**5 SEM TDC DSE CHM**
**(CBCS) 1 (H/NH)**

**2021**

( Held in January/February, 2022 )

# CHEMISTRY

( Discipline Specific Elective )

( For Honours/Non-Honours )

Paper : DSE–1

**( Analytical Methods in Chemistry )**

*Full Marks* : 53
*Pass Marks* : 21

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

**1.** Choose the correct option : 1×6=6

*(a)* The wave number corresponding to 25 μm is

*(i)* 2500 $cm^{-1}$

*(ii)* 4000 $cm^{-1}$

*(iii)* 250 $cm^{-1}$

*(iv)* 400 $cm^{-1}$

(b) The correct expression of relative error is (where $x_i$ = experimental value and $x_t$ = true value)

(i) $E_r = \frac{x_i - x_t}{x_i}$

(ii) $E_r = \left[\frac{x_i - x_t}{x_t} \times 100\right]\%$

(iii) $E_r = x_i - x_t$

(iv) $E_r = x_t - x_i$

(c) In pH metric titration, the indicator electrode used is

(i) calomel electrode

(ii) glass electrode

(iii) quinhydrone electrode

(iv) Pt electrode

(d) Chromatography with solid stationary phase is called

(i) partition chromatography

(ii) solid chromatography

(iii) adsorption chromatography

(iv) None of the above



( Continued )

(e) Solvent extraction is governed by which law?

(i) Boyle's law

(ii) Ostwald dilution law

(iii) Nernst distribution law

(iv) Beer's law

(f) In UV-visible spectroscopy, the cuvette is made of

(i) glass

(ii) quartz

(iii) plastic

(iv) KBr

**2.** Answer the following questions : 2×6=12

(a) What is a reference electrode? Mention three common reference electrodes used in potentiometry.

(b) In conductometric titration, the titrant should be 10–100 times concentrated than the solution to be titrated. Why?

(c) What is fingerprint region in IR spectroscopy?

(d) What are the various visualization techniques used in TLC?

(e) What is meant by retention time in HPLC?

(f) Sketch the conductometric titration curves for neutralization titrations of the following :

(i) Strong acid vs. Strong base

(ii) Weak acid vs. Strong base

3. What are systematic errors? Mention different types of systematic error. 1+2=3

*Or*

The molarity of a solution is determined by four separate titrations and the results are 0·2041, 0·2049, 0·2039 and 0·2043. Calculate the mean, median and range for the data. 3

**4.** Answer any *five* of the following questions : 4×5=20

*(a)* Deduce the Lambert-Beer law. What is molar extinction coefficient? 3+1=4

*(b)* What are single beam and double beam configuration in UV-vis spectrophotometer? 4

*(c)* Explain the effect of solvent polarity on *(i)* $n \rightarrow \pi$ and *(ii)* $\pi \rightarrow \pi^*$ transition. 4

*(d)* What are group frequencies in IR spectroscopy? Match the following groups with their approximate frequencies : 2+2=4

| *Group* | *Approximate frequency* (in $cm^{-1}$) |
|---|---|
| —OH | 1100 |
| $-CH_3$ (stretching) | 3600 |
| $\rangle C=O$ | 2970 |
| $\rangle C=S$ | 1750 |

(e) Write four differences between atomic absorption spectroscopy (AAS) and flame emission spectroscopy (FES). 4

(f) Discuss various sampling techniques used for the preparation of solid sample. 4

**5.** What are the main components of a TGA instrument? 3

*Or*

Explain the basic principles of TGA with example. 3

**6.** Answer any *three* of the following questions : 3×3=9

(a) What is $R_f$ value in chromatography? Explain the significance of $R_f$ value.

(b) Give the principles of HPLC.

(c) Based on mechanism of separation, classify chromatographic techniques.

(d) Show that multistep extraction with a solvent is more efficient than a single-step extraction.

(e) What are the different solvent extraction methods of metal ions from aqueous solution?

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