

- (b) What are the dependent factors of chromatographic column efficiency? State the desirable characteristics of a GC detector. What is the specificity of a detector?

5 + (3 + 2 + 2) = 12

Group - E

8. (a) What is Nitrification in a wastewater treatment process? What is its importance in measuring BOD? What are the measurement settings while measuring BOD?

- (b) Calculate BOD of the sewage if 5% solution of a sewage sample is incubated for 5 days at 20°C and depletion of oxygen was found to be 10ppm.

(2 + 2 + 3) + 5 = 12

9. Write short notes on any two of the followings

- (i) Conductivity meter
- (ii) Dissolved Oxygen meter
- (iii) Liquid chromatography
- (iv) Single beam versus double beam spectrophotometers

(6 + 6) = 12

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) How the wave number and wavelength of electromagnetic radiation are related?
 (a) Wave number is the reciprocal of wavelength
 (b) Wave number is directly proportional to wavelength
 (c) Wave number is not related to wavelength
 (d) Wave number is equal to wavelength.
- (ii) For the survival of fish in a river stream, the minimum dissolved oxygen is prescribed at
 (a) 4 ppm (b) 5 ppm
 (c) 3 ppm (d) 6 ppm.
- (iii) Chromatography is a physical method that is used to separate and analyse
 (a) simple mixtures (b) complex mixtures
 (c) viscous mixtures (d) metals.
- (iv) Crompton's scattering is due to incident ----- to the material
 (a) X-Rays (b) IR-rays
 (c) UV- rays (d) Microwaves.
- (v) If the absorption of electromagnetic radiation by matter results in the emission of radiation of same or longer wavelengths for a long or a short time, the phenomenon is termed as
 (a) luminescence (b) fluorescence
 (c) phosphorescence (d) spontaneous emission.

- (vi) Beer's law states that the intensity of light decreases with
 (a) concentration of the solution (b) optical path length
 (c) composition of the solution (d) volume of the solution.
- (vii) In which of the followings ways, absorbance is related to transmittance?
 (a) absorbance is the logarithm of transmittance
 (b) absorbance is the reciprocal of transmittance
 (c) absorbance is the negative logarithm of transmittance
 (d) absorbance is a multiple of transmittance.
- (viii) The wavelength of absorption is 287 nm. In what part of the electromagnetic spectrum does this lie?
 (a) Ultraviolet (b) Microwave
 (c) Infrared (d) Visible.
- (ix) In gas chromatography, the concentration of a substance can be determined by
 (a) height of the peak
 (b) area under the peak
 (c) retention time
 (d) comparing retention time with standard one.
- (x) Which of the following transducers must be used for dissolved oxygen analyser?
 (a) Potentiometric (b) Polarographic
 (c) Ion-selective electrode (d) Optical transducer.

Group - B

2. (a) "Photoluminescence-based dissolved oxygen meter uses LEDs". State the number of the LEDs, their spectral band in the electromagnetic spectrum and the reason of using such LEDs.
 (b) What is the importance of measuring the level of dissolved oxygen in the Boiler feed water? Justify. What is the need of dosing Hydrazine in a treated water line? What is the effect of excess oxygen in the boiler feedwater?
 $(1 + 1 + 3) + (3 + 2 + 2) = 12$
3. (a) Draw the complete scheme of a 4-electrode conductivity meter. What does it measure in the boiler feed water? Mention the unit.
 (b) Why the measurement of silica is important in a boiler steam line? Describe an arrangement of a silica analyzer.
 $(3 + 1 + 1) + (2 + 5) = 12$

Group - C

4. (a) What is the purpose of a beam splitter in a doublebeam spectrophotometer? Calculate the theoretical number of fundamental modes of vibrations of the HCl and CO₂ molecules. What are the operational steps in Atomic Fluorescence Spectrophotometry? How does it differ from the atomic emission spectroscopy?
 (b) What occurs when the moving mirror in an FTIR spectrometer is moved the same distance from the beam splitter as the static mirror? What occurs when a molecule absorbs infrared radiation?
 $(2 + 2 + 3 + 3) + (1 + 1) = 12$
5. (a) In a FTIR, what is the need of placing a compensating plate? Where such a plate is placed? Point out the basic difference between UV-VIS and IR spectrophotometers in terms of sample placement. Justify. How one gets the information about the components from an interferogram?
 (b) What type of analysis is done using an Atomic Absorption Spectrometer? How do you realize the state of the components in the sample? What should be the nature of the light source? How do you realize such a source? How does an Atomic Absorption Spectrometers differ from an Atomic Fluorescence spectrophotometer?
 $(1 + 1 + 1 + 2) + (2 + 1 + 2 + 2) = 12$

Group - D

6. (a) "Atomic fluorescence spectroscopy is element specific and is much less subject to interferences", Justify the statement. What is the difference in frequency between the incident and emitted frequencies? What are the requisites states of the sample and analyte in the Atomic Fluorescence Spectroscopy?
 (b) What is a hollow cathode lamp? How does it generate light? What is the characteristic of the emitted light?
 $(4 + 1 + 2) + (1 + 3 + 1) = 12$
7. (a) Differentiate High Performance Liquid Chromatography and Gas Chromatography in terms of (i) mobile phase (ii) volatile nature of the samples (iii) molecular weight of molecules (iv) operating pressures (v) length of columns.