

Faculty of Science

End Semester Examination May 2025

FS3EL08 Advance Instrumentation

Programme	:	B. Sc. (Hons.)	Branch/Specialisation	:	FS
Duration	:	3 hours	Maximum Marks	:	60

Note: All questions are compulsory. Internal choices, if any, are indicated. Assume suitable data if necessary.
 Notations and symbols have their usual meaning.

Section 1 (Answer all question(s))				Marks CO BL
Q1. Which of the following is the first step in the analytical approach?				1 1 1
<input type="radio"/> Designing analytical chemistry <input checked="" type="radio"/> Defining the problem		<input type="radio"/> Sampling <input type="radio"/> Assessing the data		
Q2. What is the purpose of plotting a calibration curve in analytical chemistry?				1 1 1
<input type="radio"/> To determine the chemical composition of an unknown sample <input type="radio"/> To reduce noise in analytical signals		<input checked="" type="radio"/> To establish the relationship between concentration and instrument response. <input type="radio"/> To identify systematic errors in an experiment		
Q3. Which of the following is an example of a natural separation process similar to chromatography?				1 2 1
<input type="radio"/> Filtration of sand from water <input type="radio"/> Evaporation of water from a solution		<input checked="" type="radio"/> Capillary action of water in plant roots <input type="radio"/> Mixing of gases in the atmosphere		
Q4. In chromatography, what is the function of the mobile phase?				1 2 1
<input type="radio"/> It remains fixed and retains analytes <input type="radio"/> It reacts chemically with the sample components		<input checked="" type="radio"/> It facilitates the movement of analytes through the system <input type="radio"/> It prevents separation of the mixture		
Q5. Which type of laser is commonly used as a source of radiation in forensic spectroscopy?				1 3 1
<input checked="" type="radio"/> Helium-Neon (He-Ne) laser <input type="radio"/> Carbon arc lamp		<input type="radio"/> Sodium vapor laser <input type="radio"/> Fluorescent lamp		
Q6. Which of the following best describes spectroscopy?				1 3 1
<input checked="" type="radio"/> A method to study the interaction of matter with radiation <input type="radio"/> A process of separating compounds in a mixture		<input type="radio"/> A technique used only for measuring temperature <input type="radio"/> A method to increase radiation intensity		
Q7. What does thermogravimetry (TG) measure?				1 4 2
<input checked="" type="radio"/> Changes in a material's mass with temperature <input type="radio"/> Chemical composition of a sample		<input type="radio"/> Heat flow in a material <input type="radio"/> The structure of molecules		
Q8. In differential scanning calorimetry (DSC), what property of a material is measured?				1 4 1
<input type="radio"/> Electrical conductivity <input type="radio"/> Molecular weight		<input checked="" type="radio"/> Heat flow differences during phase transitions <input type="radio"/> Absorption of radiation		

Q9. What is the role of sodium dodecyl sulfate (SDS) in SDS-PAGE?

1 5 1

- To break down DNA strands
- To denature proteins and provide a uniform negative charge
- To increase protein synthesis
- To act as an enzyme activator

Q10. Which of the following techniques is used for large-scale purification of proteins?

1 5 1

- Gel diffusion
- Preparative electrophoresis
- PCR (Polymerase Chain Reaction)
- Immuno-electrophoresis

Section 2 (Answer all question(s))

Marks CO BL

Q11. Differentiate between accuracy and precision.

2 1 2

Rubric	Marks
One mark allocate for defining accuracy.	1
One mark allocate for defining precision.	1

Q12. What are systematic errors? Give an example.

2 1 2

Rubric	Marks
One mark allocate for definition of systematic errors,	1
One mark allocate for example of systematic errors,	1

Q13. (a) What is the significance of calibration curves in analytical measurements? Explain how they are plotted and used.

6 1 3

Rubric	Marks
What is the significance of calibration curves in analytical measurements?	2
Explain how they are plotted and used.	4

(OR)

(b) Describe different types of errors in analytical chemistry and discuss methods to minimize them.

Marks CO BL

3 2 2

Rubric	Marks
Describe different types of errors in analytical chemistry	4
discuss methods to minimize them.	2

Section 3 (Answer all question(s))

Q14. Differentiate between adsorption and partition chromatography.

3 2 2

Rubric	Marks
1.5 marks allocate for defining and giving example of adsorption chromatography.	3
1.5 marks allocate for defining and giving example of partition chromatography.	

Q15. (a) Describe the different types of chromatography and their applications in scientific research and industry.

7 2 3

Rubric	Marks
4 marks allocate for describing the different types of chromatography. 3 marks allocate for applications in scientific research and industry.	7

(OR)

(b) Discuss the different classifications of chromatography based on mobile phase mode, development mode, and separation mechanism.

Rubric	Marks
3 marks allocate for classifications of chromatography based on mobile phase mode, 2 marks allocate for classifications of chromatography based development mode. 2 marks allocate for classifications of chromatography based separation mechanism.	7

Section 4 (Answer all question(s))

Q16. Define electromagnetic spectrum and list its main regions.

Marks CO BL

3 3 2

Rubric	Marks
1 mark allocate for defining electromagnetic spectrum. 2 mark allocate for list its main regions.	3

Q17. (a) Describe working principles and application of different radiation detectors such as photographic, thermal and photoelectric detectors.

7 3 3

Rubric	Marks
3 marks allocate for describing working principles and application of radiation detectors such as photographic. 2 marks allocate for describing working principles and application of radiation detectors such as thermal. 2 marks allocate for describing working principles and application of radiation detectors such as photoelectric detectors.	7

(OR)

(b) Explain the principle of spectroscopy and its importance in forensic science.

Rubric	Marks
2 marks allocate for explaining the principle of spectroscopy. 5 marks allocate for its importance in forensic science.	7

Section 5 (Answer all question(s))

Q18. Explain the basic principles of radio-chemical techniques and their applications.

Marks CO BL

4 4 2

Rubric	Marks
2 marks allocate for explaining the basic principles of radio-chemical techniques. 2 marks allocate for their applications.	4

Q19. (a) Describe neutron activation analysis (NAA) with its working principle and applications.

6 4 3

Rubric	Marks
3 marks allocate for describing neutron activation analysis (NAA) with its working principle. 3 marks allocate for applications of NAA.	6

(OR)

(b) Describe the principle, instrumentation and applications of Nuclear Magnetic Resonance (NMR) spectroscopy.

Rubric	Marks
2 marks allocate for describing the principle of Nuclear Magnetic Resonance (NMR) spectroscopy. 2 marks allocate for instrumentation of Nuclear Magnetic Resonance (NMR) spectroscopy. 2 marks allocate for application of Nuclear Magnetic Resonance (NMR) spectroscopy.	6

Section 6 (Answer any 2 question(s))

Q20. Discuss the principles and applications of preparative electrophoresis in protein purification.

Marks CO BL
5 5 2

Rubric	Marks
2 marks allocate for explaining the principles of preparative electrophoresis in protein purification. 3 marks allocate for giving the applications of preparative electrophoresis in protein purification.	5

Q21. Describe the precipitin reaction and its role in antigen-antibody interactions.

5 5 2

Rubric	Marks
2.5 marks allocate for describing the precipitin reaction. 2.5 marks allocate for its role in antigen-antibody interactions.	5

Q22. Write a note on "SDS PAGE electrophoresis."

5 5 2

Rubric	Marks
Principle: 2 marks working and instrumentation: 2 marks Applications: 1 mark	5
