

# JK LAKSHMIPAT UNIVERSITY, JAIPUR

## INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November 2016

B. Tech in Chemical Engineering, Semester V

Roll No.....

CHE 506: Process Instrumentation

Time: 3 hours

Max. Marks: 100

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Instructions to students:

1. Do not write anything other than your roll number on question paper.
  2. Assume suitable data wherever required and mention it clearly.
  3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
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Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. Which of the following temperature measuring instruments need not touch the object whose temperature is being measured ?
  - A. Mercury in glass thermometer
  - B. Radiation/infrared pyrometer
  - C. Thermo electric pyrometer
  - D. Filled system thermometer
- ii. Which of the following is the dynamic characteristic of an instrument?
  - A. Sensitivity
  - B. Reproducibility
  - C. Dead zone
  - D. Fidelity
- iii. The operation of a rotameter is based on
  - A. Rotation of a turbine.
  - B. Variable flow area.
  - C. Pressure drop across a nozzle.
  - D. Pressure at a stagnation point.
- iv. Smoke density of the flue gas going out of the chimney is measured by a
  - A. thermal conductivity meter
  - B. polarograph
  - C. photo electric cell
  - D. chromatograph
- v. Working principle of radiation pyrometer is based on the
  - A. Wien's law
  - B. Stefan-Boltzman law
  - C. Kirchoffs law
  - D. Seebeck effect
- vi. Thermistor, which has high temperature co-efficient of resistivity, is used as the sensing element in resistance thermometer. It is a/an:
  - A. Conductor
  - B. Insulator
  - C. Liquid semiconductor
  - D. Solid semiconductor

- vii. The ionization gauge an instrument used for the measurement of  
 A. Very low pressure  
 B. Medium pressure  
 C. High pressure  
 D. Very high pressure
- viii. A scale which is used to measure the acidic or alkaline nature of a substance is called  
 A. Indicator  
 B. pH scale  
 C. pH meter  
 D. balance scale
- ix. Unit of specific heat is?  
 A.  $\text{J kg}^{-1} \text{ } ^\circ\text{C}^{-1}$   
 B.  $\text{J mol}^{-1} \text{ } ^\circ\text{C}^{-1}$   
 C.  $\text{J kg}^{-1} \text{ } ^\circ\text{C}$   
 D.  $\text{J mol}^{-1} \text{ } ^\circ\text{C}$
- x. Unit of heat capacity is?  
 A.  $\text{J kg}^{-1} \text{ } ^\circ\text{C}^{-1}$   
 B.  $\text{J mol}^{-1} \text{ } ^\circ\text{C}^{-1}$   
 C.  $\text{J kg}^{-1} \text{ } ^\circ\text{C}$   
 D.  $\text{J mol}^{-1} \text{ } ^\circ\text{C}$

- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- i. Define dynamic viscosity and name of equipment to measure it?
- ii. Mention the limitations of obstruction type flowmeters?
- iii. Find the absolute pressure, if a pressure gauge reads 8.3psi, while the atm pressure is 14.7psi.
- iv. If a pool has a water with a depth of 6 ft. Find the pressure at the bottom of the pool in Pa. (assume density =  $10^3 \text{ kg/m}^3$ )
- Q.3A Explain with the help of a suitable sketch, the working principle of an electrical resistance pressure gauge. 05
- Q.3B Mention the criteria to select a suitable type of pressure gauge for pressure measurements. 05
- Q.4A What are the differences between RTD and thermistors type temperature measurement devices? 05
- Q.4B What are the characteristics of an optical pyrometer? 05
- OR
- Q.4B Can a rotameter be used in a horizontal pipe line? If not, explain why? 05
- Q.5A What is FTIR spectroscopy? Mention the applications of FTIR spectroscopy in chemical analysis. 05
- Q.5B Define sensitivity of a measuring instrument. 05
- Q.6A Explain the role of environmental effects in various analytical measurements. 05
- Q.6B Compare the shear stress vs shear rate behavior of Newtonian, pseudo plastic 05

and Bingham plastic fluids with the help of suitable graph and examples?

OR

- Q.6B What are the applications of Raman spectroscopy in carbon nanotube based materials research? Explain with the help of a Raman spectra. 05
- Q.7A A brass rod is stress-free at room temperature (20°C). It is heated up, but prevented from lengthening. At what temperature does the stress reaches -172 MPa? (Linear thermal expansion coefficient of brass is  $20 \times 10^{-6} / ^\circ\text{C}$ . Young's modulus is 100 GPa for brass.) 05
- Q.7B A copper wire 15 m long is cooled from 40 to -9°C. How much change in length will it experience? Linear thermal expansion coefficient for Cu is  $16.5 \times 10^{-6} / ^\circ\text{C}$ . 05
- OR
- Q.7B What are significant figures? How does it communicate the ability of a measuring instruments' sensitivity? 05
- Q.8A Describe different types of radioactivity and their characteristics. Explain alpha, beta and gamma decay with the help of reactions. 10
- Q.9A Describe the working principles of McLeod gauge and Pirani gauge with the help of suitable diagrams. What are important factors to select a suitable pressure measurement instrument? 10
- Q.9B Describe different types of instruments and their applications for measurements. 10
- OR
- Q.9B Explain the working principle of UV-Vis spectroscopy and illustrate how it is used to measure the concentration of colorants in a water sample? 10