

- 7.(a) What is the basic purpose of HPLC? You are given four samples as said below and you have to
- identify various pigments from a leaf extract
  - separate types of organic pesticides
  - determine the caffeine contents of coffee samples
  - determine the mercury content of the fish. Which sample will be fit for HPLC test?
- (b) With a neat and labelled diagram, explain the arrangement and operation of HPLC.

### Group - E

8. (a) What is Biological Oxygen Demand? What is its importance? Explain with a neat diagram the operation of a dissolved oxygen meter.
- (b) What are the purposes of Chlorination and Ozonation in effluent treatment process? Discuss their relative advantages and disadvantages.

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

9. Write short notes on any two of the followings:

- Conductivity meter
- FTIR
- pH- meter
- ICP torch
- Half-cell potential.

**( 6 × 2 ) = 12**

### M.TECH/AEIE/2<sup>ND</sup>SEM/AEIE 5203/2017 INSTRUMENTAL METHODS OF ANALYSIS (AEIE 5203)

**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**
- The wavenumber of a transition is 3000 cm<sup>-1</sup>. In which part of the electromagnetic spectrum does this come?
 

(a) Infrared	(b) UV
(c) VIS	(d) Microwave.
  - According to the Beer-Lambert's law, the absorbance does not depend on which one of the followings?
 

(a) Distance that the light has travelled
(b) Solution concentration
(c) Colour of the solution
(d) Extinction coefficient of the sample.
  - What is the name of an instrument used to measure the absorbance of a coloured compound in solution?
 

(a) Colorimeter	(b) Calorimeter
(c) Colour meter	(d) Coulometer.
  - A characteristic feature of any form of chromatography is
 

(a) Use of an inert carrier gas
(b) Use of a mobile and stationary phase
(c) Molecules that are soluble
(d) Calculation of R <sub>f</sub> value for the molecules separated.

- (v) High performance liquid chromatography (HPLC) cannot be used to
  - (a) identify various pigments from a leaf extract
  - (b) separate types of organic pesticides.
  - (c) determine the caffeine contents of coffee samples
  - (d) determine the mercury content of the fish.
- (vi) 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.
- (vii) Johnson noise introduces an error in the analysis system due to
  - (a) thermal agitation of electrons
  - (b) charge carriers crossing a pn-junction
  - (c) noise introduced from the surroundings
  - (d) signal frequency variation.
- (viii) Crompton's scattering is due to incident ----- to the material
  - (a) X-Rays
  - (b) IR-rays
  - (c) UV- rays
  - (d) Microwaves.
- (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) Window through which X-Rays move in experiment is made up of
  - (a) aluminium
  - (b) steel
  - (c) iron
  - (d) platinum.

**Group - B**

- 2.(a) What is SWAS? What is the need of a SWAS?
  - (b) Describe any two important instruments with neat diagrams used in SWAS.
- ( 2 + 2 ) + ( 4 × 2 ) = 12**
- 3.(a) With a neat sketch, explain the principle and operation of NO<sub>x</sub> gas analyzers.
  - (b) Why the measurement of silica is important in a boiler steam line? Describe an arrangement of a silica analyzer.

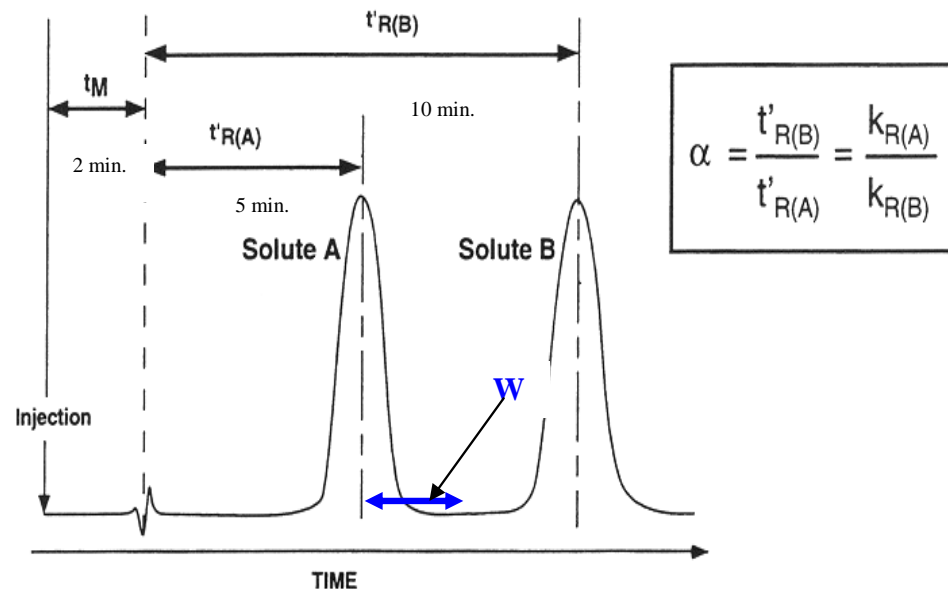
**5 + ( 2 + 5 ) = 12**

- 4.(a) Explain with a neat and labelled diagram, the operation of a double beam IR spectrometer. Calculate the theoretical number of fundamental modes of vibrations of the HCl and CO<sub>2</sub> molecules.
  - (b) In a spectrometer, calculate the resolution of a monochromator that could resolve two wavelengths 599.9 nm and 600.1 nm.
- ( 8 + 2 ) + 2 = 12**
- 5.(a) What are the instrumental noises in analysis? What are the ways to reduce the error in measurements due to such noises?
  - (b) Write down the equation of a simple harmonic oscillator used to determine the energy level of a bond. Estimate the energy of the C-H bond stretching vibration. Given force constant = 5 × 10<sup>5</sup> dynes/cm.

**( 2 + 6 ) + ( 2 + 2 ) = 12**

**Group - D**

- 6. Given the following chromatogram and a column length of 20 cm:



Calculate:

- (i) capacity factor for solutes A and B
- (ii) number of theoretical plates for solutes A and B
- (iii) plate height for solutes A and B
- (iv) separation factor.