



**C. U. SHAH UNIVERSITY**



**C. U. SHAH UNIVERSITY  
WADHWAN CITY  
FACULTY OF SCIENCES**

# **M.Sc.**

## **CHEMISTRY**

### **SEM-III**

**Syllabi (CBCS) of  
M.Sc. Chemistry  
WEF June-2016  
(Specialization:  
Analytical  
Chemistry)**



**FACULTY OF SCIENCES**

**DEPARTMENT OF CHEMISTRY**

**COURSE: M.Sc.**

**SEMESTER: III**

**SUBJECT NAME: Industrial Analytical Chemistry**

**SUBJECT CODE: 5SC03IAC1**

**Teaching & Evaluation Scheme:-**

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
4	0	0	4	4	30	1.5	70	3	--	--	--	100	

**Objectives:-**

- Understand disconnection concept of industrial analytical chemistry
- Introduction to food analysis, Pharmaceutical Analysis

**Prerequisites:-**

- Before studying industrial analytical chemistry, all students have basic knowledge of analytical chemistry and knowledge related to UG level chemistry.

**Course outline:-**

Sr. No.	Course Contents
1	<b>Automation in Measurements</b> Principles of automation, automatic and automated devices, Process control: off-line, at-line and on-line analysis. Continuous and discrete analyzers, feedback mechanism. Flow injection analysis, principles, dispersion coefficient, factors affecting peak height-sample volume, channel length, flow rate and channel geometry. Applications of FIA, stopped flow measurements and gradient FIA.
2	<b>Food Analysis</b> Introduction to food analysis, regulations and international standards related to food analysis, nutritional labelling, sample and sample preparation. Adulteration of fats and oils; milk and milk products.



<b>3</b>	<b>Pharmaceutical Analysis</b> Instrumental and titrimetric assays for anti-diabetic, anti-cancer, anti-tuberculosis, anti-malarial, anti-hypertensive and anti-HIV drugs based on USP/BP/IP. Heavy metal ion analysis in pharmaceuticals. Importance of UV-Visible spectrophotometry, IR spectroscopy and HPLC with UV, fluorescence and photodiode array detection in pharmaceutical industry.
<b>4</b>	<b>Analysis of pesticides, soaps and detergents, fertilizers:</b> Classification of pesticides. Analysis of different pesticides by classical and instrumental methods. Classification of soaps and detergents with suitable examples. Characterization of soaps and detergents. Types of fertilizers and analysis of different elements like, nitrogen, phosphates, calcium, sodium, potassium and ammonia.

### Learning Outcomes:-

After the successful completion of the course, students will be able to understand,

- Analysis of pesticides, soaps and detergents, fertilizers etc
- Instrumental and titrimetric assays for drugs.

### Books Recommended:-

1. 'Designing organic synthesis', **S. Warren**, Wiley.
2. "Analytical Chemistry" by **Gary D. Christian**, John Wiley
3. "Principles of Instrumental Analysis" by **Douglas A. Skoog**, Holt-Saunders International
4. "Flow injection analysis of pharmaceuticals: automation in the laboratory" by **Jose Martinez Calatayud**, Taylor and Francis.
5. "Food Analysis" by **S. Suzanne Nielsen**, Springer
6. "Food Analysis Laboratory Manual" by **S. Suzanne Nielsen**, Springer.
7. "Quantitative Analysis of Drugs in Pharmaceutical Formulation", **P.D. Sethi**, CBS Publishers,
8. "Handbook of Modern Pharmaceutical Analysis" by **Satinder Ahuja**, Academic Press,

### E-Resources:-

- <http://sine.ni.com/nips/cds/view/p/lang/en/nid/1380>
- [http://en.wikipedia.org/wiki/Association\\_for\\_Standardisation\\_of\\_Automation\\_and\\_Measuring\\_Systems](http://en.wikipedia.org/wiki/Association_for_Standardisation_of_Automation_and_Measuring_Systems)
- <http://people.umass.edu/mcclemen/581Toppage.html>
- <http://pharmaanalysis.blogspot.in/>
- <http://en.wikipedia.org/wiki/Pesticide>



**FACULTY OF SCIENCES**  
**DEPARTMENT OF CHEMISTRY**

**COURSE: M.Sc.**

**SEMESTER: III**

**SUBJECT NAME: Qualitative Optical Spectroscopic Method-I**

**SUBJECT CODE: 5SC03QSC1**

**Teaching & Evaluation Scheme:-**

Teaching hours/week				Credit	Evaluation Scheme/semester							
Th	Tu	Pr	Total		Theory				Practical			Total Marks
					Sessional Exam		University Exam		Internal		University	
					Marks	Hrs	Marks	Hrs	Pr	TW		
4	0	0	4	4	30	1.5	70	3	--	--	--	100

**Objectives:-**

- To understand analytical chemistry.
- To learn theories, instrumentation and principles of Spectroscopy.

**Prerequisites:-**

- Before studying Analytical Chemistry, all students have basic knowledge of instrumentation, applications and knowledge related to UG level chemistry.

**Course outline:-**

Sr. No.	Course Contents
1	<b>Infrared Spectroscopy</b> <ul style="list-style-type: none"><li>• Introduction</li><li>• IR Frequency Range and Spectrum Presentation</li><li>• Theory of Infrared Absorption</li><li>• Dispersive Spectrometers</li><li>• Fourier Transform Spectrometers</li><li>• Hyphenated Methods Involving Infrared</li><li>• Analytical Information : Qualitative and Quantitative</li><li>• Applications</li></ul>



<b>2</b>	<b>Raman Spectroscopy</b> <ul style="list-style-type: none"><li>• Introduction</li><li>• Dispersive Spectrophotometers</li><li>• Fourier Transform Spectrometers</li><li>• Normal Raman</li><li>• Resonance Raman</li><li>• FT – Raman</li><li>• Surface – enhanced Raman Spectroscopy (SERS)</li><li>• Raman Microprobe</li><li>• Remote Raman Analysis</li><li>• Raman Depolarization Ratios</li><li>• Analytical Information</li><li>• Applications</li></ul>
<b>3</b>	<b>Nuclear Magnetic Resonance Spectroscopy</b> <ul style="list-style-type: none"><li>• Introduction</li><li>• Physical and Chemical Principles</li><li>• Instrumentation</li><li>• Analytical Information : Qualitative and Quantitative</li><li>• Applications</li></ul>
<b>4</b>	<b>X – Ray Diffraction</b> <ul style="list-style-type: none"><li>• Introduction</li><li>• Single – Crystal Diffraction</li><li>• Powder Diffraction</li><li>• Analytical Information : Qualitative and Quantitative</li><li>• Applications</li></ul>

### Learning Outcomes:-

After the successful completion of the course, students will be able to understand,

- Spectroscopic techniques and analysis.
- NMR, FTIR, X-Ray diffraction and Raman Spectroscopy

### Books Recommended:-

1. "Handbook of Instrumental Techniques for Analytical Chemistry", **Frank Settle**, *Prentice Hall PTR*,
2. "Applied Infrared Spectroscopy", **Smith A L**, published by *Wiley*,
3. "Instrumental Methods of Analysis", **Willard H H**, *Belmont, CA : Wadsworth*,
4. "Raman Spectroscopy", **Long D A**, *McGraw – Hill*.
5. 'Laboratory Raman Spectroscopy", **Strommen D P, Nakamoto N**, *Wiley*,
6. "Spectrometric Identification of Organic Compounds", **Silverstein R M, Bassler G C**, *Wiley*,
7. "Introduction to NMR Spectroscopy", **Abraham R J, Fisher J, Loftus P**, *Wiley*.
8. "Elements of X – Ray Crystallography", **Azaroff L V**, *McGraw – Hill*.



**E-Resources:-**

- <http://en.wikipedia.org/wiki/analyticalchemistry>
- <http://pubs.acs.org/journal/jmcmr>
- <http://benthamsience.com/journal/index.php?journalID=mc>
- <http://omicsonline.org/analyticalchemistry.php>
- <http://www.e-booksdirectory.com/details.php?ebook=7521>
- [http://books.google.co.in/books/about/analyticalChemistry.html?id=C9qtuHZcrYEC&redir\\_esc=y](http://books.google.co.in/books/about/analyticalChemistry.html?id=C9qtuHZcrYEC&redir_esc=y)



**FACULTY OF SCIENCES**  
**DEPARTMENT OF CHEMISTRY**

**COURSE: M.Sc.**

**SEMESTER: III**

**SUBJECT NAME: Electroanalytical Techniques**

**SUBJECT CODE: 5SC03ETC1**

**Teaching & Evaluation Scheme:-**

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
4	0	0	4	4	30	1.5	70	3	--	--	--	100	

**Objectives:-**

- To understand analytical chemistry and applications.
- To learn theories and principles of Electroanalytical Techniques.
- To create interest in students in learning Electroanalytical Techniques.

**Prerequisites:-**

- Before studying Electroanalytical Techniques, all students have basic knowledge of analytical chemistry, electronics and knowledge related to UG level chemistry.

**Course outline:-**

Sr. No.	Course Contents
1	<b>Electroanalytical Measurements</b> <ul style="list-style-type: none"><li>• Voltage.</li><li>• Impedance.</li><li>• The electric double layer.</li><li>• Electrocapillarity.</li><li>• Current.</li><li>• Diffusion transport.</li></ul>



2	<b>Voltammetry</b> <ul style="list-style-type: none"><li>• Differential pulse polarography.</li><li>• Square wave polarography.</li><li>• A.C. polarography.</li><li>• Stripping analysis.</li><li>• Cycling voltametry.</li><li>• Amperometric titration.</li></ul>
3	<b>Electrodeposition and Coulometry</b> <ul style="list-style-type: none"><li>• Electrolysis.</li><li>• Current-Voltage relation.</li><li>• Electrogravimetric analysis at constant current, constant potential and at controlled potential.</li><li>• Coulometric analysis.</li></ul>
4	<b>Electrochemical and Bio-sensors</b> <ul style="list-style-type: none"><li>• Potentiometric sensors.</li><li>• Potentiometric biosensors.</li><li>• Amperometric sensors.</li><li>• Conductometric sensors.</li><li>• Applications of Field-Effect Transistors sensors.</li></ul>

### Learning Outcomes:-

After the successful completion of the course, students will be able to understand,

- Organic biosensor, Electro deposition method.
- Potentiometric sensors, Potentiometric biosensors, Amperometric sensors.

### Books Recommended:-

1. "Laboratory Techniques in Electroanalytical Chemistry", **Peter T. Kissinger, William R. Heineman** *Marcel Dekker Inc.*,
2. "Electroanalytical Chemistry", **Basil H. Vassos, Galen W. Ewing**, *John Wiley & Sons.*
3. "Electrochemical Methods – Fundamentals and Applications", **Allen J. Bard, Larry R. Faulkner**, *John Wiley & Sons.*
4. "Quantitative Chemical Analysis" **Daniel C. Harris**, *W.H. Freeman and Company.*
5. "Treatise on Analytical Chemistry", **I.M. Kolthoff**, *Wiley-Interscience.*

### E-Resources:-

- [http://en.wikipedia.org/wiki/Electroanalytical\\_method](http://en.wikipedia.org/wiki/Electroanalytical_method)
- <http://en.wikipedia.org/wiki/Voltammetry>
- [http://en.wikipedia.org/wiki/Cyclic\\_voltammetry](http://en.wikipedia.org/wiki/Cyclic_voltammetry)
- <http://pubs.acs.org/doi/abs/10.1021/ed042pA261>





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**DEPARTMENT OF CHEMISTRY**

**COURSE: M.Sc.**

**SEMESTER: III**

**SUBJECT NAME: Modern Separation Techniques**

**SUBJECT CODE: 5SC03MSC1**

**Teaching & Evaluation Scheme:-**

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
4	0	0	4	4	30	1.5	70	3	--	--	--	100	

**Objectives:-**

- To learn about advance Analytical chemistry and their applications.
- To understand Principal and instrumentation.
- Aware about separation techniques.

**Prerequisites:-**

- Before studying advance chemistry, all students have basic knowledge of basic chemistry, Chromatography and knowledge related to UG level chemistry.

**Course outline:-**

Sr. No.	Course Contents
1	<b>Liquid Chromatography</b> Principle, theory, instrumentation and applications of high-performance liquid chromatography. LC-MS, preparative chromatography, chiral chromatography, ion-chromatography, ion-pair chromatography, size-exclusion/gel permeation chromatography and affinity chromatography.
2	<b>Gas Chromatography</b> GC principle, theory, columns, detector types and applications in pharmaceutical analysis. Head space gas chromatography; Pyrolysis gas chromatography; GC-MS.



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<b>3</b>	<b>Electrophoresis</b> Principles of electrophoresis, theory and applications of polyacrylamide gel electrophoresis, capillary zone electrophoresis, micellar electrokinetic electrophoresis, capillary electrochromatography and capillary gel electrophoresis. Isoelectric focusing.
<b>4</b>	<b>Specialized chromatographic techniques</b> Principle, separation process on special columns, instrumentation and applications of counter current chromatography and ice chromatography. Superheated water chromatography- A green approach for the future. Flash chromatography.

### Learning Outcomes:-

After the successful completion of the course, students will be able to understand,

- Chromatographic techniques
- Principle, theory, instrumentation and applications of Chromatography.

### Books Recommended:-

1. "Quantitative Chemical Analysis" by **Daniel C. Harris**, *W.H. Freeman and Company*
2. "Analytical Chemistry" by **Gary D. Christian**, *John Wiley and Sons Inc.*
3. "Chiral Separation Techniques: A Practical Approach", by **Ganapathy Subramanian**, *Wiley-VCH*.
4. "Chiral Separations by Chromatography" by **Satinder Ahuja**, *American Chemical Society*.
5. "Chiral Chromatography" by **Thomas E. Beesley**, *John Wiley and Sons*,
6. "A Practical handbook of preparative HPLC" by **Donald Wellings**, *Elsevier*.
7. "Advances in Electrophoresis" by **Andreas Chrembach**, *Wiley-VCH*,
8. "High Performance Capillary Electrophoresis: An Introduction" by **David N. Heiger**. *Hewlett Packard GmbH*.
9. "High-speed counter current chromatography" by **Yoichiro Ito**, *John Wiley and Sons*,
10. "Practical Aspects of Gas Chromatography/Mass Spectroscopy" by **Gordon M. Message**, *John Wiley & Sons*.

### E-Resources:-

1. [http://en.wikipedia.org/wiki/Liquid\\_chromatography%E2%80%93mass\\_spectrometry](http://en.wikipedia.org/wiki/Liquid_chromatography%E2%80%93mass_spectrometry)
2. <http://en.wikipedia.org/wiki/Electrophoresis>
3. <http://iopscience.iop.org/0957-4484>
4. [http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1522-2683](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1522-2683)
5. [http://en.wikipedia.org/wiki/Chemical\\_industry](http://en.wikipedia.org/wiki/Chemical_industry)
6. [http://chemistry.uonbi.ac.ke/degree\\_courses/837](http://chemistry.uonbi.ac.ke/degree_courses/837)



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**COURSE: M.Sc.**

**SEMESTER: III**

**SUBJECT NAME: Chemistry Practical - III**

**SUBJECT CODE: 5SC03PRA1**

**Teaching & Evaluation Scheme:-**

Teaching hours/week				Credit	Evaluation Scheme/semester								
Th	Tu	Pr	Total		Theory				Practical				Total Marks
					Sessional Exam		University Exam		Internal		University		
					Marks	Hrs	Marks	Hrs	Pr	TW			
0	0	12	12	6	--	--	--	--	30	20	150	200	

**Objectives:-**

- To understand organic compounds and identification of their functional group.
- To learn practical principles related to drug synthesis, organic separation and preparation of dyes
- To create interest in students in learning basic chemistry.

**Prerequisites:-**

- Before studying practical of chemistry, all students have basic knowledge of organic and organic compounds, properties, medicinal chemistry, drugs and knowledge related to PG level chemistry.

**Course outline:-**

Sr. No.	Course Contents
1	<ol style="list-style-type: none"><li>1. pKa determination of drugs by spectrophotometry</li><li>2. Characterisation of drugs substance by IR.</li><li>3. Flame Photometry and Atomic Absorption Spectrophotometry.</li><li>4. Simultaneous determination of metal ions by spectrophotometry.</li><li>5. Solvent extraction of transition metal ions</li><li>6. Ion-exchange separation of cations and anions</li><li>7. Fluorimetric determination of vitamins and drugs</li><li>8. Method validation for linearity, accuracy and precision.</li><li>9. Characterization of drug substances by IR Spectroscopy.</li><li>10. High performance liquid chromatography.</li><li>11. Gas chromatography.</li></ol>



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### **Learning outcomes:-**

After the successful completion of the course, students will be able to,

- Understand basic principal of chemistry practical's
- Understand drug and dyes synthesis.

### **Books for References:**

1. 'Textbook of practical chemistry', **Vogel**.
2. 'Practical chemistry', **Pandey**.
3. 'Practical in Analytical chemistry', **Dr. Ramesh K. Goyal**, *B.S. Shah Prakashan*.

### **E-Resources:-**

1. <http://en.wikipedia.org/wiki/Chromatography>
2. <http://www.rpi.edu/dept/chem-eng/Biotech-Environ/CHROMO/chromintro.html>
3. [http://en.wikipedia.org/wiki/High-performance\\_liquid\\_chromatography](http://en.wikipedia.org/wiki/High-performance_liquid_chromatography)
4. <http://www.chem.ucla.edu/~bacher/General/30BL/gc/theory.html>