

**COLLEGE OF ENGINEERING, PUNE**  
(An Autonomous Institute of Government of Maharashtra)

**T.Y.B. Tech (Instrumentation and Control)**  
**End -Semester Examination**  
**(IE 304) Analytical Instrumentation**

Year: 2012-13  
Duration: 3 hrs

Semester: I  
Max. Marks: 50

*Instr & Control*

**Instructions:**

1. All questions are compulsory
  2. Assume suitable data if necessary
  3. Figures to right indicate full marks
  4. Draw neat figures wherever required
  5. Use of non-programmable calculator is allowed
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- Q.1 a) Define the following with its typical equations: (any four)
- i. Transmittance in optical spectroscopy
  - ii. % absorbance in optical spectroscopy
  - iii. Response of GC detector
  - iv. Sensitivity of GC detector
  - v. Bragg's law with significance in X-ray spectroscopy 04
- b) Write the typical measurement range for following:
- i. UV-Visible spectrophotometer
  - ii. Globar rod
  - iii. mobile phase flow rate
  - iv. Flame Ionization detector in GC 02
- c) It is required to determine analyte concentration for metals in certain applications from the amount of absorption. Suggest and elaborate the following components required for the same:
- i. sample introduction system
  - ii. source
  - iii. atomizer
  - iv. detector 04
- Q.2 a) Solve the following: (any three)
1. A cell constant of  $20.0 \text{ cm}^{-1}$  is recommended for conductivity bridge designed to span the range from 1 to 18% HCl. The corresponding conductance range from 0.0630 to about  $0.750 \Omega^{-1}$ . Calculate resistance range values.
  2. Calculate the increase trace sample analysis with the increase of from 1 to 5 ml sample

volume for the 2mm outer diameter column and a column inlet pressure of 3 atm.

3. What will be the frequency of fundamental absorption of its first overtone was observed at  $1820\text{ cm}^{-1}$ ?

4. Find out difference in arrival time between ions of  $m/e=44$  and  $m/e=43$  for Time of Flight Mass spectrometer with a drift length of 100 cm and accelerating voltage of 2800V. 06

b) Each atom in the periodic table has a unique electronic structure with a unique set of X-ray spectral line. Discuss the typical instrumentation required for representing the same. 04

3 a) Which method will be suitable for petroleum analysis using chromatographic process? Justify your answer with the typical features and specifications of:

i. column

ii. detector

iii. data acquisition 06

b) Suggest the typical instrument required for following applications with its any two specifications : (any four)

i. clarity of water

ii. quality of fruit juice

iii. taste of pharmaceutical drug/salinity of water

iv. impurity removal from chewing gum raw material

v. continuous mixing of materials in chemical research laboratory 04

4 a) Is it possible to separate nonvolatile or thermally unstable compounds using Gas Chromatography? Justify your answer with the detailed instrumentation for the separation. 06

b) Identify an instrument and list down its working principle as well as component details required for the following :

1. to measure the concentration of oxygen from a process / stream

2. to measure the concentration of sulphur in a continuous stream 04

5 a) State the following statements are true or false and rewrite the correct statements:

1. Qualitative and quantitative analysis of sodium and lithium can be performed by using absorption spectroscopy

2. Glass columns are used in GC

3. Carbowax is used as stationary material in GC columns

4. Syringe pumps are used in commercial HPLC

5. Precolumn filters are used in GC

6. Tungsten filament lamps are used in AAS.

7. Absorption filters are used in commercial IR spectrophotometer 05

8. Monochromators are used in colorimeters
  9. Ghosts is one of the characteristic of monochromator
  10. Thermal conductivity gas analyzer is used for most of the applications
- b) Discuss the significance of mass spectrometer as one of the detector for GC with its two ionization techniques and any two mass analyzers.

05

----- All the Best -----