with the help of block diagram. **(10 Marks)**

   b.   Explain with a neat sketch, the various components and functioning of a pneumatic control valve. **(10 Marks)**

OR

8   a.   What are the advantages of Combination of controllers? Obtain expressions for the Proportional Derivative (P-D) and Proportional Integral (P-I) controller. **(10 Marks)**

   b.   A proportional controller is used to control temperature within the range of 50° - 90°C. The controller is adjusted so that the output pressure goes from 3 psi to 15 psi as the measured temperature goes from 61 to 65°C with the set point held constant. Find the gain and the proportional band. **(10 Marks)**

Module-5

9   a.   Explain in detail bode stability criteria. **(08 Marks)**

   b.   Explain the rules to be followed to determine the stability of the system. **(04 Marks)**

   c.   Give the characteristic equation, $s^4 + 3s^2 + 5s^2 + 4s + 2 = 0$. Determine the stability by Routh criterion. **(08 Marks)**

OR

10 a.   Explain in detail about Root locus diagram. **(10 Marks)**

   b.   Determine the stability of the control system having the Open loop transfer function given by $G(s) = \dfrac{K_C}{s(s+1)(s+2)}$. **(10 Marks)**

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