



COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005

End Semester Examination

(IE-201) Transducers I

Course: B.Tech.

Branch: Instrumentation and Control Engineering

Semester: Sem III

Max.Marks:60

Year: 2014-2015

Date:26/11/2014

Duration: 8 Hours Time:- 10 am to 6 pm

Instructions:

MIS No.

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1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of anything like stationery, calculator is not allowed.
5. Assume suitable data if necessary.
6. Write your MIS Number on Question Paper
7. All questions are compulsory and carries equal marks

As a part of an Instrumentation Engineer's professional career you are required to select the sensors as detailed in the process description below. This is a plant, which produces a special variety of food product. The purpose of measurement of each parameter is described along with the details of the measurement parameter under consideration. The plant has three sections viz. Raw material preparation tank, Processing section, and Dispatch section. To support all the processes the utility section is located on the periphery of the main plant. The details (process description, parameter details under measurement, requirements etc.) of each section are mentioned as follows:

1. **Utility section:** This section comprises of three main sections viz. (For the utility section the measurement of temperature, pressure, level and flow is used for control purpose hence the accuracies expected are as per the requirement. Local indications are required by the operator to only view the data but the cost for this purpose is a constraint.)

- Instrument Air Supply (Maximum flow: 100 Cfm, Maximum Pressure: 10 Kg/cm², Line size: 100 NB GI Pipe)
- Liquid Nitrogen (Capacity 200 Liters, each time charge: 1 Liter)
- Hot water: Temperature: 98⁰C, Flow: 1500 l/h, Line size: 25 NB, Pressure: 1 Kg/cm²
- Chilled water: (Temperature: 4⁰C, Flow: 200 l/h, Pressure: 1 Kg/cm², Line Size: 15 NB)
- Steam: Pressure: 4 Kg/cm², Flow: 50 Kg/Hr, Temperature: 150⁰C, Line size: 25 NB,

2. **Raw Material Preparation:** A vertical cylindrical vessel of 5-meter diameter and height of 10 meter is placed in the preparation section. The batch size (the quantity selected for each time to prepare the product) selected for the vessel is 500 Liter. The ingredient A (very close to coconut oil) is filled through a tanker and the billing will be made immediately based on the quantity consumed. The details of ingredient A: Line size: 40 NB, flow: 2500 l/h (max), Pressure: 1.5 Kg/Cm², temperature: Ambient.

Purging of 5 Liters Liquid Nitrogen per batch, and 50 Liters of hot water will form a batch for production.

The measurement of all the quantities will be used for accurate control of these quantities as the product quality solely depends on the accuracy of measurement of these ingredients. In this vessel it is required to measure level for ensuring no overflow takes place, temperature to be indicated to the local operator. The prepared raw material will be pumped (Centrifugal pump) to a processing section through a pipeline of 25 NB and which is vertically connected to the tank. There is no horizontal space between the pump and the vessel. It is required to know the amount of material pumped to the processing section. Due to addition of other material there is no change in the chemical properties of the material.

3. **Processing Section:** In this section the material transferred from the raw material section is processed as per the quantity recommended by the product expert. The vessel used for this section is similar to the previous section. The material will be exposed to heating and cooling cycle with the help of hot and chilled water from the utility section. The temperature measurement of the tank required so as to accurately controlling the temperature and the range of temperature is 20 to 80°C.

The expected accuracy of temperature is $\pm 1^{\circ}\text{C}$. In this process due to a typical reaction the pH and Conductivity also needs to be maintained by adding reagents. It is recommended to measure these parameters online while the process is carried out. After the process is over the material is converted in to a slurry form and will be transferred using a positive displacement pump. The amount of material transferred also needs to be measured and indicated in an electronic form to the local operator. In this section most of the measurements are meant for the purpose of control and accurate control will ensure the quality of the product.

4. **Dispatch Section:** In this section the finished product is packed in pouches of various sizes ranging from 100 ml to 500 ml. The displacement of the piston used for sealing, quantity to be packed, conveyor motor bearing, winding temperature, pressure of the lubricating oil, total amount of finished product displaced for packing are to be measured for the benefit of billing purpose.

Based on the above process description prepare a conceptual drawing indicating all the measurement points. Select the appropriate sensor for the measurement; justify the selection and list static and dynamic characteristics of the sensors selected. To verify the raw output of the sensor state clearly the governing equation and also indicate the output values at 20, 45, 65, 100 % of the process variable.