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# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

*A Constituent Institution of Manipal University*

**FOURTH SEMESTER B.TECH. (INSTRUMENTATION & CONTROL ENGG.)**

**END SEMESTER EXAMINATIONS, APRIL/MAY 2017**

SUBJECT: INDUSTRIAL INSTRUMENTATION [ICE 2202]

Time: 3 Hours MAX. MARKS: 50

**Instructions to Candidates:**

- Answer **ALL** the questions.
- Missing data may be suitably assumed.

**1A.** Venturi meter is used for measurement of flow rate .Derive the expression for the volumetric flow rate for the same flowmeter with its construction details. Also comment on the pressure variations upstream and downstream of throat with proper justification. **5**

**1B.** Explain the working of Doppler based Ultrasonic flowmeter with suitable expressions and its limitations. **3**

**1C.** The 20m long steel pipe has a 25mm inner diameter. It carries water at a rate of $4.5m^3/h$, the density of water is $1000kg/m^3$ and water has an absolute viscosity of $1.00 \times 10^{-3}$ pascal –seconds. Using the above data, comment on the profile of the water. **2**

**2A.** A multi-tube manometer using water and mercury is used to measure the pressure of air in a vessel as shown in FIG. Q2A. Given, $h_1=0.4m$, $h_2=0.5m$, $h_3=0.3m$, $h_4=0.7m$, $h_5=0.1m$ and $h_6=0.5m$, density of mercury=$13600kg/m^3$, density of water=$1000kg/m^3$. Calculate the gauge pressure in the vessel. Ignore the effect of air density and atmospheric pressure. **5**

**2B.** A multiphase flow is formed by mixing oil, water and gas. What are the different ways for the measurement of individual flow rates of the three components? **3**

**2C.** Explain the working of Pirani Gauge. **2**

**3A.** Elaborate on the principle and working of the following level sensors: **4**

(i) Capacitive level sensor

(ii) Bubbler type level sensor

**3B.** Determine the relative humidity of air at atmospheric pressure when the dry and wet **3**

bulb thermometer readings are $t_1$=80°F and $t_2$=60°F respectively. For $t_1$ and $t_2$ from the steam table $p_{s1}$=0.5069 PSIA, $h_{v1}$=1096.6 BTU/pound mole, $p_{v2}$=0.256PSIA, $h_{w2}$=28.06 BTU, $h_{e2}$=1059.9 BTU/pound mole. Barometric pressure=14.7 PSIA

**3C.** Identify the type of pressure measured in FIG. Q3C and modify it for the measurement of other types of pressure. **3**

**4A.** With neat figure and expressions, explain the working of Coriolis densitometer. Also draw and explain the signal processing diagram for the same. **5**

**4B.** Explain the working of Digital pH meter and also comment the effect of temperature on measurement of pH. **3**

**4C.** The instrument shown in FIG. Q4C is used for the measurement of flow. Name the type of flowmeter and write its two applications. **2**

**5A.** Derive the expression for viscosity using falling sphere resistance method. **5**

**5B.** Explain the working of paramagnetic oxygen analyzer with neat figure. **5**

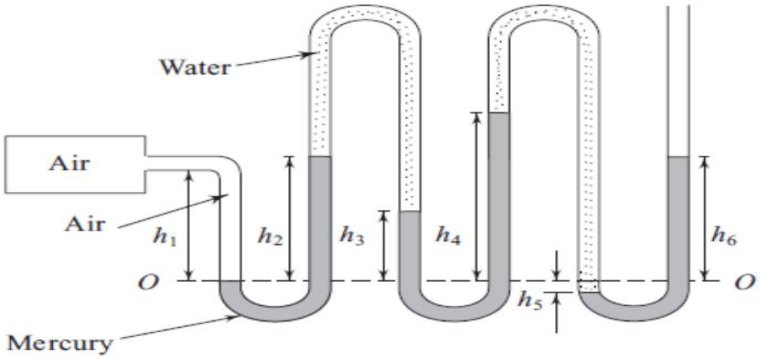


FIG. Q2A

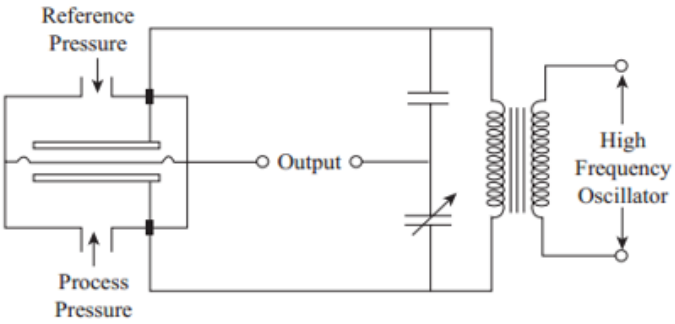


FIG. Q3C

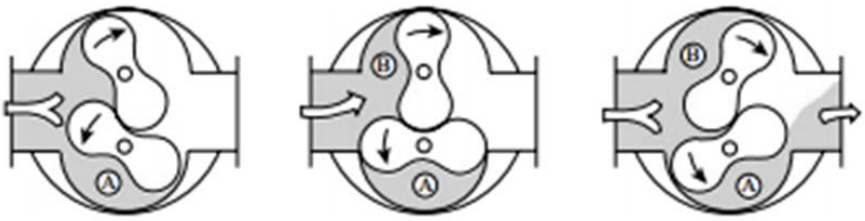

FIG. Q4C