



**Gyanmanjari**  
Innovative University

Course Syllabus  
Gyanmanjari Science College  
Semester-2(M.Sc)

**Subject:** Instrumental Techniques - II – MSCFS12510

**Type of course:** Major

**Prerequisite:** Familiarity with standard lab practices, safety protocols, and handling of chemicals and instruments.

**Rationale:** The syllabus is designed to equip students with a comprehensive understanding of advanced instrumental methods used in forensic analysis. It emphasizes practical applications in evidence examination, enabling students to analyze and interpret complex forensic samples accurately. This knowledge is crucial for solving crimes, ensuring justice, and advancing forensic science as a discipline.

#### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
CI	T	P	C	Theory Marks		Practical Marks		CA	
				ESE	MSE	V	P	ALA	
4	0	0	4	60	30	10	00	50	150

*Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.*

#### Course Content:

Unit No.	Course content	Hrs	% Weight age
1	<b>Unit – 1 Meaning and Terminology of Instrumentation:</b> Definition, Need of Instrumentation in Forensic Science, Qualitative and quantitative methods of analysis, Destructive and Non-Destructive Methods, Separatory techniques, Hyphenated techniques, Accuracy, Precision, Signal to noise ratio, Sensitivity and detection limit, sources of noise, Instrument calibration. Scientific Calculations: Scientific volume and weight measurements, Centrifugation, Extraction, Filtration,	15	25



	Distillation, Density, Specific Gravity, Specific Volume, Percentage, Ratio Strength, and other Expressions of Concentration.		
2	<b>Unit – 2 Schematic analysis of Chemical, Biological and Physical samples:</b> Preliminary and Confirmatory methods of analysis, Colour spot tests in Forensic Biological, Chemical and Physical analysis, Microcrystalline test. Centrifuge Techniques: Centrifugation Techniques, Basic principles of sedimentation, Various types of centrifuges, Density gradient centrifugation, Preparative centrifugation, Ultra-centrifuge-Refrigerated Centrifuges.	15	25
3	<b>Unit -3 Microscopy:</b> Theory and basic principles, setup and Forensic applications of Compound, Comparison, Fluorescence, Polarized, Stereo-zoom microscope. Introduction, Geometrical optics, Image formation, Magnification and Resolution, Lens aberrations, Distortion of image and curvature of field. Electron Microscopy- Theory and basic principles of Electron Microscopy, Structure and Forensic applications of Scanning Electron microscope (SEM), Transmission Electron Microscope (TEM).	15	25
4.	<b>Unit – 4 Introductory Chromatography:</b> Definition, Chromatographic Techniques, History of Chromatography, Theoretical principles of Chromatography, Classification of Chromatographic Methods, Adsorption and Partition Chromatography. Thin Layer Chromatography: Basic Principle, Setup, visualization and Forensic applications etc.	15	25

**Continuous Assessment:**

Sr. No	Active Learning Activities	Marks
1.	<b>Comparison Table Creation</b> Students create a comparison table listing destructive and non-destructive methods, their advantages, disadvantages, and forensic applications and upload it on GMIU web Portal.	10
2.	<b>Microcrystalline Test Interpretation</b> Faculty will provide diagrams or written descriptions of microcrystalline structures for various substances. Students identify the substance and explain the basis of their identification and then upload it on GMIU web Portal.	10



3.	<b>Comparison Chart on Microscope Types</b> Students create a comparison chart detailing the principles, magnification, resolution, advantages, and forensic applications of compound, fluorescence, polarized, SEM, and TEM microscopes and will upload it on GMIU web Portal.	10
4.	<b>Forensic Case Study Analysis</b> Faculty will present a forensic case where chromatography was used (e.g., drug analysis or ink identification). Students will outline the steps of the chromatographic analysis and interpret hypothetical results and will upload it on GMIU web Portal.	10
5.	<b>Forensic Image Analysis Activity</b> Faculty will provide descriptions or images of sample scenarios (e.g., hair under a polarized microscope, gunshot residue under SEM). Students will identify the type of microscope used and justify their answers based on the observed features and then upload it on GMIU web Portal.	10
<b>Total</b>		<b>50</b>

### Suggested Specification table with Marks (Theory):60

<b>Distribution of Theory Marks</b> (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weight age	25%	30%	30%	10%	5%	00

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

### Course Outcome:

<b>After learning the course the students should be able to:</b>	
CO1	Perform scientific calculations related to volume, weight, concentration, and physical properties like density and specific gravity.
CO2	Identify and differentiate between preliminary and confirmatory methods of analysis for chemical, biological, and physical forensic samples.



CO3	Evaluate the forensic applications of advanced microscopy techniques in the analysis of trace evidence and microstructures.
CO4	Differentiate between adsorption and partition chromatography and explain their applications in forensic investigations.

**Instructional Method:**

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

**Reference Books:**

- [1] Willdard, H. H (1974) Instrumental Methods of Analysis.
- [2] Moonesens A.A. (1979) Scientific Evidence in Criminal Cases.
- [3] E. Stahl (1969) Thin Layer Chromatography: A Laboratory Handbook.
- [4] Sue Jickells and Adam Negrusz (2008) Clarke's Analytical Forensic Toxicology.

