		<b>SYLLABUS</b>
<b>Course Title</b>	<b>ANALYTICAL CHEMISTRY-II</b>	
<b>Course Code</b>	MAC201	
<b>Course Credit</b>	Lecture	: 04
	Tutorial	: 00
	Practical	: 03
	Total	: 07
<b>Detailed Syllabus:</b>		
<b>Sr. No.</b>	<b>Name of chapter &amp; Details</b>	<b>Session Allotted</b>
<b>SECTION - I</b>		
<b>1</b>	<b>Introduction to Environmental Chemistry:</b> Definition of air pollution, energy balance between earth –atmosphere systems, Water pollution, Land Pollution, Deforestation, particulates types classification, organic particulates, photochemical. <b>Water Cycle, Carbon cycle, Sulphur cycle, Nitrogen Cycle</b>	<b>15</b>
<b>2</b>	<b>Industrial Analysis:</b> 1. Paint and varnish analysis 2. Fine chemical analysis 3. Cement analysis	<b>15</b>
<b>SECTION - II</b>		
<b>3</b>	<b>Flame Photometry:</b> Principle, theory, instrumentation, sample handling and application.	<b>10</b>
<b>4</b>	<b>Fluorimetry and Phosphorimetry:</b> Principle, theory, instrumentation, sample handling and application.	<b>10</b>
<b>5</b>	<b>Spectropolarimetry:</b> Introduction polarized light, optical activity, specific rotation, measurement of rotator power, ORD and CD, instrumentation and application.	<b>10</b>
<b>List of Practicals (3 Hour/Week):</b>		
1. To determine the concentration of unknown solution of optically active compound by polarimeter. 2. To determine the specific and molar rotation of given compound and find out intrinsic rotation by polarimeter. 3. To determine the iodide ion in the given sample of water. 4. To determine the amount of chloride ion in water sample.		

5. To determine the iron content in the given sample of water by using spectrophotometer.
6. Estimation of calcium and zinc in admixture.
7. To determine the % purity of sodium bicarbonate by direct titration method.
8. To determine % of methyl salicylate in the given sample.
9. To determine amount of paracetamol in the given sample using a colorimeter.
10. Flame photometric determination of Na, K, Li and Ca.

#### **Instructional Method and Pedagogy:**

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
5. Minimum ten experiments shall be there in the laboratory related to course contents.


#### **Students Learning Outcomes:**

At the end of the course the students will be able to:

- **Know** about water and air pollution, energy balance between earth–atmosphere systems and water analysis.
- **Able to** analyses different water and air pollutants and set their limits.
- **Identify** a quality parameters of cement, paint and fine chemicals.
- **Know** about the importance of flamephotometry, flourimetry and phosphorimetry that are most widely used in soil testing, dairy and pharmaceutical industries etc.

#### **Reference Books:**

1. Instrumental method of Chemical Analysis by B.K. Sharma.24<sup>th</sup> edition, Gohel publishing house Meerut, 2005
2. Vogel Textbook of Quantitative Chemical Analysis, 6<sup>th</sup> edition.
3. Instrumental method of Chemical Analysis by G. R. Analysis, 5<sup>th</sup> edition, Himalaya Publishing House, 2012
4. Principles of instrumental analysis by D. A. Skoog, 5<sup>th</sup> edition, Saunders College Publisher.
5. Analytical chemistry by G. D. Christian. 6<sup>th</sup> edition. John Wiley & sons, Inc. 2004
6. Environmental chemistry by A. K. De, 6<sup>th</sup> edition, Himalaya Publishing House, 2010

		<b>SYLLABUS</b>	
<b>Course Title</b>		<b>ENVIRONMENTAL CHEMICAL ANALYSIS AND POLLUTION CONTROL</b>	
<b>Course Code</b>		MAC202	
<b>Course Credit</b>		Lecture	: 04
		Tutorial	: 00
		Practical	: 03
		Total	: 07
<b>Detailed Syllabus:</b>			
<b>Sr. No</b>	<b>Name of chapter &amp; Details</b>		<b>Session Allotted</b>
<b>SECTION-I</b>			
<b>1</b>	<b>Land Pollution</b> Structure of Lithosphere, Classification of Soil , Causes of Land Pollution, Effects and Control of Land Pollution <b>Analysis of soil:</b> Moisture, pH, Total nitrogen, Phosphorous, Silica, Lime, Magnesium, Manganese, Sulfur & alkali salts.		<b>08</b>
<b>2</b>	<b>Water pollution</b> Types, Sources and Classification of Water Pollutants, Industrial Water Pollution, Constituents of Aquatic Environment, Oxygen Content of Water, Mercury Pollution, Water Quality std. by WHO, Effects of Water Pollutants on Life and Environment		<b>12</b>
<b>3</b>	<b>Waste Water analysis</b> Quality of Industrial waste Water analysis for organic and Inorganic Constituents Analytical methods, treatment by using stream. Gas stripping, solvent extraction, Water treatment plant. Method of control of water pollution Water and waste water treatment, aerobic and anaerobic, aeration of water, Removal of suspended particles (coagulation, sedimentation and filtration), softening (soda lime, hot soda and ion-exchange), disinfection, demineralization and fluoridation.		<b>10</b>
<b>SECTION-II</b>			
<b>4</b>	<b>Air Pollution</b> Sources and sinks of gases pollutants, classification & effects of air pollutants on living and nonliving things, Air pollution problems in India, pollution problems in industrial area, global air pollution problems, greenhouse effect, acid rain, ozone depletion and their consequences on Environment. Major air pollution disasters. <b>Method of control of air pollution</b>		<b>12</b>

	Method of control of air pollution, electrostatic precipitation wet & dries scrubber, filters, gravity and cyclonic separation, Adsorption, absorption and condensation of gaseous effluent	
<b>5</b>	<b>Chemistry of Air pollutants</b> Characterization. Source, methods of analysis of air pollutants; CO, CO <sub>2</sub> , NO <sub>x</sub> , NH <sub>3</sub> , H <sub>2</sub> S, SO <sub>2</sub> , etc. Monitoring Instruments, , major and minor components, , Threshold odor number	<b>08</b>
<b>6</b>	<b>Environment its characteristics and Classification</b> Metallic and non-metallic pollutants, Cr, Hg, Pb, Cd, Cu, As etc. Their physiological manifestation, source, analysis and control of inorganic compounds.	<b>10</b>
<b>List of Practicals (3 hours/week)</b>		
	<ol style="list-style-type: none"> <li>1. Determination of Acidity</li> <li>2. Determination of Alkalinity</li> <li>3. Determination of BOD</li> <li>4. Determination of COD</li> <li>5. Determination of Total Hardness</li> <li>6. Determination of Calcium Hardness</li> <li>7. Determination of Total Dissolved Solids</li> <li>8. Determination of Chloride</li> <li>9. Determination of Residual Chlorine</li> <li>10. Determination of Noise Level</li> </ol>	
<b>Instructional Method and Pedagogy:</b>		
<ol style="list-style-type: none"> <li>1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.</li> <li>2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.</li> <li>3. Surprise tests/Quizzes/Tutorials will be conducted.</li> <li>4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.</li> <li>5. Minimum ten experiments shall be there in the laboratory related to course contents.</li> </ol>		
<b>Students Learning Outcomes:</b>		
<ol style="list-style-type: none"> <li>1. After Successful completion of the above course, students will be able to:</li> <li>2. Know various basic fundamental air pollution and water pollution.</li> <li>3. Know the waste water treatment, and analysis.</li> <li>4. Known air and water pollution control and Environment its characteristics and Classification.</li> <li>5. The Students will also know chemistry of air pollutants.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Principles of Environmental Chemistry by H. Kolhandaraman and Geetha Swaminathan.</li> <li>2. Manual on Water &amp; Wastewater Analysis by Neeri.</li> <li>3. Water pollution by Dr. V.P. Kudesia.</li> <li>4. Basic concepts of Environmental Chemistry by Des W. Connel.</li> <li>5. Environmental Chemistry by A.K. De.</li> <li>6. An introduction to Air Pollution by R.K. Trivedi and P.K. Goel.</li> <li>7. Atmospheric Pollution by Black W (McGraw Hill Company, New York.)</li> <li>8. A textbook of Environmental Chemistry and Pollution Control by S.S. Dara (S.Chand &amp; Co.)</li> </ol>		



# SYLLABUS

<b>Course Title</b>	<b>SEPRATION TECHNIQUES</b>	
<b>Course Code</b>	MGC201	
<b>Course Credit</b>	Lecture	: 04
	Practical	: 03
	Tutorial	: 00
	Total	: 07
<b>Detailed Syllabus</b>		
<b>Sr. No.</b>	<b>Name of chapter &amp; details</b>	<b>Hours Allotted</b>
<b>SECTION – I</b>		
<b>1</b>	<b>Introduction:</b> History, Classification, definition of terms, principles, basic theory of chromatographic technique and sample handling. Band broadening and column efficiency: Definition, plate theory and rate theory of chromatographic technique, their limitation and applications.	<b>12</b>
<b>2</b>	<b>TLC AND HPTLC</b> Introduction, preparation of TLC plate, Basic principles, instrumentation of HPTLC, Application of HPTLC.	<b>08</b>
<b>3</b>	<b>HPLC:</b> Principles of HPLC, instrumentation of HPLC, Types of column, Types of detectors use in HPLC, and difference between HPLC and UPLC, Application of HPLC.	<b>10</b>
<b>SECTION – II</b>		
<b>4</b>	<b>GC:</b> Introduction, Basic principle of GC, difference between GLC and GSC, instrumentation of GC, Types of column, Types of detectors use in GC. Application of GC.	<b>12</b>
<b>5</b>	<b>Ion chromatography:</b> Principle theory , instrumentation and applications	<b>08</b>
<b>6</b>	<b>Hyphenated techniques:</b> Introduction, GC-MS, LC-MS theory working and applications.	<b>10</b>

### List of Practicals (3 Hour/Week)

1. To determine the  $R_f$  value of the amino acids present in a given mixture by paper chromatography.
2. To determine the  $R_f$  value of the amino acids present in a given mixture by circular paper chromatography.
3. To determine the  $R_f$  value of the amino acids present in a given mixture by thin layer chromatography.
4. To determine the  $R_f$  value of the components present in a given binary mixture by thin layer chromatography.
5. Separation of different pigments present in spinach leaf by using paper chromatography and calculate their  $R_f$  values.
6. Separation of different pigments present in spinach leaf by using thin layer chromatography and calculate their  $R_f$  values.
7. Detection of carotene in carrot by using thin layer chromatography and calculation of  $R_f$  value.
8. Identification of caffeine present in tea extract by thin layer chromatography.
9. Identification of quinine present in cinchona bark extract by thin layer chromatography.
10. To separate an unknown mixture of A and B by column chromatography.

### Instructional Method and Pedagogy:

1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
3. Surprise tests/Quizzes/Tutorials will be conducted.
4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
5. Minimum ten experiments shall be there in the laboratory related to course contents.


### Students Learning Outcomes:

At the end of the course the students will be able to:

- **Know** various basic fundamental of chromatography and its classification.
- **Know** the utilization of various instrumental techniques for separation and chemical analysis.
- **Know** the various Hyphenated techniques like GCMS, LCMS etc.

### Reference Books:

1. Instrumental method of Chemical Analysis by B.K. Sharma. 24<sup>th</sup> edition, Gohel publishing house Meerut, 2005
2. Vogel Textbook of Quantitative Chemical Analysis, 6<sup>th</sup> edition.
3. Instrumental method of Chemical Analysis by G. R. Analysis, 5<sup>th</sup> edition, Himalaya Publishing House, 2012
4. Principles of instrumental analysis by D. A. Skoog, 5<sup>th</sup> edition, Saunders College Publisher.
5. Analytical chemistry by G. D. Christian. 6<sup>th</sup> edition. John Wiley & sons, Inc. 2004

		<b>SYLLABUS</b>
<b>Course Title</b>		<b>IPR AND RESEARCH METHODOLOGY</b>
<b>Course Code</b>		MGC202
<b>Course Credit</b>	Lecture	: 04
	Project	: 00
	Tutorial	: 00
	Total	: 04
<b>Detailed Syllabus:</b>		
Sr. No.	Name of chapter & Details	Session Allotted
<b>SECTION - I</b>		
1	<b>GMP:</b> introduction, Enforcement (Area covered in GMP), Schedule-M, cGMP. <b>GLP:</b> Introduction, Principles (OECD). <b>QC:</b> Introduction, Basic requirements of QC area. <b>ICH</b> guideline.	15
2	<b>Patents:</b> Definition, Need for patenting, Types of Patents, Condition to be satisfied by an invention to be patentable, Inventions which are not patentable, Introduction to patent search, The essential elements of patents, Nonobviousness in patents, Process and product protection, Patent of addition. Priority date, Revocation of patent, True inventor, First inventor, Issues to be evaluated before entering into patent license agreements Patent Infringement, Drafting of patent claims patent filling and forms to be submitted along with a patent application. Important patent related websites.	15
<b>SECTION - II</b>		
3	<b>Research:</b> Meaning, purpose, Types, (industrial, Clinical, Experimental, Historical, Descriptive, Basic and applied Research) and objectives of research, phases of research. <b>Research Design:</b> Review of Research Literature: Purpose and use of literature review, locating relevant information, use of library & electronic databases, preparation & presentation of literature review, research article reviews.	10
4	<b>Documentation:</b> Techniques of documentation. Importance of documentation. Use of computer packages in documentation. <b>Research Publication:</b>	10

	Thesis, Research paper, Review Article & Technical Reports: Organization of thesis and reports, formatting issues, citation methods, Bibliography, effective oral presentation of research. Quality indices of research publication: impact factor, H-index and other citation indices.	
5	<p><b>Cost analysis of the project:</b> Cost incurred on raw materials, Procedure, instrumentations and clinical trials.</p> <p><b>Sources for procurement of research grants:</b> Major and minor projects. International agencies, government and private bodies.</p> <p><b>Research Ethics and Morals:</b> Ethics, research and professional ethics. Standards of Ethical Conduct in Science, Moral Theory, Moral Choices. Issues related to plagiarism, collaborative models and ethics, Acknowledgements.</p>	10
<b>Instructional Method and Pedagogy:</b>		
<ol style="list-style-type: none"> <li>1. Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.</li> <li>2. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.</li> <li>3. Surprise tests/Quizzes/Tutorials will be conducted.</li> <li>4. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.</li> <li>5. Minimum ten experiments shall be there in the laboratory related to course contents.</li> </ol>		
<b>Students Learning Outcomes:</b>		
<p>At the end of the course the students will be able to:</p> <ul style="list-style-type: none"> <li>▪ <b>Understand</b> the importance of patents and IPR in Chemical industries.</li> <li>▪ <b>Appreciate</b> the component of Scholarly writing and evaluate its quality.</li> <li>▪ <b>Able</b> to write proper research proposal, report and Thesis</li> <li>▪ <b>To take</b> suitable decision between moral and ethics.</li> </ul>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. USP-2017 – United State Pharmacopeia 40, USA, 2017.</li> <li>2. Quality Guideline: ICH – 2016.</li> <li>3. GLP for nonclinical laboratory studies, 2<sup>nd</sup> edition. Springer, Inc. 2004</li> <li>4. Research Methodology methods and techniques by C. R Kothari, IIT, Lacknow, India</li> </ol>		