SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT

OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

VI SEMESTER
1907607 – Analytical Instruments
Regulation – 2019
Academic Year 2024 – 2025 EVEN

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DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING
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SUBJECT : 1907607- ANALYTICAL INSTRUMENTS
SEM / YEAR : VI / III

UNIT I - SPECTROPHOTOMETRY				
Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.				
PART – A				
Q.No	**Questions**	**CO**	**BT Level**	**Competence**
1.	Define Beer-Lambert law.	**CO1**	**BTL 1**	Remember
2.	Compare single beam and double beam instrument.	**CO1**	**BTL 2**	Understand
3.	Mention the sources used in atomic absorption spectrometry.	**CO1**	**BTL 1**	Remember
4.	Name the different types of spectrophotometers.	**CO1**	**BTL 1**	Remember
5.	What is the principle of hollow cathode lamp used in atomic absorption spectroscopy?	**CO1**	**BTL 1**	Remember
6.	Define transmittance and absorbance.	**CO1**	**BTL 1**	Remember
7.	Distinguish between AAS and FES.	**CO1**	**BTL 2**	Understand
8.	What is total internal reflection in spectrometry?	**CO1**	**BTL 2**	Understand
9.	List the wavelength range of IR radiation.	**CO1**	**BTL 1**	Remember
10.	Identify the detectors to be used in IR Spectroscopy.	**CO1**	**BTL 1**	Remember
11.	What are the basic requirements of radiation sources in absorption photometry?	**CO1**	**BTL 1**	Remember
12.	Define interference filters.	**CO1**	**BTL 1**	Remember
13.	List the limitations of absorption filters.	**CO1**	**BTL 1**	Remember
14.	Why sensitive detector is required for Spectrophotometer?	**CO1**	**BTL 2**	Understand
15.	What is pyrolysis?	**CO1**	**BTL 1**	Remember
16.	What is attenuated total reflectance with respect to photometer?	**CO1**	**BTL 2**	Understand
17.	Interpret the range covered by UV visible spectrophotometers.	**CO1**	**BTL 2**	Understand
18.	Outline the advantages of double beam spectrophotometer.	**CO1**	**BTL 2**	Understand
19.	Demonstrate the application of flame emission spectrometry.	**CO1**	**BTL 2**	Understand
20.	What are the major design requirements of monochromator?	**CO1**	**BTL 1**	Remember
21.	Difference between absorption filter and interference filter.	**CO1**	**BTL 2**	Understand
22.	Define Beer's law.	**CO1**	**BTL 1**	Remember
23.	Compare the detector used in IR Spectroscopy.	**CO1**	**BTL 2**	Understand
24.	Write about photo multiplier detector.	**CO1**	**BTL 2**	Understand
PART-B				
1.	**i.** State and derive Beer's law from basic principles. Discuss the limitations of it. **(6)**	**CO1**	**BTL 3**	Apply
	ii. With the Instrumentation setup, describe the working of single beam spectrometer. **(7)**			

2.	Explain in detail, the sources and detectors used in UV-Visible spectroscopy with necessary diagrams. **(13)**	**CO1**	**BTL 4**	Analyze
3.	**i.** Illustrate with a neat sketch the principle and operation of a typical single beam UV spectrograph. How does this differ from a double beam instrument? **(7)**	**CO1**	**BTL 3**	Apply
	ii. Draw and explain the schematic diagram of a typical double beam spectrophotometer. **(6)**			Apply
4.	Explain in detail about grating mono chromator system with neat diagram. **(13)**	**CO1**	**BTL 4**	Analyze
5.	Describe about single beam and double beam instruments used in IR spectrophotometer with necessary diagrams. **(13)**	**CO1**	**BTL 3**	Apply
6.	With necessary diagram, describe the principle, construction and working of U-V spectrophotometer. **(13)**	**CO1**	**BTL 2**	Understand
7.	**i.** With relevant diagrams, examine the working principle of various radiation sources used in IR-Spectrophotometers. **(5)**	**CO1**	**BTL 2**	Understand
	ii. With the help of a neat diagram, describe the construction and principle of FTIR, giving emphasis on its advantages over double beam IR. **(8)**			Understand
8.	**i.** Show the detectors used in IR. Explain any one detector in detail. Also mention about different sample handling techniques in IR. **(7)**	**CO1**	**BTL 3**	Apply
	ii. Illustrate the operation of attenuated total reflection Spectrophotometer. **(6)**			Apply
9.	With a neat instrumentation setup, examine the principle of IR spectrometer and label the various components involved in it. **(13)**	**CO1**	**BTL 2**	Understand
10.	Elaborate the FTIR spectrophotometer with neat optical path diagram and block diagram of the instrument. **(13)**	**CO1**	**BTL 2**	Understand
11.	**i.** Illustrate the operating principle of atomic absorption spectroscopy. **(6)**	**CO1**	**BTL 2**	Understand
	ii. Explain the various sources and detectors used in AAS. **(7)**			Understand
12.	Describe the operating principle of flame emission photometer with neat diagram. **(13)**	**CO1**	**BTL 2**	Understand
13.	Briefly, discuss the working technique and applications of AAS with suitable diagrams. **(13)**	**CO1**	**BTL 2**	Understand
14.	Explain in detail working principle of fluorescence spectrophotometer. **(13)**	**CO1**	**BTL 4**	Analyze
15.	Explain in details about filter used in spectrometer. **(13)**	**CO1**	**BTL 3**	Apply
16.	Elaborate the operation of double beam UV-spectrometer. **(13)**	**CO1**	**BTL 3**	Apply
17.	Illustrate the operating principle of NDIR spectrometer. **(13)**	**CO1**	**BTL 3**	Apply
	PART-C			
1.	Explain the operation of Atomic absorption **(15)**	**CO1**	**BTL4**	Analyze

	spectrometer in detail. Mention its applications.			
2.	List the advantages of double beam configuration of UV Spectrometer over single beam configuration. Illustrate the double beam configuration of UV Spectrometer with real time application. Explain it using neat sketch **(15)**	**CO1**	**BTL 3**	Apply
3.	What are non-dispersive spectrophotometers? Explain in detail the Fourier Transform IR spectrometer. Also specify the advantages of Fourier Transform IR spectrophotometer. **(15)**	**CO1**	**BTL4**	Analyze
4.	With a neat instrumentation setup, demonstrate the visible spectrophotometer. **(15)**	**CO1**	**BTL 3**	Apply
5.	Demonstrate the different sources and detectors in UV spectrometer. **(15)**	**CO1**	**BTL 3**	Apply

UNIT II - CHROMATOGRAPHY

General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications. Ion exchange chromatography - size-exclusion chromatography.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	Define retention time in a chromatograph.	**CO2**	**BTL 1**	Remember
2.	Discuss the function of chromatographic column.	**CO2**	**BTL 2**	Understand
3.	What are the detectors to be used in gas chromatography?	**CO2**	**BTL 1**	Remember
4.	Why temperature programming is required for column oven used in Gas chromatography?	**CO2**	**BTL 2**	Understand
5.	What do you mean by the open tubular columns in gas chromatography?	**CO2**	**BTL 1**	Remember
6.	Define Column Chromatography.	**CO2**	**BTL 1**	Remember
7.	What are the detectors used in Liquid Chromatography?	**CO2**	**BTL 2**	Understand
8.	Define chromatography.	**CO2**	**BTL 1**	Remember
9.	Write about liquid chromatography.	**CO2**	**BTL 2**	Understand
10.	Define partition ratio.	**CO2**	**BTL 1**	Remember
11.	Identify the selection criteria for carrier gas.	**CO2**	**BTL 2**	Understand
12.	Define thin layer chromatography.	**CO2**	**BTL 1**	Remember
13.	Write about sample injection system.	**CO2**	**BTL 2**	Understand
14.	What is the stationary phases in chromatography?	**CO2**	**BTL 1**	Remember
15.	Define dead time in chromatograph.	**CO2**	**BTL 1**	Remember
16.	Classify the various types of chromatographic column.	**CO2**	**BTL 2**	Understand
17.	How thin layer chromatography is better than paper chromatography?	**CO2**	**BTL 2**	Understand
18.	On what factor does the choice of detector will depend on liquid chromatography?	**CO2**	**BTL 2**	Understand
19.	List the limitations of bulk property detector.	**CO2**	**BTL 1**	Remember
20.	What the solvents to be used for mobile phase in chromatography?	**CO2**	**BTL 1**	Remember
21.	Mention the types of open tubular column.	**CO2**	**BTL 1**	Remember
22.	Classify the chromatography.	**CO2**	**BTL 2**	Understand
23.	What is ion exchange chromatography?	**CO2**	**BTL 1**	Remember

24.	What is size-exclusion chromatography?	**CO2**	**BTL 1**	Remember
	PART-B			
1.	**i.** With a neat schematic diagram, quote the separation principle of HPLC (High Pressure Liquid Chromatography). **(10)** **ii.** List the applications of HPLC. **(3)**	**CO2**	**BTL 1**	Remember
2.	**i.** What is meant by column chromatography? And mention the advantages of column chromatography. **(4)** **ii.** Draw the instrumentation diagram for column chromatography and discuss how separation process will be performed in column chromatography. **(9)**	**CO2**	**BTL 3**	Apply
3.	Describe the different stages of Gas Chromatography in the separation of two phases with schematic diagram. **(13)**	**CO2**	**BTL 2**	Understand
4.	Explain with neat sketches any two detectors used in gas chromatography. **(13)**	**CO2**	**BTL 4**	Analyze
5.	Discuss the electron capture detector and flame ionization detector. **(13)**	**CO2**	**BTL 2**	Understand
6.	**i.** Quote the principle and applications of Refractive index detector used in HPLC. **(6)** **ii.** Describe the different parts in gas chromatography with relevant diagrams. **(7)**	**CO2**	**BTL 1**	Remember
7.	Derive the relationship between retention time and distribution constant. **(13)**	**CO2**	**BTL 4**	Analyze
8.	Describe the following terms : **(13)** i.Retention volume ii.Retention factor iii.Dead volume and Dead time iv.Adjusted retention volume and adjusted retention time.	**CO2**	**BTL 1**	Remember
9.	Explain any three types of detectors used in liquid chromatography. **(13)**	**CO2**	**BTL 4**	Analyze
10.	With necessary diagrams, Assess the working principle of High Pressure Liquid Chromatography. **(13)**	**CO2**	**BTL 4**	Analyze
11.	**i.** Show the different types of chromatography. **(4)** **ii.** What are the requirement of HPLC pumping system and discuss the advantage and disadvantages of it? **(9)**	**CO2**	**BTL 3**	Apply
12.	With suitable diagrams, formulate the various sampling techniques in Gas Chromatography. **(13)**	**CO2**	**BTL 3**	Apply
13.	**i.** Give in detail the classification of Chromatography. **(4)** **ii.** Discuss on Liquid Chromatography. **(9)**	**CO2**	**BTL 2**	Understand
14.	**i.** Name the two types of Chromatographic column used in Gas chromatography and explain in detail. **(6)** **ii.** With a neat diagram, describe the **(7)**	**CO2**	**BTL 2**	Understand

	construction and working of katharometer.			
15.	Illustrate Ion Exchange Chromatography.	**CO2**	**BTL 3**	Apply
16.	Describe the size-exclusion chromatography in detail with neat sketch. **(13)**	**CO2**	**BTL 3**	Apply
17.	Describe the partition chromatography in detail with neat sketch. **(13)**	**CO2**	**BTL 3**	Apply
PART-C				
1.	**i.** Explain the strategy to separate sample in HPLC with a neat instrumentation set up. **(10)**	**CO2**	**BTL 4**	Analyze
	ii. Classify and explain the different types of pumps used in HPLC. **(5)**			
2.	Recommend suitable chromatography for separation of non volatile mixture. Also draw suitable diagrams and discuss on it. **(15)**	**CO2**	**BTL 3**	Apply
3.	**i.** Specify the role of chromatography in power plant. Also elaborate the method of gas chromatography. **(10)**	**CO2**	**BTL 3**	Apply
	ii. State the factors to be considered in Carrier Gas Supply System in Gas Chromatography. **(5)**			
4.	Evaluate a suitable method to separate the sample based on their size of molecular weight and explain it with neat diagram. **(15)**	**CO2**	**BTL 4**	Analyze
5.	Recommend suitable chromatography for separating compounds based on their net charge. Also draw suitable diagrams and discuss on it. **(15)**	**CO2**	**BTL 4**	Analyze

UNIT III - INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS

Gas analyzers – Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	How the carbon-monoxide in the air is monitored?	**CO3**	**BTL 2**	Understand
2.	Draw a typical diagram to measure dust particles.	**CO3**	**BTL 1**	Remember
3.	What is the principle of H2S analyzer?	**CO3**	**BTL 2**	Understand
4.	Identify the detection methods of Carbon Monoxide Analyzer.	**CO3**	**BTL 2**	Understand
5.	What is the principle of domestic smoke alarm?	**CO3**	**BTL 1**	Remember
6.	List the few gas pollutants.	**CO3**	**BTL 1**	Remember
7.	Demonstrate the principle of Dust density measurement in Exhaust.	**CO3**	**BTL 2**	Understand
8.	Define Thermal conductivity.	**CO3**	**BTL 1**	Remember
9.	Identify the methods to estimate Nitrogen-oxides present in air.	**CO3**	**BTL 1**	Remember
10.	Define thermal conductivity analyzer.	**CO3**	**BTL 1**	Remember
11.	List a few types of Gas analyzers.	**CO3**	**BTL 1**	Remember
12.	What the use of gold films in Hydrogen Sulfide analyser?	**CO3**	**BTL 2**	Understand
13.	Define Ionization.	**CO3**	**BTL 1**	Remember

14.	Write about the principle of Smoke meter.	**CO3**	**BTL 2**	Understand
15.	List the properties of Gas used for the measurement of quantity.	**CO3**	**BTL 1**	Remember
16.	What is the principle of Dust measurement in Thermal power plant?	**CO3**	**BTL 2**	Understand
17.	What is the need of measuring carbon monoxide in flue gas?	**CO3**	**BTL 2**	Understand
18.	Write the applications of conductivity analyzer.	**CO3**	**BTL 1**	Remember
19.	What is the principle behind IR analyzer?	**CO3**	**BTL 2**	Understand
20.	Write the need for sulphur dioxide estimation.	**CO3**	**BTL 2**	Understand
21.	Demonstrate the principle Smoke density measurement in Exhaust.	**CO3**	**BTL 2**	Understand
22.	Write the applications of IR gas analyzer.	**CO3**	**BTL 1**	Remember
23.	Where are the electrochemical sensors used?	**CO3**	**BTL 2**	Understand
24.	How is nitrogen-di-oxide prepared by chemiluminescence?	**CO3**	**BTL 2**	Understand
	PART-B			
1.	With a neat diagram, explain how oxygen content is measured using its paramagnetic property. **(13)**	**CO3**	**BTL 4**	Analyze
2.	**i.** Demonstrate the working principle of a Paramagnetic Oxygen Analyzer with a functional diagram. **(10)** **ii.** Specify the need of Oxygen measurement. **(3)**	**CO3**	**BTL 3**	Apply
3.	Write a note on: - **i.** Method used to estimate sulphur dioxide **(6)** **ii.** NO_2 gas analyser. **(7)**	**CO3**	**BTL 1**	Remember
4.	Describe with a neat sketch carbon monoxide monitor and Nitrogen oxide analyzer. **(13)**	**CO3**	**BTL 1**	Remember
5.	Explain how the H_2S analyzer is used. **(13)**	**CO3**	**BTL 3**	Apply
6.	Draw the schematic diagram and show the operation of a thermal conductivity analyzer. **(13)**	**CO3**	**BTL 2**	Understand
7.	Discuss how to estimate the amount of hydrocarbons present in air with neat instrumentation setup. **(13)**	**CO3**	**BTL 2**	Understand
8.	Describe the constructional details and working of a dust monitor. **(13)**	**CO3**	**BTL 1**	Remember
9.	With a schematic diagram, explain the method of measuring sulphur dioxide (SO_2) estimation using conductivity method **(13)**	**CO3**	**BTL 4**	Analyze
10.	**i.** Estimate CO level in air and how it can be analysed using NDIR analyzer with relevant diagrams. **(10)** **ii.** Compose the consequences of air pollution. **(3)**	**CO3**	**BTL 4**	Analyze
11.	Discuss on dust and smoke measurements. **(13)**	**CO3**	**BTL 2**	Understand
12.	**i.** Deduce the principle of pollution monitoring instruments used for monitoring automobile exhaust gases. **(10)** **ii.** Why should such pollution testing be carried out? **(3)**	**CO3**	**BTL 4**	Analyze
13.	With neat diagram, explain the working principle of thermal conductivity analyzer and IR **(13)**	**CO3**	**BTL 4**	Analyze

	analyzers.			
14.	Write short notes on Air pollution due to Carbon monoxide & Nitrogen oxide **(13)**	**CO3**	**BTL 2**	Understand
15.	Write short notes on Air pollution due to Hydrocarbons & Sulphur dioxide. **(13)**	**CO3**	**BTL 2**	Understand
16.	Explain the measurement techniques available for sulphur Dioxide pollutant. **(13)**	**CO3**	**BTL 3**	Apply
17.	With a neat diagram, explain how oxygen content is measured. **(13)**	**CO3**	**BTL 3**	Apply
PART-C				
1.	With a block diagram, propose the method of measuring carbon monoxide using Non-Dispersive Infrared Analyzer **(15)**	**CO3**	**BTL 3**	Apply
2.	With a schematic diagram, explain the method of analyzing various flue gas content in smoke using Hot wire thermal conductivity analyzer. **(15)**	**CO3**	**BTL 3**	Apply
3.	Propose a method to estimate the amount of sulphur-di-oxide. **(15)**	**CO3**	**BTL 4**	Analyze
4.	Describe the working of an analyzer that can be used to estimate the content of NO_2 and SO_2 in a gas, also assess the working of Dust monitor. **(15)**	**CO3**	**BTL 4**	Analyze
5.	Prepare a methodology to estimate the amount of nitrogen oxides. **(15)**	**CO3**	**BTL 4**	Analyze

UNIT IV - pH METERS AND DISSOLVED COMPONENT ANALYZERS

Principle of pH and conductivity measurements - glass electrodes - Selective ion electrodes - ammonia electrodes, biosensors - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	Define redox potential.	**CO4**	**BTL 1**	Remember
2.	List the demerits of glass electrode.	**CO4**	**BTL 1**	Remember
3.	Name the different types of electrodes used for pH measurements	**CO4**	**BTL 1**	Remember
4.	Why ammonia gas is added to the sample in Sodium analyzer?	**CO4**	**BTL 1**	Remember
5.	How will the temperature of the solution affect the measurement of pH in potentiometric method?	**CO4**	**BTL 2**	Understand
6.	List the industrial applications of ion selective electrodes.	**CO4**	**BTL 2**	Understand
7.	Give the pH equation.	**CO4**	**BTL 2**	Understand
8.	Identify the sources of error in oxygen analyzer.	**CO4**	**BTL 1**	Remember
9.	What is the need to measure pH in a solution?	**CO4**	**BTL 1**	Remember
10.	What is the purpose of biosensors?	**CO4**	**BTL 2**	Understand
11.	Definition of pH.	**CO4**	**BTL 1**	Remember
12.	Distinguish between glass electrode and reference electrode.	**CO4**	**BTL 2**	Understand
13.	Mention the applications of biosensors.	**CO4**	**BTL 2**	Understand
14.	Name the different types of electrodes.	**CO4**	**BTL 1**	Remember
15.	What is the role of buffer solution in pH measurement?	**CO4**	**BTL 1**	Remember
16.	Compare pH electrodes and Ion selective electrodes.	**CO4**	**BTL 2**	Understand
17.	List the use of blank in silica analyzer.	**CO4**	**BTL 2**	Understand

18.	Show the advantages of Ion selective electrodes.	**CO4**	**BTL 1**	Remember
19.	List out the advantages of Hydrogen electrodes.	**CO4**	**BTL 1**	Remember
20.	Why thermistors are used in thermal conductivity analyzer as a heat sensing element?	**CO4**	**BTL 2**	Understand
21.	Give the different types of electrodes used for pH measurements?	**CO4**	**BTL 1**	Remember
22.	Write the Nernst equation.	**CO4**	**BTL 1**	Remember
23.	What is chemical blank measurement?	**CO4**	**BTL 2**	Understand
24.	What are the two measurements made in Silica analyzer?	**CO4**	**BTL 1**	Remember
	PART-B			
1.	**i.** List the types of electrodes used for pH measurement. **(3)** **ii.** Describe the construction of a pH electrode. Draw the electronic circuit diagram for measuring pH of a liquid and explain its working. **(10)**	**CO4**	**BTL 1**	Remember
2.	Explain with neat diagram a method of measuring oxygen dissolved in water. **(13)**	**CO4**	**BTL 4**	Analyze
3.	How pH is measured using glass electrode with suitable diagram? **(13)**	**CO4**	**BTL 3**	Apply
4.	With neat diagram, describe the operating principle of solid state sensors **(13)**	**CO4**	**BTL 1**	Remember
5.	Describe the construction and working principle of reference electrode with necessary diagram. **(13)**	**CO4**	**BTL 1**	Remember
6.	**i.** Obtain the advantages and limitations of biosensors as analytical instruments. **(3)** **ii.** How a glucose biosensor can be fabricated from oxygen sensor? **(10)**	**CO4**	**BTL 3**	Apply
7.	**i.** Describe in detail about the constructional details and working principles of ion selective electrodes. **(8)** **ii.** Discuss how pH values are measured. Explain the role of calomel electrodes in this measurement. **(5)**	**CO4**	**BTL 2**	Understand
8.	With a schematic diagram, explain the working principle of water quality analyzer. **(13)**	**CO4**	**BTL 4**	Analyze
9.	With a schematic diagram, explain the working principle of dissolved oxygen analyzer. **(13)**	**CO4**	**BTL 4**	Analyze
10.	Illustrate the construction and working principle of ammonia electrodes. **(13)**	**CO4**	**BTL 3**	Apply
11.	Write short notes on Sodium analyzer **(13)**	**CO4**	**BTL 2**	Understand
12.	**i.** Explain the construction and working principle of hydrogen electrode to measure pH. Use neat diagrams to explain it. **(10)** **ii.** List out the advantages of hydrogen electrode. **(3)**	**CO4**	**BTL 1**	Remember
13.	Describe the operation of industrial sodium analyzer with neat sketch. **(13)**	**CO4**	**BTL 2**	Understand
14.	Demonstrate the operating principle of kathrometer in measuring dissolved oxygen. **(13)**	**CO4**	**BTL 3**	Apply
15.	Describe the operating principle of liquid matrix electrodes with relevant diagram. **(13)**	**CO4**	**BTL 3**	Apply

16.	With neat diagram, explain the Bio sensor.	**(13)**	**CO4**	**BTL 4**	Analyze
17.	Demonstrate the operation of Silicon analyzer.	**(13)**	**CO4**	**BTL 3**	Apply
	PART-C				
1.	What is meant by Selective Ion Electrodes? How it is classified? Explain the operation of Ammonia Electrode. Also Specify the advantages of Selective Ion Electrodes.	**(15)**	**CO4**	**BTL 4**	Analyze
2.	Explain the working principles of biosensors with a conceptual diagram. Also assess the various parameters to be measured using Biosensor.	**(15)**	**CO4**	**BTL 3**	Apply
3.	State the principle of measuring Dissolved Oxygen in Boiler Feed Water. Why the dissolved oxygen content is monitored in feed water?	**(15)**	**CO4**	**BTL 4**	Analyze
4.	Define pH. Assess the design criteria of pH meters. Explain one type of pH meter in detail.	**(15)**	**CO4**	**BTL 3**	Apply
5.	Explain any one method to measure the dissolved oxygen. Also specify the cause of dissolve oxygen content in feed water.	**(15)**	**CO4**	**BTL 4**	Analyze

UNIT V - NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Electron spin Resonance spectroscopy: – Basic principles, Instrumentation and applications. Mass Spectrometry – Sample system – Ionization methods – Mass analyzer Applications.

PART – A

Q.No	Questions	CO	BT Level	Competence
1.	List the applications of mass spectrometers.	**CO5**	**BTL 1**	Remember
2.	Point out the advantages of mass spectrometry.	**CO5**	**BTL 2**	Understand
3.	Interpret the principle of Faraday cup used in Mass spectrometry.	**CO5**	**BTL 2**	Understand
4.	Label a typical NMR spectrum.	**CO5**	**BTL 1**	Remember
5.	How can the NMR spectrum be scanned?	**CO5**	**BTL 3**	Apply
6.	Define the term NMR.	**CO5**	**BTL 1**	Remember
7.	What are the selection criteria of collimator?	**CO5**	**BTL 2**	Understand
8.	Demonstrate the principle of mass spectrometer?	**CO5**	**BTL 2**	Understand
9.	Describe the principle of NMR spectrometer?	**CO5**	**BTL 2**	Understand
10.	What is magnetic resonance?	**CO5**	**BTL 1**	Remember
11.	Mention the disadvantages of ionization chamber.	**CO5**	**BTL 2**	Understand
12.	Name the types of ion transducer used in mass analyzer.	**CO5**	**BTL 1**	Remember
13.	Why high intensity magnets are preferred for NMR?	**CO5**	**BTL 2**	Understand
14.	How can we measure radioactivity?	**CO5**	**BTL 2**	Understand
15.	Formulate the rules to determine Nuclear spin.	**CO5**	**BTL 2**	Understand
16.	Point out the advantages of Electron spin Resonance spectroscopy.	**CO5**	**BTL 2**	Understand
17.	Give the limitations of NMR.	**CO5**	**BTL 2**	Understand
18.	Tabulate the advantages and disadvantages of time of flight mass spectrometer.	**CO5**	**BTL 1**	Remember
19.	What is the nuclear shielding in NMR?	**CO5**	**BTL 1**	Remember
20.	List the limitations of quadruple mass analyzer.	**CO5**	**BTL 2**	Understand
21.	What are the basic components of NMR Spectrometry?	**CO5**	**BTL 2**	Understand
22.	What are the various parts of the Mass spectrometer?	**CO5**	**BTL 2**	Understand

23.	How can we obtain the NMR absorption spectra?	**CO5**	**BTL 2**	Understand
24.	Why do we go for a solid state detector instead of scintillation detector?	**CO5**	**BTL 2**	Understand
	PART-B			
1.	**i.** Explain the working of NMR spectrometer with a neat schematic diagram. **(10)** **ii.** List the applications of NMR spectrometer. **(3)**	**CO5**	**BTL 1**	Remember
2.	**i.** What are the basic components of Electron spectroscopy? **(3)** **ii.** Describe the working of Electron spectroscopy with a block diagram **(10)**	**CO5**	**BTL 1**	Remember
3.	Illustrate the construction and working principle of Magnetic sector analyzer spectrometer with neat sketch. **(13)**	**CO5**	**BTL 3**	Apply
4.	With neat diagram, brief about the principle, operation of ion transducer. **(13)**	**CO5**	**BTL 1**	Remember
5.	**i.** Propose the method to sort the ions based on their mass to charge ratio. **(3)** **ii.** Elaborate its function with its instrumentation set up with a neat sketch. **(10)**	**CO5**	**BTL 3**	Apply
6.	Demonstrate the construction and working principle of single focusing mass spectrometer. **(13)**	**CO5**	**BTL 3**	Apply
7.	Describe how various samples are analyzed using NMR spectrometer with neat diagram. **(13)**	**CO5**	**BTL 2**	Understand
8.	**i.** Give a detailed explanation about proton NMR, with its principle, instrumentation and applications. **(7)** **ii.** With the help of a neat diagram, discuss the principle, working and applications of a double-focussing mass spectrometer. **(6)**	**CO5**	**BTL 2**	Understand
9.	Explain the principle of operation of continuous wave NMR spectrometer. **(13)**	**CO5**	**BTL 4**	Analyze
10.	Draw the block diagram of a pulsed Fourier Transform NMR spectrometer and explain its working principle. **(13)**	**CO5**	**BTL 1**	Remember
11.	Explain the working of quadrupole mass spectrometers. **(13)**	**CO5**	**BTL 4**	Analyze
12.	Explain the working principle of Electron spin resonance spectroscopy with block diagram and mention the application. **(13)**	**CO5**	**BTL 3**	Apply
13.	Explain the working of time of flight mass spectrometers. **(13)**	**CO5**	**BTL 4**	Analyze
14.	Describe the working principle of GM counter & proportional counter in detail **(13)**	**CO5**	**BTL 2**	Understand
15.	Draw the block diagram of SEM and explain it. **(13)**	**CO5**	**BTL 2**	Understand
16.	**i.** Differentiate the optical microscope and electron microscope. **(7)** **ii.** Difference between a continuous wave and Fourier transform NMR. **(6)**	**CO5**	**BTL 4**	Analyze
17.	**i.** What are mass spectrometers? Discuss its advantages and applications. **(4)**	**CO5**	**BTL 2**	Understand

	ii. Explain a simple mass spectroscopy system with neat diagram. **(9)**			
PART-C				
1.	Draw the block diagram of an NMR spectrometer. Explain the function of each part and explain how it is used to obtain NMR spectra. How are these spectra useful? **(15)**	**CO5**	**BTL 4**	Analyze
2.	Explain the instrumentation and applications of magnetic sector analyzer and double focussing spectrometer. **(15)**	**CO5**	**BTL 3**	Apply
3.	What are the basic components of a Mass spectrometer? Explain the functions of each component. **(15)**	**CO5**	**BTL 3**	Apply
4.	Explain the different types of mass spectrometers with the neat diagrams **(15)**	**CO5**	**BTL 4**	Analyze
5.	What are the basic components of ESR? Explain the functions of each component. **(15)**	**CO5**	**BTL 4**	Analyze