

## KAT 244/3 - Separation Methods

**Course Objective :** To introduce the fundamental principles and theory of separation techniques: sample preparation, gas and liquid chromatography.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of the course, the student should be able to:
1. Sample Preparations and Solvent Extraction	<ul style="list-style-type: none"> <li>• Distribution coefficient and ratio</li> <li>• Justifications for extraction</li> <li>• Percent extracted</li> <li>• Improving percent extraction</li> <li>• Solvent extraction of metals</li> <li>• Examples</li> <li>• Solid-phase extraction</li> <li>• Microwave assisted digestion</li> </ul>	6	<ul style="list-style-type: none"> <li>• Understand the underlying principles in liquid-liquid extraction.</li> <li>• Understand the possible equilibria involved in extraction.</li> <li>• Offer ways to increase extraction efficiency.</li> <li>• State common applications of extraction.</li> </ul>
2. Chromatography Principles and Theory	<ul style="list-style-type: none"> <li>• Principles of chromatography</li> <li>• Classification of chromatographic techniques</li> <li>• Migration rates of solutes</li> <li>• Band broadening and column efficiency</li> <li>• Variables that affect column efficiency</li> <li>• Resolution</li> <li>• Quantification</li> </ul>	6	<ul style="list-style-type: none"> <li>• Explain how solutes are separated on a column.</li> <li>• Understand the various types of chromatography.</li> <li>• Understand the factors that affect column efficiency.</li> <li>• Understand the inter-play of retention time, resolution and capacity on migration.</li> <li>• Explain how quantitative and qualitative analysis are performed.</li> </ul>

Topic	Content	Number of lecture hours	Expected outcome – upon completion of the course, the student should be able to:
3. Gas Chromatography	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Packed and capillary columns</li> <li>• Temperature selection</li> <li>• Stationary phases</li> <li>• Detectors</li> <li>• GC-MS</li> <li>• Specialized GC methods</li> </ul>	5	<ul style="list-style-type: none"> <li>• Distinguish the differences between packed and capillary columns.</li> <li>• Understand the properties of stationary phases.</li> <li>• Understand the common detectors and their operation.</li> <li>• Understand quantitative analysis using internal standards.</li> <li>• Understand the benefits to be derived from GC-MS.</li> <li>• Discuss the common applications of GC.</li> </ul>
4. Liquid Chromatography	<ul style="list-style-type: none"> <li>• Principles</li> <li>• HPLC components</li> <li>• Stationary phases</li> <li>• Mobile phase manipulation and optimization strategies</li> <li>• Detectors</li> <li>• Narrow-bore columns</li> <li>• Size exclusion chromatography</li> <li>• Ion exchange chromatography</li> <li>• Thin layer chromatography</li> </ul>	10	<ul style="list-style-type: none"> <li>• Understand the components of HPLC.</li> <li>• Understand method development – column and solvent selection.</li> <li>• Understand the common stationary phases.</li> <li>• Understand the advantages of using narrow-bore columns.</li> <li>• Discuss the other modes of liquid chromatography.</li> </ul>
5. Electrophoretic Techniques	<ul style="list-style-type: none"> <li>• Introduction</li> <li>• Separation principles</li> <li>• Factors affecting solute migration</li> <li>• Gel electrophoresis</li> <li>• Capillary electrophoresis</li> <li>• Electroosmotic mobility</li> <li>• Electrophoretic mobility</li> <li>• Instrumentation</li> <li>• Selected applications</li> </ul>	6	<ul style="list-style-type: none"> <li>• Understand the principles of electrophoresis.</li> <li>• Understand the limitations of gel electrophoresis.</li> <li>• Explain the phenomenon of migration.</li> <li>• Understand the components of capillary electrophoresis.</li> <li>• Discuss the common applications of capillary electrophoresis.</li> </ul>
6. Miscellaneous Techniques	<ul style="list-style-type: none"> <li>• Supercritical fluid chromatography (SFC).</li> </ul>	3	<ul style="list-style-type: none"> <li>• Understand the principles of SFC.</li> </ul>
<b>TOTAL</b>		<b>36</b>	