TIME: 2 ½ HOURS  

Please check whether you have got the right question paper.

N.B. 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Use of logarithmic table/non programmable calculator is allowed.
4) At. Wts: H=1, C=12, N=14, O=16, Na=23, Al=27, S=32, Cl=35.5, K=39, Ca=40, Ag=108, Ba=137, Pb=207, Mg= 24.3, F=19, Cu= 63.5, Cr = 52

Q.1  A) Attempt any two of the following:
   a) Define ‘Determinate Errors’. Discuss (a) Instrumental Errors (b) Personal Errors.  
   b) Discuss briefly the following terms with respect to quantitative performance criteria of an analytical instrument i) Detection limit ii) Dynamic range  
   c) What six sigma? What is DMAIC process of six sigma?  
   d) Define the term: ‘Quality system review’ Discuss the activities involved in quality system review meeting.

B) Attempt any one of the following:
   a) Discuss briefly Indian government standards with respect to ISI, Hallmark and Agmark.  
   b) Name the different methods to minimize determinate errors. Discuss any two in brief.

Q.2  A) Attempt any two of the following:
   a) 1) How many milligrams of sodium chloride present in 100cm³ of 0.4 molar solution of sodium chloride?  
      2) Assign oxidation number to each element in V₂O₇⁻⁴  
   b) Chloroform reacts with chlorine, to form CCl₄ and hydrogen chloride. In an experiment 25 gm of chloroform and 15 gm of chlorine were allowed to react. Which is the limiting reagent? What is the maximum yield of CCl₄ in moles and grams?  
   c) A 21.70cm³ sample of Ca(OH)₂solution was titrated with 0.25 M HCl. 45.8 cm³ of the acid was required to reach the endpoint of the titration i) What is the equation of the reaction?  
      ii) What was the molarity of calcium hydroxide solution?  
   d) What is the minimum pH of 0.1M Mg²⁺ solution, from which Mg (OH)₂ will not precipitate. Given: Ksp of Mg (OH)₂ =1.2x10⁻¹¹M.

B) Attempt any one of the following:
   a) Calculate the mass of anhydrous HCl in 5.0 ml concentration of HCl (sp.gr.19 g/ml) containing 37.23% of HCl by weight.  
   b) Calculate the pH of a buffer solution containing 0.1 M acetic acid and 0.1M sodium acetate. What will be the change in pH on adding, (i) 0.01M HCl to 1.0 dm³ of buffer and  
      (ii) 0.01M NaOH to 1.0 dm³ of buffer. ( Kₐ = 1.8 X 10⁻⁵)
Q.3  A) Attempt any two of the following:
   a) With the help of block diagram describe the Dual Wavelength Spectrophotometer. 4
   b) Enlist different types of Infrared transducers. Describe pyroelectric transducer 4
   c) Discuss the effect exerted by solvents on Wavelength of peaks in absorption spectroscopic techniques. 4
   d) Explain charge transfer absorption with respect to UV-Visible spectroscopy 4

B) Attempt any one of the following:
   a) Explain the sample handling methods with respect to IR spectroscopy. 4
   b) A solution containing two absorbing species ‘A’ and ‘B’ was analysed spectrophotometrically at two different wavelengths in a cell of path length 1.0 cm. The absorbance of mixture was 0.620 and 0.045 at 400nm and 700nm respectively. The molar absorptivities of two species were given as below:-

<table>
<thead>
<tr>
<th>Species</th>
<th>Molar absorptivity (ε) mol⁻¹ dm³ cm⁻¹</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>400 nm</td>
</tr>
<tr>
<td>A</td>
<td>3640</td>
</tr>
<tr>
<td>B</td>
<td>3300</td>
</tr>
</tbody>
</table>

Calculate the molar concentration of A and B.

Q.4  A) Attempt any two of the following:
   a) Give the differences between power compensated and heat flux DSC instruments. 4
   b) How does automation enhance the acceptability of the results? 4
   c) Explain “Flow injection analysis” with suitable example. 4
   d) Explain application of Differential Scanning Calorimetry (DSC) for drug analysis and oxidative stability.

B) Attempt any one of the following:
   a) What are the gas monitoring equipments? 4
   b) Give a brief account on comparison between DSC and DTA (Any 4 points) 4

Q.5  Attempt any four of the following: 12
   a) Explain calibration curve method to quantify an analyte in a sample.
   b) Discuss in brief, ’Klimisch score’
   c) Calculate the number of hydrogen present in 5.0 moles of Ethyl alcohol. (Given Avogadro number Nₐ = 6.02 x 10²³)
   d) Calculate the pH of 2 x 10⁻³ M solution of acetic acid. Kₐ for acetic acid is 1.75 x 10⁻⁵.
   e) In what way the Fourier Transform (FT) instruments differ from other optical instruments?
   f) With respect to spectroscopic studies, discuss continuum sources and Line sources in brief.
   g) Explain how sample size and sample shape affect DSC curves.
   h) Distinguish between discrete and continuous automated devices.