EX / FTBE / T / 412 /

B.E. Food Technology & Biochemical Engineering

Fourth Year First Semester-,

INSTRUMENTATION AND PROCESS CONTROL

Time: Three hours   Full Marks: 100

Use separate Answer Script for each   Part

PART-I (50 Marks)

Answer any Three questions.   All questions carry equal marks

1.   What   do you mean by process and variables? Discuss these two items using a diagram of a temperature control process in a steam heated tank.

2.   What are the differences between   a   transducer and an ordinary measuring instrument? Distinguish between   open and closed loop system. Draw a schematic representation of a flow control system.

3. A control valve has been installed in a pipeline having a **25mm** inside diameter and is **30 meters** in length. The control valve has a coefficient C_V =   **4** . Determine the flow rate of water   through the pipe when the control valve is **50%** open. Given that , water has viscosity **1.5 milli Pa.s** Assume the valve characteristics follows   linearity between y and x where **y = q/q_{max} and x = L/L_{max}** where   q and L are   flow rate in gpm and   stem travel in meter. Assume flow rate **20 gpm** and pressure drop across the valve p_1 - **pressure drop in the pipe** having fanning friction factor **f = 0.0052** , and given that p_1 = 100 psi.

[Turn over

4. Discuss the term **First –Order Lag** in a process control system consisting of a steam heated tank where a liquid enters and leaves at a constant rate , **w mass/ time**. The purpose of the process is to heat the incoming cold liquid at a temperature T_i to a desired elevated temperature T_o.

5. Deduce the equation of a transfer function of **a second order system** describing the dynamic behavior (**under damped , over damped, and critically damped**) of a manometer measuring fluid pressure which is varying with time.

6. Write short notes on) Any Four)

 a) Control valve characteristics

 b) First order system

 c) PI and PID control

 d) Laplacian block diagram in a control loop analysis.

 e.) What are the responses of ---------

 First order system to step input of magnitude A ?

 First order to impulse input of magnitude B ?

B.E. FTBE – 4th Year 1st Semester Examination-2018

Instrumentation and Process Control

Time : 3 Hrs.   Full Marks-100

Part-II

[Answer any three questions, Marks 50]

1. Fig. (attached) shows a differential gauge to measure minor pressure difference of a system. A and B are connected to two different sources. With the equal pressure at A and B , tops of Kerosene coloumn stand at common level J-J and water at O-O. Points A and B are at the same level. Find the difference in head between A and B . h is 0.6 m. Take the reservoir cross-section 100 times that of glass tube . Assume the value of any properties if required.   (16)

2. (a)   Discuss the working principle of Thermopile to measure the temperature of a reactor or flame with a neat diagram. What is the temperature range it is capable of measuring.
   (b)   A platinum resistance thermometer has a resistance 2.9 ohms at 0^{0}C and 3.9 ohm at 100^{0}C. Calculate the temperature when the resistance indicated is 6.0 ohm.   (10 + 6)

3. Write short notes on (any two) with diagram   (8 x 2)

   (a)   Different types of liquid level meter used in industries

   (b)   Use of optical pyrometer for measuring high temperature

   (c)   Bourdon tube (gauge) for measuring pressure

   (d)   Function of Transducers

4. (a)   Differentiate between head flow meter and area flow meters, which of the category gives better result in measuring flow of fluids?

   (b)   Oil is flowing through a horizontal pipe line having an actual inside diameter of 10 cm, a properly made pitot tube is inserted at the centre line of the pipe and its leads are filled with oil and attached to a vertical gas U tube containing water and oil. The difference in the water levels is found to be 90 cm. Based on the data given, calculate the rate of oil flow expressed in terms of cubic meter per minute. The oil has a sp.gravity of 0.90 and viscousity 1.5 cp. Use manometric principle to find out the pressure drop.   (4 + 12)

5. Answer any two   : (2 x 8)

   (a)   What are the basic principles of chromatographic methods for separation of components present in gas liquid phase

   (b)   Explain with the help of the Lambert & Beer's Law the relationship of concentration to absorption for determination of the concentration of a substance by measuring the relative absorption of light.

   (c)   The use of Saybolt Viscometer for measurement of the viscousity of a non-newtonian fluid. State based on which law this measurement is done..