

BACHELOR OF CHEMICAL ENGINEERING 3RD YR 2ND SEMESTER EXAMINATION,**2017**(1st / 2nd-Semester/Repeat/Supplementary/Annual/Bi-Annual)**SUBJECT: - PRINCIPLES OF MEASUREMENT AND INSTRUMENTATION**

Full Marks 100

Time: ~~Two hours~~/Three hours/ ~~Four hours~~/ ~~Six hours~~

(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
1.	<p>Answer questions no. 1 and any two from the rests:</p> <p>Answer any four :</p> <p>a) Discuss the various factors upon which the performance of float type level sensor depend.</p> <p>b) Distinguish between the working principle of obstruction type and variable area type flow sensor.</p> <p>c) Distinguish between the working principle of Thermocouple type and Piranha type vacuum pressure sensor.</p> <p>d) Distinguish between the working principle of Volumetric flow sensor and positive displacement type flow sensor</p> <p>e) Discuss how flapper-Nozzle system can be used for pressure transmission</p> <p>f) Explain what are the processes involved for separation in Chromatography.</p>	4X5=20
2.	<p>a) Illustrate a suitable scheme for level gauge calibration using Bubbler gauge following hydrostatic method.</p> <p>b) Explain the working principle of resistive / potentiometric type level sensor giving suitable diagram.</p> <p>c) Illustrate a suitable scheme for level measurement and transmission system using force balance method.</p>	5+4+6
3.	<p>a) Design an Orifice for maximum flow rate of 0.6 m³/min in a 25 cm diameter line to produce a head of 25 cm of Hg assuming the correction factor of 0.8 . What will be actual flow rate at full scale value ? If the density of water changes by 25% due to temperature</p>	

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	<p>effect , what will be the value of correction factor ?</p> <p>b) Describe the working principle of torque type mass flow meter showing its each part in a diagram.</p> <p>c) A turbine type flow sensor has a bore of internal diameter of 150 mm. The rotor consists of 10 no of blades, each of mean thickness of 5 mm , mounted on a hub of mean diameter of 30 mm . The clearance between the inlet blade tip and the bore is 2 mm and the inlet blade tip angle is 25 degree. Estimate the meter constant K in pulses / m³ and the frequency of induced AC emf in the pick up coil.</p>	5+5+5
4.	<p>a) Describe with the help of diagram, the working principle of pneumatic type differential pressure transmitter. Also derive the expression between input and output quantity involved.</p> <p>b) Show a suitable scheme for installation of head type flow sensor with U-tub manometer. State the important factors to be considered.</p> <p>c) Discuss the salient factors for designing a rotameter float under different flow condition.</p>	6+5+4
5.	<p>Write short notes on any three of the following:</p> <p>a) McLeod gauge</p> <p>b) Application of Diaphragm Box</p> <p>c) Impeller type flow sensor</p> <p>d) Hot and Cold cathode type Ionization gauge</p>	3X5=15

BACHELOR OF CHEMICAL ENGINEERING EXAMINATION, 20173rd year, 2nd Semester**SUBJECT: - PRINCIPLES OF MEASUREMENT AND INSTRUMENTATION**

Time: Three hours

Full Marks: 100
(Each Part 50 Marks)**PART - II**

Answer Q.1 and any TWO questions.

1. Answer any Four. 4×5=20
 - a) Under which situations pyrometers are generally employed for temperature measurement?
 - b) How does the ambient temperature variation affect the measurement accuracy in strain gauges?
 - c) Distinguish between self regulation and non self regulation type processes giving suitable examples.
 - d) Explain how anti integral windup scheme can be implemented using clegg integrator.
 - e) What is the advantage of manual mode of operation of process controller?
 - f) What is the importance of Cold Junction Compensation for a temperature measuring circuit using thermocouple?

2. a) Derive the operational transfer function of a first-order instrument. Hence derive the step response of a first-order instrument. 8+7
b) How can you classify errors in measurements? What are the important objectives for applying statistics to measurement data? How can you calculate dispersion of measurement data?

3. a) Why do we employ pulse type excitation voltages for bridge measurements in conjunction with RTDs? Describe in detail the implementation of such a scheme. 5+10
b) Differentiate between total radiation pyrometer and selective radiation pyrometer. Is there any difference between the terms emittance and emissivity? With a neat schematic diagram, explain in detail the operating principle of Fery's total radiation pyrometer.

4. a) Draw the functional diagram of pneumatic PD controller containing flapper – nozzle, feedback bellows and relay elements. Hence derive the transfer function relating error as input and manipulated variable as output. 8+7
b) Describe the operating principle of a 'manual balance' type constant-temperature anemometer, employed for measurement of average flow velocity.

5. Write short notes any TWO. 7.5×2
 - a) Constant temperature type hot wire anemometer (CTA);
 - b) Realization of an electronic analog PID controller employing two op-amps only.
 - c) Frequency response of a second-order instrument;
 - d) Linearization of RTDs.