

**ANALYTICAL INSTRUMENTATION
(AEIE 4241)**

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

***Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.***

***Candidates are required to give answer in their own words as far as
practicable.***

**Group – A
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**

- (i) The detector used in molecular absorption spectroscopy is
(a) photomultiplier tube (b) Geiger Muller counter
(c) flame ionization detector (d) goniometer.
- (ii) In atomic spectroscopy nebulization process is done in
(a) inductively coupled plasma method (b) flame atomizer
(c) direct current plasma method (d) graphite furnace.
- (iii) X-ray diffraction type monochromator obeys
(a) Beer's law (b) Lambert's law
(c) Bragg's law (d) Snell's law.
- (iv) Solvent programming is used in
(a) high pressure liquid chromatography (b) gas chromatography
(c) molecular spectroscopy (d) atomic spectroscopy.
- (v) Density can be measured by using a/an
(a) hygrometer (b) hydrometer
(c) anemometer (d) tachometer.
- (vi) The pH value of NaOH is
(a) 13 (b) 6
(c) 8 (d) 10.
- (vii) In chromatogram, the peak base width is expressed in
(a) centimeter (b) meter
(c) minute (d) micrometer.

- (viii) Wavelength of visible range in electromagnetic spectrum lies between
 (a) 200 - 400 nm (b) 2.5 - 50 μ m
 (c) 50 - 1000 μ m (d) 400 - 800 nm.
- (ix) The Zirconia cell is used to determine
 (a) density of a fluid
 (b) oxidation – reduction potential of an electrolyte
 (c) moisture content of a gas
 (d) percentage of oxygen in a gas mixture.
- (x) A buffered solution is a solution that
 (a) retains its pH for a long time
 (b) cannot retain its pH for a long time
 (c) has no electrolytic property
 (d) acts as an intermediate solution between two solutions of different pH.

Group - B

2. Define paramagnetic and diamagnetic substance. Explain the working principle and construction of magnetodynamic (dumbbell) type gas analyzer. Describe another method of Paramagnetic gas analyzer with neat diagram.

(2 + 3 + 3 + 4) = 12

3. (a) Define the following terms:
 (i) Absolute humidity
 (ii) Specific humidity
 (iii) Relative humidity.
- (b) Which meter measures relative humidity? Describe its various constructions.
- (c) Draw the sketches of electrolysis type hygrometer and explain its working principle.

3 + (1 + 4) + 4 = 12**Group - C**

4. (a) What is polarography? Draw a typical polarograph and write some of its application used for routine analysis. Briefly discuss the pulse polarographic method.

- (b) Explain how densitometer works?

(1 + 3 + 3) + 5 = 12

5. What do you mean by conductivity of a solution? State the factors on which conductivity of a liquid depends. What is cell constant of a conductivity cell? Describe the operation of a liquid conductivity cell. Why pulse dc or ac excitation is more appropriate than dc excitation?

(1 + 2 + 2 + 4 + 3) = 12**Group - D**

6. (a) With necessary derivation show how transmittance and absorption of electromagnetic radiation are related to concentration of a sample?
- (b) How concentration of a liquid is measured by using a single beam filter photometer?

6 + 6 = 12

7. (a) What is atomization of a sample? With a neat diagram, explain how graphite furnace is used to atomize a sample in atomic spectroscopy.
- (b) What are X-ray emission, X-ray fluorescence, X-ray absorption and X-ray diffraction spectrographies?

(2 + 6) + 4 = 12**Group - E**

8. (a) Draw the scheme of gas chromatography. Briefly explain the different parts of it.
- (b) What are the reasons for chromatographic band broadening?
9. (a) What are retention volume, selectivity factor and retention ratio in chromatography?
- (b) How does a flame ionization detector work in gas chromatography? How liquid chromatography is classified in different types?

4 + (5 + 3) = 12