Gyanmanjari Innovative University

Syllabus
Gyanmanjari Science Colleges
Semester-3.(M.Sc. MLT)

Subject: Advanced Instrumentation and Techniques- MSCMT13514

Type of course: Major

Prerequisite: Basic knowledge of biochemistry, molecular biology, and analytical techniques, along with fundamental laboratory skills and handling of basic instruments.

Rationale: This syllabus provides knowledge of key separation and analytical techniques used in clinical laboratories. It focuses on centrifugation, chromatography, electrophoresis, and molecular methods for analysis of biological samples. The course develops skills in handling advanced instruments and interpreting laboratory results. It prepares students for accurate diagnosis, quality control, and research applications in healthcare.

Teaching and Examination Scheme:

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

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

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Clinical Technique Selection Game** Faculty will provide patient cases and students must "bid" on the most appropriate diagnostic technique (e.g., PCR vs ELISA vs chromatography) and justify their choice competitively.	10
2	**Poster Pitch – Technique Innovation** Instead of just presenting posters, students "pitch" a technique (e.g., flow cytometry or HPLC) as if convincing a hospital to adopt it, highlighting advantages, cost, and applications.	10
3	**Case-Based Centrifugation Analysis** Faculty will provide clinical samples (e.g., blood, urine) and be asked to select appropriate centrifugation techniques (differential, density gradient, ultracentrifugation), justify their choice, and interpret separation outcomes.	10
4	**Chromatography Experiment & Interpretation** Students perform paper chromatography or TLC to separate biomolecules, calculate Rf values, and relate results to clinical applications such as drug or metabolite analysis.	10
5	**Molecular Technique Simulation (PCR/Blotting)** Students simulate or perform PCR/RT-PCR, analyze amplification or hybridization results, and interpret their relevance in disease diagnosis.	10
	Total	**50**

Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Centrifugation & Separation Techniques** • Principles of centrifugation • Types: 1. Differential centrifugation 2. Density gradient centrifugation 3. Ultracentrifugation • Dialysis and filtration techniques • Applications in clinical laboratories	15	25
2	**Chromatography Techniques** • Principle of chromatography • Types: 1. Paper chromatography 2. Thin Layer Chromatography (TLC) 3. Column chromatography 4. Ion-exchange chromatography 5. Gel filtration • Instrumentation: 1. Gas Chromatography (GC) 2. High Performance Liquid Chromatography (HPLC) • Clinical applications	15	25
3	**Electrophoresis & Molecular Techniques** • Principles and types of electrophoresis: o Agarose gel electrophoresis o PAGE & SDS-PAGE • DNA/RNA isolation • Blotting techniques: o Southern, Northern, Western blot • PCR, RT-PCR • Applications in diagnosis	15	25
4	**Advanced Instrumentation & Automation** • Spectrophotometry (UV-Visible) • Nuclear Magnetic Resonance spectroscopy • Flame photometry • Atomic absorption spectrophotometry • Auto analyzers & lab automation • Flow cytometry • Calibration and maintenance of instruments	15	25

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	20%	20%	30%	10%	10%	10%

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:

After learning the course the students should be able to:	
CO1	Explain the principles and applications of centrifugation, dialysis, and filtration techniques, and select appropriate methods for separation in clinical laboratory settings.
CO2	Describe the principles, types, and instrumentation of chromatography techniques (including GC and HPLC) and interpret their role in clinical analysis and diagnostics.
CO3	Apply electrophoresis and molecular biology techniques (DNA/RNA isolation, blotting, PCR/RT-PCR) for analysis and diagnosis of biological samples.
CO4	Demonstrate the understanding of advanced analytical instruments such as spectrophotometry, NMR, flow cytometry, and automated systems, including their calibration, maintenance, and clinical applications.

Instructional Method:

The course delivery method will depend upon the requirement of content and the needs of students. The teacher in addition to conventional teaching methods by black board, may also use any 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 the laboratory.

Reference Books:

1. Glick, B. R., Pasternak, J. J., & Patten, C. L. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA* (4th ed.). ASM Press.
2. Brown, T. A. (2016). *Gene Cloning and DNA Analysis: An Introduction* (7th ed.). Wiley-Blackwell.
3. Primrose, S. B., & Twyman, R. M. (2006). *Principles of Gene Manipulation and Genomics* (7th ed.). Blackwell Publishing.
4. Nelson, D. L., & Cox, M. M. (2017). *Lehninger Principles of Biochemistry* (7th ed.). W.H. Freeman.
5. Kuby, J., Kindt, T. J., Goldsby, R. A., & Osborne, B. A. (2013). *Kuby Immunology* (7th ed.). W.H. Freeman.
6. Willey, J. M., Sherwood, L. M., & Woolverton, C. J. (2011). *Prescott's Microbiology* (8th ed.). McGraw-Hill.
7. Brooks, G. F., Butel, J. S., & Morse, S. A. (2021). *Jawetz, Melnick & Adelberg's Medical Microbiology* (29th ed.). McGraw-Hill.
8. Tille, P. M. (2014). *Bailey & Scott's Diagnostic Microbiology* (13th ed.). Elsevier.
9. Paniker, C. K. J., & Ananthanarayan, R. (2017). *Textbook of Microbiology* (10th ed.). University Press.
10. Strachan, T., & Read, A. (2018). *Human Molecular Genetics* (5th ed.). Garland Science.