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) Factor influencing humidity includes
(a) water (b) temperature
(c) pressure (d) osmosis

(ii) Which of the following gases has strongest paramagnetic property?
(a) oxygen (b) nitrous oxide
(c) nitric oxide (d) hydrogen

(iii) Amount of water vapour in air is regarded as
(a) moisture (b) humidity
(c) dew point (d) pressure

(iv) In which of the following ways, absorption is related to transmittance?
(a) absorption is the reciprocal of transmittance
(b) absorption is the logarithm of transmittance
(c) absorption is the negative logarithm of transmittance
(d) absorption is a multiple of transmittance

(v) The conductivity meter is used in a water treatment plant to monitor the
(a) dissolved silica (b) total dissolved solids
(c) cationic level in the water (d) anionic level in the water

(vi) Density can be measured by using a/an
(a) hygrometer (b) hydrometer
(c) anemometer (d) tachometer

(vii) X-ray diffraction type monochromator obeys
(a) Beer's law (b) Lambert's law
(c) Bragg's law (d) Snell's law

(viii) Chromatography is a physical method that is used to separate and analyse _____
(a) metals (b) viscous mixture
(c) complex mixtures (d) simple mixtures

(ix) How is the wave number of electromagnetic radiation related to wavelength?
(a) directly proportional to wavelength (b) equal to wavelength
(c) reciprocal to wavelength (d) not related to the wavelength

(x) What occurs when the moving mirror in an FTIR spectrometer is in the same distance from the beam splitter as the static mirror?
(a) constructive interference (b) destructive interference
(c) radio interference (d) the spectrum is measured

Group – B

2. (a) Differentiate between (i) Qualitative and Quantitative analysis (ii) Off-line and On-line analysis techniques. State the working principle of a thermal conductivity type gas analyzer.

(b) What is a Pauling Cell? Which factor governs the amount of force produced during operation of a paramagnetic oxygen analyzer? What type of relation exists between the factor and the force produced? What happens to the magnetic susceptibility of gases when the surrounding temperature changes?

(2 + 2 + 3) + (1 + 1 + 2 + 1) = 12

3. (a) Differentiate between humidity and moisture. Draw a neat sketch to realize a meter that measures the ambient relative humidity.

(b) Show a four-electrode scheme to measure the conductivity of a water sample. State some of the industrial applications of conductivity measurements.

(2 + 4) + (4 + 2) = 12

Group – C

4. (a) Define the cell constant of a conductivity cell. Explain the basic working principle of conductivity measurement. Show a 4-electrode scheme for the measurement of conductivity of a water sample.

(b) How does the colour and/or turbidity of the solution affect the performance of the ion selective electrode? State the characteristic of ion selective electrodes.

(2 + 3 + 3) + (2 + 2) = 12

5. (a) What are pH and Electrical Conductivity? How can one measure the soil pH? How does the temperature variation affect pH and electrical conductivity measurements? How to get rid of it?

(b) Can pH of a solution put any effect on its conductivity? What are the components that represent the concentration of a solution?

(2 + 2 + 2 + 2) + (2 + 2) = 12

Group – D

6. (a) What is the principle involved in colorimetry? Which is the source of light in colorimetry? Which detector is used in colorimetry? What is the sample cell made of in colorimetry? What are the applications of colorimetry?

   (b) What is the principle of X-Ray diffraction? State the law involved in X-Ray diffractometer. Name the components used to focus the generated X-Ray on specimen.

(2 + 1 + 1 + 1 + 2) + (2 + 1 + 2) = 12

7. (a) What is the difference between single beam and double beam spectrophotometer? What are the different energy transitions of the matters in UV, Visible and IR Spectrophotometry? State the law which is involved in the Spectrophotometry.

   (b) What is the basic principle of FTIR? Which detector is used in FTIR? What is difference between FTIR and IR? Is FTIR meant for qualitative or quantitative analysis?

(3 + 2 + 2) + (2 + 2 + 1) = 12

Group – E

8. (a) What are the different types of chromatography? How does the gas chromatography work? What is the purpose of chromatography?

   (b) What should be the behaviour of solvents employed in chromatography? What is the basic purpose of Liquid chromatography?

(2 + 4 + 2) + (2 + 2) = 12

9. Write short notes on any **two** of the following: **(2 × 6) = 12**
   (i) Magneto dynamic type oxygen analyzer
   (ii) Polarography
   (iii) Humidity measurement
   (iv) Mass spectrophotometer
   (v) Flame photometer.

Department & Section	Submission Link
AEIE	https://classroom.google.com/c/Mjk5MzI1MTgwMjAw/a/MzYwNDE0MjQxMzM3/details