Q. P. Code : 29457

[Time: $2\frac{1}{2}$ Hours]   [Marks:60]

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)   What are transducers and sensors? Explain the 'piezoelectric effect' that forms the basis of   4
     quartz crystal micro balance (QCM) sensor. What is the detection limit for a piezoelectric
     sensor?

b)   What is six sigma? Explain the DMAIC approach in implementing six sigma.   4

c)   Describe the use of standard addition method for standardization of an analytical technique.   4

d)   What is ISO series? How does an organization go for ISO certification?   4

B)   Attempt any one of the following:

a)   Define the term: 'Quality system review'. Discuss the activities involved in quality system   4
     review meeting.

b)   Give a brief account of i) Instrumental errors   ii) Methodic errors   4

Q. 2 A)   Attempt any two of the following:

a)   i)   Calculate the pH of 2.0×10^{-3} M solution of acetic acid. (K_a for acetic acid is 1.8×10^{-5}).   2
     ii) How many hydrogen atoms are present in 2.0 moles of methanol?   2
          (Avogadro's number $N_A = 6.023 \times 10^{23}$).

b)   A sample of pure $CaCO_3$ (MW = 100.09) weighing 0.45 g is dissolved in 1:1 hydrochloric acid   4
     and the solution is diluted to 250 cm^3. 25cm^3 of above solution is titrated with EDTA solution
     using EBT indicator. A volume of 20.19 cm^3 of EDTA is required to reach the end point.
     Calculate the molarity of the EDTA solution.

c)   A solution is prepared by dissolving 1678 mg of $K_2Cr_2O_7$ in 500cm^3 water.   4
     Calculate
          i)   Molar concentration of the solution
          ii)   w/v percentage of $K_2Cr_2O_7$

d)   In an experiment 0.25 mole of methane was heated with 0.98 mole of oxygen in a sealed vessel   4
     to yield water and carbon dioxide. Find the limiting reagent in the production of carbon
     dioxide. Calculate the theoretical yield of water in grams.

B)   Attempt any one of the following:

a)   What is the normality of 12.3% (v/v) solution of sulphuric acid (specific gravity = 1.085 g/cm^3). 4
     Calculate the volume of 3M potassium hydroxide required to neutralize 18.0 cm^3 of the acid?

b)   Calculate the amount of sodium acetate that should be added to 0.2dm^3 of an aqueous solution   4
     containing 0.05 mol acetic acid to obtain a buffer solution of pH 4.5.
     (Given: Ka for acetic acid = 1.8×10^{-5}).

Q. 3 A) Attempt **any two** of the following:

a) In what way the Fourier transform instruments differ from other optical instruments? What are the advantages of FTIR?   4

b) With the help of labeled diagram, explain the working of Diffraction grating monochromator.   4

c) Give an account of Fiber Optics used in Spectroscopy.   4

d) Discuss charge transfer absorption with respect to UV-visible spectroscopy   4

B) Attempt **any one** of the following:

a) Enlist the different types of Infrared transducers. Describe pyroelectric transducer in detail.   4

b) A simultaneous determination of two metals M and N is based upon absorption by their respective oxine complexes. Calculate the molar concentration of metals M and N in a mixture of M and N on the basis of the following data. (Thickness of cell b = 1cm)   4

Metal/s	Molar Absorptivity (ϵ) $dm^3\ mol^{-1}\ cm^{-1}$		Absorbance	
	370nm	700nm	370nm	700nm
M	4456	459	--	--
N	2235	18	--	--
Mixture of M and N	--	--	0.44	0.29

Q. 4 A) Attempt **any two** of the following :

a) Describe heat flux DSC cell with a schematic diagram.   4

b) Explain the application of DSC for characterization of polymers.   4

c) Compare and contrast discrete analyzers and continuous flow analyzers.   4

d) Discuss how automation enhances the acceptability of results.   4

B) Attempt **any one** of the following:

a) Explain factors affecting nature of DSC curves.   4

b) Describe the principle of flow injection analysis.   4

Q. 5 Attempt **any four** of the following: 12

a) With respect to analytical chemistry explain the following terms.
i) Analysis   ii) Determination   iii) Measurement

b) Define Accreditation and Certification.

c) How will you prepare 0.5 dm^3 of 200 ppb of Cu^{+2} solution from $CuSO_4$?

d) The pH of magnesium hydroxide is 10.45 at 25^0C. Calculate the solubility product constant of magnesium hydroxide.

e) Describe the use of CO_2 laser source in IR Spectroscopy.

f) Explain the basic principles of diffuse reflectance spectroscopy.

g) In thermal methods, why is the thermocouple seldom immersed directly into the sample?

h) What are gas monitoring equipments?

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