U.S.N.										

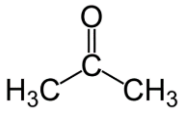
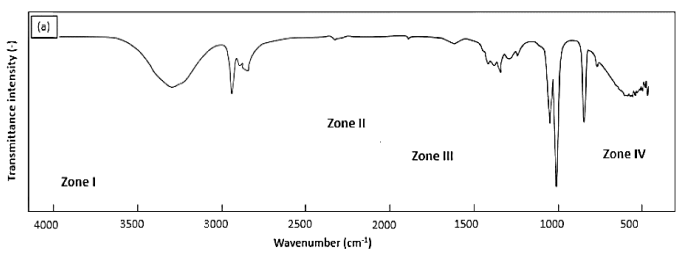
B.M.S. College of Engineering, Bengaluru-560019

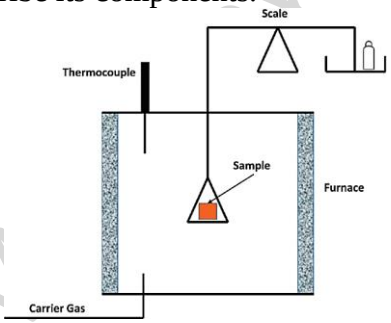
Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23CH4ESANI **Max Marks: 100**
Course: ANALYTICAL INSTRUMENTS

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

			CO	PO	Marks
		UNIT - I			
1	a)	Define accuracy and precision. Explain the different types of errors that can affect the accuracy and precision of the measured quantity.	*CO1*	*PO1*	**10**
	b)	Elucidate the external standard calibration method used in analytical instrument analysis with the help of a calibration graph.	*CO1*	*PO1*	**10**
		UNIT - II			
2	a)	Consider the acetone compound and analyze the possible electronic transitions when the compound is exposed to UV radiation. Distinguish the allowed and forbidden electronic transitions in this molecule and the draw energy diagram for the same. 	*CO2*	*PO2*	**08**
	b)	The absorption spectrum for titanium peroxide complex ion in perchloric acid showed a maximum of 400 nm. The absorbance of a 35 µg/mL solution of titanium gave an absorbance of 0.50. An unknown solution treated in an identical manner gave an absorbance of 0.58. Assuming identical cells, find out the concentration of the unknown.	*CO2*	*PO2*	**06**
	c)	Answer the following questions. (i) Analyze the below graph, and suggest the analytical instrument used to collect the data. (ii) What are functional and fingerprint regimes in the below spectra and locate their range of wavenumbers? (iii) Locate the bending and stretching vibrations of water molecule from the below spectra and mention its wave number 	*CO2*	*PO2*	**06**

			OR			
	3	a)	Illustrate the working principle of a double beam UV spectroscopy with a neat sketch and label all the instrumentation involved.	***CO2***	***PO2***	**07**
		b)	Convert the following transmittance data into absorbance value and plot path length v/s absorbance. Table: The experimental data obtained from UV-vis Spectroscopy. Path length (cm): 0 | 0.2 | 0.4 | 0.6 | 0.8 | 1 %T: 100 | 50 | 25 | 12.5 | 6.25 | 3.125	***CO2***	***PO2***	**06**
		c)	Briefly discuss the working principle of Bolometer detector used in Fourier Transform Infrared Spectroscopy with the help of neat sketch.	***CO2***	***PO2***	**07**
			UNIT - III			
	4	a)	With the help of neat sketch, describe the working principle of a power compensated differential scanning calorimeter (DSC).	***CO2***	***PO2***	**07**
		b)	A 0.5 g sample of naphthalene ($C_{10}H_8$) is burned in a bomb calorimeter containing 650 g of water at an initial temperature of 20ºC. After the reaction, the final temperature of the water is 26.4ºC. The heat capacity of the calorimeter and water are 420 J/ºC and 4.18 J/g.ºC. Using these data, calculate the heat of combustion of naphthalene in kJ/mol.	***CO3***	***PO2***	**07**
		c)	Identify the below-mentioned analytical instrument. Explain the principle and describe its components. 	***CO3***	***PO2***	**06**
			UNIT - IV			
	5	a)	Explain the working principle of gas chromatography with a neat sketch and identify the components involved.	***CO2***	***PO2***	**10**
		b)	Why non-volatile or low thermally stable compounds cannot be analyzed in GC? Justify.	***CO3***	***PO2***	**05**
		c)	What is a measure of the effectiveness of the GC column? Explain with an equation.	***CO6***	***PO12***	**05**
			OR			
	6	a)	Describe the Thermal Conductivity detector and Flame Ionization detectors used in gas chromatography with the help of neat sketches.	***CO3***	***PO2***	**12**
		b)	Differentiate the following i. Mobile phase v/s Stationary phase ii. Packed column v/s capillary column iii.	***CO3***	***PO2***	**08**

			UNIT - V			
	7	a)	What is the principle of High Performance Liquid Chromatography (HPLC)?	***CO2***	***PO2***	**06**
		b)	Describe the criteria for selection of mobile phase in HPLC.	***CO2***	***PO2***	**08**
		c)	Enlist and describe the different types of HPLC columns.	***CO6***	***PO12***	**06**

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