SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603 203

DEPARTMENT

OF

ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

V SEMESTER

PROFESSIONAL ELECTIVES

Vertical-III-(Applied Instrumentation

PEI301– Analytical Instrumentation

Regulation – 2023

Academic Year 2025 – 2026 ODD

Prepared by

Dr. R. Arivalahan, M.E., Ph.D

Professor / EIE

SRM VALLIAMMAI ENGINEERING COLLEGE

SRM Nagar, Kattankulathur – 603 203.

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

QUESTION BANK

SUBJECT : PEI301- ANALYTICAL INSTRUMENTATION

SEM / YEAR : V / 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. **(8)**	**CO1**	**BTL 3**	Apply
	ii.	With the Instrumentation setup, describe the working of single beam spectrometer. **(8)**			

2.	Explain in detail, the sources and detectors used in UV-Visible spectroscopy with necessary diagrams.	**(16)**	**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?	**(8)**	**CO1**	**BTL 3**	Apply
	ii. Draw and explain the schematic diagram of a typical double beam spectrophotometer.	**(8)**			Apply
4.	Explain in detail about grating mono chromator system with neat diagram.	**(16)**	**CO1**	**BTL 4**	Analyze
5.	Illustrate about single beam and double beam instruments used in IR spectrophotometer with necessary diagrams.	**(16)**	**CO1**	**BTL 3**	Apply
6.	With necessary diagram, describe the principle, construction and working of U-V spectrophotometer.	**(16)**	**CO1**	**BTL 3**	Apply
7.	**i.** With relevant diagrams, examine the working principle of various radiation sources used in IR-Spectrophotometers.	**(8)**	**CO1**	**BTL 3**	Apply
	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)**			Apply
8.	**i.** Show the detectors used in IR. Explain any one detector in detail. Also mention about different sample handling techniques in IR.	**(8)**	**CO1**	**BTL 3**	Apply
	ii. Illustrate the operation of attenuated total reflection Spectrophotometer.	**(8)**			Apply
9.	With a neat instrumentation setup, examine the principle of IR spectrometer and label the various components involved in it.	**(16)**	**CO1**	**BTL 3**	Apply
10.	Elaborate the FTIR spectrophotometer with neat optical path diagram and block diagram of the instrument.	**(16)**	**CO1**	**BTL 4**	Apply
11.	**i.** Illustrate the operating principle of atomic absorption spectroscopy.	**(6)**	**CO1**	**BTL 3**	Apply
	ii. Explain the various sources and detectors used in AAS.	**(10)**			Apply
12.	Describe the operating principle of flame emission photometer with neat diagram.	**(16)**	**CO1**	**BTL 2**	Understand
13.	Briefly, discuss the working technique and applications of AAS with suitable diagrams.	**(16)**	**CO1**	**BTL 2**	Understand
14.	Explain in detail working principle of fluorescence spectrophotometer.	**(16)**	**CO1**	**BTL 4**	Analyze
15.	Explain in details about filter used in spectrometer.	**(16)**	**CO1**	**BTL 4**	Analyze
16.	Elaborate the operation of double beam UV-spectrometer.	**(16)**	**CO1**	**BTL 4**	Analyze
17.	Illustrate the operating principle of NDIR spectrometer.	**(16)**	**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.				
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)**	**CO2**	**BTL 3**	Apply
	ii. List the applications of HPLC. **(6)**			
2.	**i.** What is meant by column chromatography? And mention the advantages of column chromatography. **(4)**	**CO2**	**BTL 3**	Apply
	ii. Draw the instrumentation diagram for column chromatography and discuss how separation process will be performed in column chromatography. **(12)**			

3.	Describe the different stages of Gas Chromatography in the separation of two phases with schematic diagram. **(16)**	**CO2**	**BTL 4**	Analyze
4.	Explain with neat sketches any two detectors used in gas chromatography. **(16)**	**CO2**	**BTL 4**	Analyze
5.	Discuss the electron capture detector and flame ionization detector. **(16)**	**CO2**	**BTL 4**	Analyze
6.	**i.** Quote the principle and applications of Refractive index detector used in HPLC. **(8)** **ii.** Describe the different parts in gas chromatography with relevant diagrams. **(8)**	**CO2**	**BTL 1**	Remember
7.	Derive the relationship between retention time and distribution constant. **(16)**	**CO2**	**BTL 4**	Analyze
8.	Describe the following terms : **(16)** i.Retention volume ii.Retention factor iii.Dead volume and Dead time iv.Adjusted retention volume and adjusted retention time.	**CO2**	**BTL 4**	Analyze
9.	Explain any three types of detectors used in liquid chromatography. **(16)**	**CO2**	**BTL 4**	Analyze
10.	With necessary diagrams, Assess the working principle of High Pressure Liquid Chromatography. **(16)**	**CO2**	**BTL 4**	Analyze
11.	**i.** Show the different types of chromatography. **(7)** **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. **(16)**	**CO2**	**BTL 3**	Apply
13.	**i.** Give in detail the classification of Chromatography. **(6)** **ii.** Discuss on Liquid Chromatography. **(10)**	**CO2**	**BTL 4**	Analyze
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 construction and working of katharometer. **(10)**	**CO2**	**BTL 3**	Apply
15.	Illustrate Ion Exchange Chromatography. **(16)**	**CO2**	**BTL 3**	Apply
16.	Describe the size-exclusion chromatography in detail with neat sketch. **(16)**	**CO2**	**BTL 4**	Analyze
17.	Describe the partition chromatography in detail with neat sketch. **(16)**	**CO2**	**BTL 3**	Apply

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. **(16)**	**CO3**	**BTL 4**	Analyze
2.	**i.** Demonstrate the working principle of a Paramagnetic Oxygen Analyzer with a functional diagram. **(10)**	**CO3**	**BTL 3**	Apply
	ii. Specify the need of Oxygen measurement. **(6)**			
3.	Write a note on: -	**CO3**	**BTL 3**	Apply
	i. Method used to estimate sulphur dioxide **(8)**			
	ii. NO_2 gas analyser. **(8)**			
4.	Describe with a neat sketch carbon monoxide monitor and Nitrogen oxide analyzer. **(16)**	**CO3**	**BTL 4**	Analyze
5.	Explain how the H_2S analyzer is used. **(16)**	**CO3**	**BTL 4**	Analyze
6.	Draw the schematic diagram and show the operation of a thermal conductivity analyzer. **(16)**	**CO3**	**BTL 3**	Apply
7.	Discuss how to estimate the amount of hydrocarbons present in air with neat instrumentation setup. **(16)**	**CO3**	**BTL 4**	Analyze

8.	Describe the constructional details and working of a dust monitor. **(16)**	**CO3**	**BTL 4**	Analyze
9.	With a schematic diagram, explain the method of measuring sulphur dioxide (SO_2) estimation using conductivity method **(16)**	**CO3**	**BTL 4**	Analyze
10.	**i.** Estimate CO level in air and how it can be analysed using NDIR analyzer with relevant diagrams. **(10)**	**CO3**	**BTL 4**	Analyze
	ii. Compose the consequences of air pollution. **(6)**			
11.	Discuss on dust and smoke measurements. **(16)**	**CO3**	**BTL 4**	Analyze
12.	**i.** Deduce the principle of pollution monitoring instruments used for monitoring automobile exhaust gases. **(10)**	**CO3**	**BTL 4**	Analyze
	ii. Why should such pollution testing be carried out? **(6)**			
13.	With neat diagram, explain the working principle of thermal conductivity analyzer and IR analyzers. **(16)**	**CO3**	**BTL 4**	Analyze
14.	Write short notes on Air pollution due to Carbon monoxide & Nitrogen oxide **(16)**	**CO3**	**BTL 3**	Apply
15.	Write short notes on Air pollution due to Hydrocarbons & Sulphur dioxide. **(16)**	**CO3**	**BTL 3**	Apply
16.	Explain the measurement techniques available for sulphur Dioxide pollutant. **(16)**	**CO3**	**BTL 3**	Apply
17.	With a neat diagram, explain how oxygen content is measured. **(16)**	**CO3**	**BTL 3**	Apply

UNIT IV - pH METERS AND DISSOLVED COMPONENT ANALYZERS

Selective ion electrodes- Principle of pH and conductivity measurements - - 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. **(6)** **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 4**	Analyze
2.	Explain with neat diagram a method of measuring oxygen dissolved in water. **(16)**	**CO4**	**BTL 4**	Analyze
3.	How pH is measured using glass electrode with suitable diagram? **(16)**	**CO4**	**BTL 3**	Apply
4.	With neat diagram, describe the operating principle of solid state sensors **(16)**	**CO4**	**BTL 3**	Apply
5.	Describe the construction and working principle of reference electrode with necessary diagram. **(16)**	**CO4**	**BTL 4**	Analyze
6.	**i.** Obtain the advantages and limitations of biosensors as analytical instruments. **(6)** **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. **(8)**	**CO4**	**BTL 4**	Analyze
8.	With a schematic diagram, explain the working principle of water quality analyzer. **(16)**	**CO4**	**BTL 3**	Apply
9.	With a schematic diagram, explain the working principle of dissolved oxygen analyzer. **(16)**	**CO4**	**BTL 3**	Apply
10.	Illustrate the construction and working principle of ammonia electrodes. **(16)**	**CO4**	**BTL 3**	Apply
11.	Write short notes on Sodium analyzer **(16)**	**CO4**	**BTL 3**	Apply
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. **(6)**	**CO4**	**BTL 4**	Analyze
13.	Describe the operation of industrial sodium analyzer with neat sketch. **(16)**	**CO4**	**BTL 3**	Apply
14.	Demonstrate the operating principle of kathrometer in measuring dissolved oxygen. **(16)**	**CO4**	**BTL 3**	Apply
15.	Describe the operating principle of liquid matrix electrodes with relevant diagram. **(16)**	**CO4**	**BTL 3**	Apply

16.	With neat diagram, explain the Bio sensor.	**(16)**	**CO4**	**BTL 4**	Analyze
17.	Demonstrate the operation of Silicon analyzer.	**(16)**	**CO4**	**BTL 3**	Apply

UNIT V - NUCLEAR MAGNETIC RESONANCE AND MASS SPECTROMETRY				
NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer - Mass Spectrometry – Sample system – Ionization methods – Mass analyzers- Types of mass spectrometry.				
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)**	**CO5**	**BTL 4**	Analyze
	ii. List the applications of NMR spectrometer. **(6)**			
2.	**i.** What are the basic components of Electron spectroscopy? **(6)**	**CO5**	**BTL 4**	Analyze
	ii. Describe the working of Electron spectroscopy with a block diagram **(10)**			
3.	Illustrate the construction and working principle of Magnetic sector analyzer spectrometer with neat sketch. **(16)**	**CO5**	**BTL 3**	Apply
4.	With neat diagram, brief about the principle, operation of ion transducer. **(16)**	**CO5**	**BTL 3**	Apply

5.	**i.** Propose the method to sort the ions based on their mass to charge ratio. **(6)** **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. **(16)**	**CO5**	**BTL 3**	Apply
7.	Describe how various samples are analyzed using NMR spectrometer with neat diagram. **(16)**	**CO5**	**BTL 3**	Apply
8.	**i.** Give a detailed explanation about proton NMR, with its principle, instrumentation and applications. **(8)** **ii.** With the help of a neat diagram, discuss the principle, working and applications of a double-focussing mass spectrometer. **(8)**	**CO5**	**BTL 3**	Apply
9.	Explain the principle of operation of continuous wave NMR spectrometer. **(16)**	**CO5**	**BTL 4**	Analyze
10.	Draw the block diagram of a pulsed Fourier Transform NMR spectrometer and explain its working principle. **(16)**	**CO5**	**BTL 3**	Apply
11.	Explain the working of quadrupole mass spectrometers. **(16)**	**CO5**	**BTL 4**	Analyze
12.	Explain the working principle of Electron spin resonance spectroscopy with block diagram and mention the application. **(16)**	**CO5**	**BTL 3**	Apply
13.	Explain the working of time of flight mass spectrometers. **(16)**	**CO5**	**BTL 4**	Analyze
14.	Describe the working principle of GM counter & proportional counter in detail **(16)**	**CO5**	**BTL 3**	Apply
15.	Draw the block diagram of SEM and explain it. **(16)**	**CO5**	**BTL 2**	Understand
16.	**i.** Differentiate the optical microscope and electron microscope. **(8)** **ii.** Difference between a continuous wave and Fourier transform NMR. **(8)**	**CO5**	**BTL 4**	Analyze
17.	**i.** What are mass spectrometers? Discuss its advantages and applications. **(7)** **ii.** Explain a simple mass spectroscopy system with neat diagram. **(9)**	**CO5**	**BTL 4**	Analyze Analyze