

 <p>Estd. 1962 "A++" Accredited by NAAC(2021) With CGPA 3.52</p>	<p align="center"><b>SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA</b></p> <p align="center"><a href="http://www.unishivaji.ac.in">www.unishivaji.ac.in</a>, <a href="mailto:bos@unishivaji.ac.in">bos@unishivaji.ac.in</a></p> <p align="center"><b>शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४, महाराष्ट्र</b></p> <p align="center">दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दूरध्वनी ०२३१-२६०९०९३/९४</p>	
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**SU/BOS/Science/576**

**Date: 02/08/2023**

**To,**

The Principal, All Concerned Affiliated Colleges/Institutions Shivaji University, Kolhapur	The Head/Co-ordinator/Director All Concerned Department (Science) Shivaji University, Kolhapur.
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**Subject:** Regarding syllabi under the Faculty of Science and Technology of as per NEP-2020

**Sir/Madam,**

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of degree programme under the Faculty of Science and Technology.

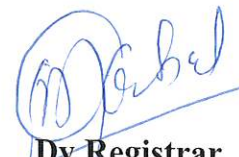
	<b>M.Sc.-Part II (Sem. III &amp; IV) as per NEP-2020</b>
1.	M.Sc. Part II Chemistry (Inorganic, Organic, Physical, Analytical, Industrial, Applied)

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website [www.unishivaji.ac.in](http://www.unishivaji.ac.in) > Online Syllabus.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

  
**Dy Registrar**  
**Dr. S. M. Kubal**

**Copy to:**

1	The Dean, Faculty of Science & Technology	5	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	6	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	7	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	8	Centre for Distance Education



# **Shivaji University, Kolhapur**

## **Department of Industrial Chemistry**

**Revised M.Sc. Part-II Syllabus  
as Per NEP-2020**

*To be implemented from June 2023-2024*  
(Industrial Chemistry)

**SHIVAJI UNIVERSITY, KOLHAPUR**  
**DEPARTMENT OF INDUSTRIAL CHEMISTRY**  
**M.Sc. COURSE IN “INDUSTRIAL CHEMISTRY**  
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**1. About the Course:** The Indian chemical industries occupy a unique position in the Indian economy in terms of contribution to employment and export potential. In spite of a strong natural resource base India's share in the global market is meager one. The experts in Industrial Chemistry have emphasized the need for capital infusion capacity, modernization and up gradation in various segments of industrial processes to bring about efficiencies and economies of scale in order to achieve in global markets. Keeping in view the need of Indian industries, Shivaji University has started M.Sc. course in Industrial Chemistry from academic year 1993-1994 in the Chemistry Department to educate and train the science graduates in industrial chemistry to serve the industrial sector as a technical, R & D personnel and quality control production personnel to manage the industrial production and contribute to the development of nation.

One of the objectives of the M.Sc. Industrial Chemistry Course is to attain new heights in industrial teaching and research and to provide trained manpower to vast developing Indian industries to develop the young graduate as a premier precision tool for future creation. M.Sc. course in industrial chemistry is a potential base provided by the Shivaji University on the University campus to educate the students from rural area who will get employment on large scale in Indian Chemical industries. Since last twelve years, M.Sc. industrial chemistry students have obtained employment on large scale in Indian chemical industries.

**2. Eligibility Criteria for Admission:** Admission to the M.Sc. Industrial Chemistry course will be open to candidates passing B.Sc. degree of Shivaji University or any other statutory university in India or abroad with minimum 55% marks and Chemistry as a principal subject of study.

**3. Selection Procedure:** Selection will be based on common entrance test of Chemistry Department and personal interview. Maximum '30' candidates will be admitted to M.Sc. Industrial Chemistry.

**4. Fee Structure for the Course:** For the detailed fee structure, please see our web site – [unishivaji.ac.in](http://unishivaji.ac.in)

**5. Strength of the students:**

**For M. Sc. Industrial Chemistry Course**

**36(18 Open + 18 Reserve) + 4(Other University) = Total 40.**

**5.2. For elective courses for students of other than Departments: Minimum 10 students per course and maximum 20 students**

**6. Duration of the Course:** The duration of the M.Sc. Industrial Chemistry course is – two years consisting of '4' semesters, each semester spanning for 6 months of minimum 120 working days.

## 7. Teaching facilities:

1. Co-ordinator 01, Assistant Professor : 2 Teaching Assistant.: 02
2. Inter and intra faculty, contributory staff, professors, readers, lecturers, M. Tech., B. Tech. Industrial personnel etc. qualification of the teacher for M.Sc. Industrial Chemistry will be M.Sc., M.Sc., Ph.D., M. Tech., B. Tech.etc.

Scheme of Examination / Assessment with scheme of standard of passing. The structure of M.Sc. Industrial Chemistry consists of –

- 1) Theory course
- 2) Practical course
- 3) Seminars
- 4) Industrial training#.

Each semester will have theory examination of four papers of 100 marks each (80 marks university examination + 20 marks internal.)

Each Semester will have two practical courses of 100 marks each

Semester-IV will have two practical courses out of which one practical course will have 50 marks project work.

**#Industrial Tour is compulsory for Semester III and IV Students.**

## 8. Choice Based Credit System of M.Sc. Industrial Chemistry

The newly designed choice-based M. Sc. Industrial Chemistry Course consists of total 96 credits. In order to accommodate the excellence achieved by the student in various activities like sports, National Service Scheme, National Cadet Corps and other activities, extra credits of maximum four will be given to the students. The student has to produce sufficient proof in the form of certificate by the competent authority to earn credits for other activities. The Scheme of number of credits given for other activities will be according to the Shivaji University procedure. The total credits that can be earned by a student will be 100 including the credit for other activities. The course consists of Core (Theory, Practical, Seminar and Project) and Elective courses for the third and fourth semester. The elective courses are also offered to the students of other science departments. The M. Sc. Industrial Chemistry consists of total four semesters and the courses offered in the first and second semester are compulsory for students seeking admission. The student admitted to M. Sc. Industrial Chemistry must choose three core courses of theory (of 12 credits), two core courses of practical (of 8 credits) and or Project (of 2 credits) of Industrial Chemistry offered in the third and fourth semesters. He/ she is allowed to choose either the elective theory course of Industrial Chemistry or of other Department of 4 credits under the Choice Based Credit System in each semester. The minimum credits to be obtained by the student to obtain Postgraduate degree in Industrial Chemistry in all the four semesters will be 35% of total marks in each course (Core, Elective, Practical and Project) separately equivalent of 34 credits except for the credit of other activities.

**L= Lecture, T = Tutorial, P = Practical, C = Credits**

All core courses for each semester are compulsory for M. Sc. Industrial Chemistry Students. The students are allowed to choose supportive courses from other departments as an alternative for Elective courses of third and fourth semesters.

**Total Credits for M. Sc. Industrial Chemistry**

A) Sem I (24) (16 T + 8 P) + Sem II (24) (16 T + 8 P) + Sem III (24) (16 T + 8 P) + Sem IV (24) (16 T + 8 P) = 96 (64 T + 32 P) + 4 credits for other activities likesports, N. S. S., N.C.C., etc. = **100 credits.**

**Minimum credits to be chosen from IndustrialChemistry**

B) Sem I (24) (16 T + 8 P)  
Sem II (24) (16 T + 8P) Sem III (20) (12 T+ 8 P) Sem IV (20)(12 T + 8 P) **Total = 88(56 T + 32 P)**

**Maximum credits to be chosen from courses offered by other departments**

C) Sem III (4T) + Sem IV (4T) =8T  
D) Credits for Other Activities =4

**So that B + C + D = A**

**Grades and average grade point calculation**

Grade	Marks	Grade points
<b>O</b>	<b>70 and above</b>	<b>7</b>
<b>A</b>	<b>60 to 69.99</b>	<b>6</b>
<b>B</b>	<b>55 to 59.99</b>	<b>5</b>
<b>C</b>	<b>50 to 54.99</b>	<b>4</b>
<b>D</b>	<b>45 to 49.99</b>	<b>3</b>
<b>E</b>	<b>40 to 44.99</b>	<b>2</b>
<b>F(Fail/ Unsatisfactory)</b>	<b>39.99 and below</b>	<b>0</b>

i) Semester grade point average (SGPA): Semester wise index grade of a student  $SGPA = (g_1 \times c_1) + (g_2 \times c_2) + \dots + (g_n \times c_n) / \text{Total credits of a semester.}$

ii) Cumulative grade point average (CGPA): Cumulative index grade pointaverage.  $CGPA = (g_1 \times c_1) + (g_2 \times c_2) + \dots + (g_n \times c_n) / \text{Total credits of a student up to and including semester for which cumulative average is required.}$

iii) Final grade point average (FGPA): Final Index of a student  $FGPA = (\sum g_i \times c_i) / (nc_T)$   
{ $g_i$  = grade point secured by the student,  $c_i$  = credit of the course,  $c_T$  = number of credits and n = total number of courses.}

**Illustration with a hypothetical case.**  
**For M.Sc. I, Semester I**

<b>Papers</b>	<b>I</b>	<b>II</b>	<b>III</b>	<b>IV</b>				
<b>practical's</b>					<b>I</b>	<b>II</b>		
<b>Credits</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>4</b>	<b>24</b>	
<b>Grade points secured</b>	<b>7</b>	<b>6</b>	<b>8</b>	<b>6</b>	<b>7</b>	<b>7</b>	<b>41</b>	
$\sum g_i \times c_i$	<b>28</b>	<b>24</b>	<b>32</b>	<b>32</b>	<b>28</b>	<b>28</b>	<b>164</b>	
$\sum g_i \times c_i / c_T$	<b>(164 / 24) = 6.83</b>							
<b>Overall grade</b>	<b>6.83</b>							

The cumulative grade point average is the sum of SGPA of a student of each semester. Suppose it is 164 (6.83) for a semester I, 170(7.08) for semester II, 168(7.0) for semester III and 176(7.33) for semester IV then the CGPA for semester I and II will be =  $[164 + 170] / 48 = 6.958 = 6.96$   
The FGPA for all semesters will be =  $[164 + 170 + 168 + 176] / 96 = 7.0265 = 7.03$

**M.Sc. Part II, Semester III, Industrial Chemistry**

Total credits = 16 Theory + 6 Practical + 2 Seminar = 24, Minimum Credits to be chosen = 12  
Theory + 08 Practical  
= 20 Credits to be chosen from the elective courses of other departments = 4

No	Paper Code		Title of the paper	Hours	L	T	P	C
1	IND 3.1	Core	Organic Chemical Industries-I	60	4	-	-	4
2	IND 3.2	Core	Inorganic Chemical Industries-I	60	4	-	-	4
3	IND 3.3	Core	Methods of Analysis in Industries	60	4	-	-	4
4	IND E01	Elective	General Chemical Technology	60	4	-	-	4
5	IND E02	Elective	Advanced Analytical Techniques in Industry	60	4	-	-	4
6	IND E03	Elective	Chemical Analysis in Agro, Food and Pharmaceutical Industry	60	4	-	-	4
5	IND P05	Core	Practical V	60			8	4
6	IND P06	Core	Practical VI	60			8	4

## M.Sc. Part II, Semester IV, Industrial Chemistry

Total credits = 16 Theory + 8 Practical = 24, Minimum Credits to be chosen = 12 Theory + 08 Practical = 20 Credits to be chosen from the elective courses of other departments = 4

### M. Sc. Part II, Semester IV

No	Paper Code		Title of the paper	Hours	L	T	P	C
1	IND 4.1	Core	Drug and Pharmaceuticals	60	4	-	-	4
2	IND 4.2	Core	Inorganic Chemical Industries-II	60	4	-	-	4
3	IND 4.3	Core	Selected Topics in Industrial Chemistry	60	4	-	-	4
4	IND E04	Elective	Environmental Chemistry	60	4	-	-	4
5	IND E05	Elective	Pharmaceutical Chemistry	60	4	-	-	4
6	IND E06	Elective	Chemistry of Industrially Important Materials	60	4	-	-	4
5	IND P07	Core	Practical VII	45			8	3
6	IND P08	Core	Practical VIII	45			8	3

\*\*Includes 50 Marks for Project

### M.Sc. –II SEM-III

#### Paper IND 3.1 Organic Chemical Industries – I

##### Unit – I: Dyes and Pigments:

**15 Hrs**

Dyes, Pigments and Intermediates: Classification of Dyes, Preparation of important dye intermediates, Methods of preparation of commercial dyes of different classes with suitable examples. Typical manufacturing processes of few dyes, Fluorescent brightening agents, and Special dyes: Photosensitive dyes, dyes as food additives, natural dyes.

##### Unit – II: Food Processing and food Additives

**15 Hrs**

Classification, chemical composition and nutritional value of common food stuffs, properties of foods, food preservation and processing, food deterioration, methods of preservation and processing by heat, cold, chill storage, deep freezing, drying, concentration, fermentation, and radiation. Permitted food additives and their role; antioxidants, coloring agents, sweeteners

##### Unit – III: Cane Sugar Based Chemistry

**15 Hrs**

Introduction, manufacturing processes of Acetic acid, oxalic acid, citric acid, acetic anhydride, furfural from bagasse, anhydrous alcohol, sugar based chemical industries in India. Preparation of organic jaggery, analysis of jaggery

##### Unit – IV: Soap and Detergents

**15 Hrs**

**Oils, soaps and Detergents:** Refining of edible oils, Manufacturing of soaps, Detergents, Liquid Soaps, aptholmic solution. Manufacturing of glycerol from fatty acids, greases from fatty acids, turkey – red oil.

**Paints:** Introduction, properties, manufacture of paint and applications

**Varnishes and Inks:** Constitutions, examples of preparation and applications.



## REFERENCE BOOKS

1. K. Venkatraman: The Chemistry of Synthetic Dyes Vol. 1-7 (A.P)
2. Abranart: Dyes and Their intermediates (Pergaman)
3. Beech: Fiber reactive Dyes (Logos Press)
4. Frig and David – Dyes intermediate
5. Allan: Color Chemistry
6. Kent: Riehels Industries Chemistry.
7. M Ash & I Ash: A formulary of paints & other coatings.
8. M Ash & I Ash: A formulary of cosmetic preparation (Godwin)
9. P.H. Groggings: Unit Processes in organic synthesis (MGH)
10. Kiik& other: Encyclopedia of Chemical technology.
11. L. W. Aurand, A. E. Woods, Food Chemistry, AVI Publishing Inc.
12. L. H. Mayer, Food Chemistry, Affiliated East-West Press Ltd., New Delhi.
13. N. Shakuntala Manay, M. Shadaksara Swamy, Foods-Facts and Principles.
14. John M. deMan, Principles of Food Chemistry.
15. The Complete Book on Sugarcane Processing and By-Products of Molasses (with Analysis of Sugar, Syrup and Molasses) -H. Panda

## Paper IND 3.2 Inorganic Chemical Industries – I

### Unit –I:

15 Hrs

**Dairy Chemistry:** Milk and milk products, composition and structure of milk, milk proteins, enzymes, vitamins, minerals, density and viscosity of milk, effect of heat on milk, milk processing, basic milk categories, butter, ghee and clarified butter.

**Leather Chemistry:** Introduction, constituents of animal skin, manufacture and preparation of hides, cleaning, soaking, limiting and degreasing, finishing and sharing, tanning; leather, vegetable, chrome, tanning effluents; pollution and control

### Unit – II

15Hrs

#### Cosmetics and Perfumes

A general study including preparation and uses of the following: Hair dye, hair spray, Shampoo, Sun-tan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), antiperspirants and artificial flavours. Water: Special consideration for cosmetics use. Surfactants: Classification and application in cosmetics – Foaming agents, emulsifiers, and solubilizers. Classification and application in cosmetics Antioxidants, antimicrobial and chelating agents used as preservatives,. Factors affecting effectiveness of antimicrobial preservatives

### Unit–III

15 Hrs

**Preparations and applications of Nano materials**-Synthesis of nano materials via –gas phase and liquid phase methods, high energy ball milling metal-semiconductor-ceramics and composites- size dependent properties - uniqueness in these properties compared to bulk and microscopic solids– nanomaterials and nanostructures in nature,  $\text{TiO}_2$ ,  $\text{ZnO}$ ,  $\text{ZrO}_2$ , Composites and their applications.

### Unit – IV

15 Hrs

**Nanotechnology in Agriculture** - Precision farming, Smart delivery system – Nanofertilizers: Nanourea and mixed fertilizers, Nanofertigation - Nanopesticides, Nanoseed Science, organic manures, micronutrients, biopesticide, biofertilizers and agrochemicals.

## REFERENCE BOOKS

1. F A Henglein: Chemical Technology (pergamon)

2. R.W. Thomas and P. Farago: Industrial Chemistry (HEB)
3. E. Stocchi: Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK
4. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai & Sons, Delhi
5. Introduction to Nanoscience and Nanotechnology, Gabor .L et al
6. Fundamentals of Nanotechnology, Hornyak, G. Louis, Tibbals, H. F., Dutta, Joydeep, CRC Press, 2009
7. Nanomaterials: An introduction to synthesis, properties and application, Dieter Vollath, WILEY-VCH, 2008
8. Lynn J. Frewer, Willehm Norde, R. H. Fischer and W. H. Kampers, Nanotechnology in the Agri-food sector, Wiley-VCH Verlag, (2011)
9. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut

### **Paper IND 3.3 Methods of Analysis in Industries**

#### **Unit – I Voltammetry Techniques:**

**15 Hrs**

Introduction, Modified polarographic techniques, stationary electrode polarography, sinusoidal alternate current polarography, rapid scan polarography, pulse polarography, square wave polarography, Cyclic voltammetry, stripping voltammetry, numerical.

#### **Unit – II NMR Spectroscopy:**

**15 Hrs**

General introduction and definition; chemical shift; spin –spin interaction; shielding mechanism of measurement; chemical shift values and correlation for protons bonded to carbons [aliphatic; olefinic; aldehydic and aromatic] and other nuclei [alcohols; phenols; enols; acids; amines; amides and mercapto]; chemical exchange; effect of deuteration; complex spin-spin interaction between two; three; four; and five nuclei [first order spectra]; virtual coupling. Stereochemistry; hindered rotation; Karplus curve variation of coupling constant with dihedral angle. Simplification, Simplification of complex spectra; nuclear magnetic double resonance; shift reagent; solvent effect. Fourier transform technique; nuclear overhauser effect [NOE] Resonance of other nuclei – F & P.

#### **Unit – III: Chemical Analysis of surfaces:**

**15 Hrs**

Introduction to photoelectron spectroscopy, Ion Scattering Spectroscopy, Secondary Ion Mass Spectrometry, Auger Electron Spectroscopy, Electron Spectroscopy for Chemical Analysis. Basic principles, Instrumentation and applications of these techniques

#### **Unit – IV Gas and Fuel analysis:**

**15 Hrs.**

Modern concept of fuels, classification of fuels, characteristics of good fuels, Orsat apparatus and its use in gas analysis, Instrumentation and working of bomb calorimetry, boy's calorimeter and numerical, coal analysis, calorific value of fuels, determination of calorific value of a solid or liquid fuel, Flash point, determination of flash point by Abel's method.

### **REFERENCE BOOKS**

1. F. J. Welder: standard Methods of chemical analysis Vol. III Part A&B
2. H.A. Strobel chemical instrumentation (AW)
3. Willard, Merritt & Dean, Instrumental Methods of analysis (FWAP)

4. F.D. Snell, Encyclopedia of Industrial: Chemical Inorganic analysis Vol. 1 to 20 (J.W)
5. Hillebrand, Lhundell and Hoffman: Applied inorganic analysis (Interscience)
6. D.K. Chakrabarty: Solid state Chemistry
7. H. Kaur, Instrumental method of analysis.
8. .V.M. Parikh, Application spectroscopy of organic molecules. (Mehata)
9. D.W. Williams and Flemming, Spectroscopic methods of organic compound10.Silverstein and Basallar, Spectroscopic identification of organic compounds
11. V. M. Parikh Absorption Spectroscopy for Organic Molecules ( J. Wiley )
12. P.S. Kalsi Spectroscopy of organic compounds (New age publisher)
13. Jackman and Sterneil , Application of NMR spectroscopy
- 14.J.D. Roberts, Nuclear magnetic resonance (J. Wiley)
15. D.L.Pavia, G.M.Lampman and G.S.Kriz, Introduction to Spectroscopy.
16. Analytical Chemistry-Gurudeep R. Chatwal Edited by Madhu Arora, Himalayapublication.
17. Instrumental method of chemical analysis- H. Kaur , Pragati prakashan

### **Paper IND E01: General Chemical Technology**

#### **Unit-I**

**15 Hrs**

#### **Chemical reactors and Unit Processes:**

Classification of chemical reactors, continuous reactor and batch reactor, chemical composition of reactor.

**Nitration:** Nitrating agents, Kinetics and mechanism of nitration of aromatic compounds, Nitration of paraffinic hydrocarbons, Nitrate esters, N-nitro compounds, Process equipment. Typical industrial manufacturing processes

#### **Unit-II**

**15 Hrs**

**Sulphonation:** Sulphonating agents, Kinetics and mechanism. Desulphonation Workup Procedures, Industrial equipment and technique, Batch and continuous processes,

**Amination by reduction and ammonolysis:** Methods of reduction to give amino compounds, Aminating Agents, Manufacture of amino compounds by reduction as well as by Ammonolysis

#### **Unit-III**

**15 Hrs**

**Halogenation:** Kinetics and mechanism. Survey of methods, Catalytic chlorination, photohalogenation, Manufacturing processes for chlorobenzene, Chlorinated methanes, monochloroacetic acid, chloral

**Oxidation:** Oxidising agents with typical applications of each, Liquid phase oxidation with oxidising compounds, Typical manufacturing processes.

#### **Unit-IV**

**15Hrs**

**Esterification:** Kinetics and mechanism. Esterification of carboxylic acid derivatives, Esters by addition to unsaturated systems, Industrial esterifications, Ethyl acetate, butyl acetate, Vinyl acetate, methyl methacrylate.

**Petrochemicals:** petroleum refining, outline of chemicals derived from ethylene, xylene and naphthalene

## REFERENCE BOOKS

1. P. H. Groggins: Unit Processes in Organic Synthesis (MGH)
2. F. A. Henglein: Chemical Technology (Pergamon)
3. M. G. Rao and M. Sittings: Outlines of Chemical Technology (EWP)
4. Clausen, Mattson: Principles of Industrial Chemistry
5. H A. Lowenheim and M. K. Moran: Industrial Chemicals
6. Kirk and Othmer: Encyclopedia of Chemical technology.
7. Kent, Riegel's Industrial Chemistry (N-R).
8. S. D. Shukla and G. N. Pandey: A Textbook of Chemical Technology, Vol-II
9. J. K Stille: Industrial Organic Chemistry (P.I I.).
10. Chemical Reactor Design, Optimization, and Scaleup-E. Bruce Newman 2nd Edition

## Paper- IND E02- Advanced Analytical Techniques in Industries

Basic theory, Instrumentation, Laboratory technique and Applications of following methods

**Unit – I** **15 Hrs**

X – ray Methods: Diffraction, Fluorescence, absorption, & emission spectroscopy.

**Unit – II** **15 Hrs**

Thermoanalytical Methods: Thermogravimetric Analysis, Differential Thermal Analysis, Differential scanning calorimetry.

**Unit – III** **15 Hrs**

ElectroAnalytical Methods: Coulometry, Polarography, Amperometry, electrogravimetry.

**Unit – IV** **15 Hrs**

Radiochemical Methods of analysis: Radiation Dosimetry, Radiolysis of water, Free Radicals in Water Radiolysis, Radiolysis of some aqueous solutions, A time scale of Radiolytic Events Radiation-induced Color Centers in Crystals: Storing and release of Energy.

## REFERENCE BOOKS

1. H J Arnika: Essential of Nuclear Chemistry
2. R.D. Braum, Introduction to Instrumental Analysis.
3. Willard, Deritt, Dean and Settle, Instrumental methods of Analysis
4. G.W. Ewing, Instrumental Methods of Analysis 4th and 5th editions.
5. Chatawal and Anand, Instrumental Methods of Analysis.

## Paper- IND E03- Chemical Analysis in Agro, Food and Pharmaceutical Industries.

**Unit – I** **15 Hrs**

Analysis of soil: Moisture, pH, total nitrogen, phosphorous, silica, lime, Magnesia, Manganese, sulfur & alkali salts.

Fuel analysis: Solid, liquid and Gas, ultimate and proximate analysis heating values, grading of coal, liquid fuels, flash points, aniline point, octane number and carbon residue, gaseous fuels – producer gas and water gas – calorific value.

#### **Unit- II**

**15 Hrs**

Clinical Chemistry and drug analysis: Composition of blood collection, and preparation of samples, clinical analysis – serum electrolytes, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, barbiturates, acidic and alkaline phosphates,

Immunoassay, principles of radioimmunoassay and applications, The blood- gas analysis – trace elements in the body.

Drug analysis: Narcotics and dangerous drugs, classification of drugs, screening by gas chromatography and spectrophotometric analysis.

#### **Unit – III**

**15 Hrs**

Food analysis: Moisture, ash, crude protein, fat, crude fiber, carbohydrate, calcium, potassium, sodium, and phosphates, food adulteration – common adulteration in food, contamination of food stuffs, microscopic examination of foods for adulterants, Pesticide analysis in food products, Extraction and purification of sample, HPLC, gas chromatography for organo – phosphates, thin layer chromatography for identification of chlorinated pesticides in food products

#### **Unit –IV**

**15Hrs**

Fluorescence in Biological, Medical and Drug Development: Fluorescence instrumentation for analysis, fluorophores and their modification, pH – indicators, membrane potential probes, lipid membrane protein, labeling of protein and DNA.

#### **REFERENCE BOOKS**

1. Fundamentals of analytical chemistry by D. A. Skoog, D. M. West and F. J. Horner, W. B. Saunders.
2. Chromic phenomenon, The Technological application of color chemistry Peter Bamfield.

#### **M.Sc. Part-II, Semester – III (Practical V/VI) Physical Chemistry Practical's**

1. Conductometry

Determination of percentage of acetic acid in commercial vinegar solution

2. Fluorimetry

To determine the amount of riboflavin in given B-complex tablet

3. Latent Heat of fusion

To determine the latent heat of fusion of given solid

4. Polarography

To study the effect of Oxygen supporting electrolyte and maximum suppressor and determine the half wave potential of Cd/Zn in given solution by Half wave potential method. Differential method and half wave equation method.

5. Potentiometry

To determine the dissociation constant of dibasic acid by potentiometric method

6. pH – metry

To determine the dissociation constant of dibasic acid pH – metrically.

7. pH – metry

To determine pH value of various buffer using pH meter and determination of dissociation

constant of acetic acid.

8. Spectrophotometry:

To determine pK value of phenolphthalein indicator by spectrophotometric method.

9. Spectrophotometry:

To study the stoichiometry and stability of ferric sulphate complex by Job's method and Mole ratio method.

**Organic Chemistry practical's**

1. Preparation of p – amino benzoic acid from p – toluidine
2. Preparation of NBS (N – bromo Succinimides)
3. Preparation of p – iodonitrobenzene
4. Estimation of Cu from copper fungicide
5. Estimation of Endosulfan

**Inorganic Chemistry practical's Alloy Analysis**

1. Chrome -steel alloy

Analyze the given sample of chrome - steel alloy & determine the percentage of

i) Chromium-----Calorimetrically.

ii) Nickel----- Gravimetrically.

2. Determine the amount of copper and zinc from given sample of **brass alloy**

i) Copper, Volumetrically/ Gravimetrically. ii) Zinc, Gravimetrically

3. Cement analysis:

Analyze the given sample of cement for its following constituents. i) SiO<sub>2</sub> -

Gravimetrically

ii) Calcium, Volumetrically

iii) Iron, Volumetrically

iv) Magnesium, Complexometrically

v) Aluminium, Gravimetrically.

4. Find out the percentage of available chlorine in the given sample of bleaching powder

5. Determine the percentage of calcium present in a given sample of plaster of Paris volumetrically.

6. Find out the amount of Iron present in a given sample of Sulpha - drug; calorimetrically.

7. Determine the percentage of phosphorus present in terms of P<sub>2</sub>O<sub>5</sub> from a given fertilizer sample volumetrically.

**M.Sc. Part-II Sem-IV**

**Paper- IND 4.1- Drugs and Pharmaceuticals**

**Unit – I**

**15 hrs**

**Drugs, Pharmaceuticals and Pharmaceuticals analysis:**

Introduction & classification of the drugs based upon their mode of action, Q-SAR, Molecular docking, Manufacturing processes of few important drugs, Aspirin, Ibuprofen, Paracetamol etc.

**Unit– II**

**15hrs**

**Drugs Acting on infectious diseases:**

**Anthelmintic agents;** synthesis of diethyl carbazine, niclosamide

**Antitubercular drugs;** synthesis of isoniazid, p-amino salicylic acid ethambutol and thioacetazone

**Anti-leprosy drugs;** synthesis of dapsone and clofazimine.

**Sulpha drugs;** classification, mode of action, synthesis of sulfadiazine, sulphaisoxazole,

sulfadimethoxine.

### Unit – III

15 hrs

**Cancer therapy:** Types of cancers, Causes of cancer and therapy: surgery, radiation therapy, immunotherapy, chemotherapy, combination therapy, adjuvant therapy.

**Antineoplastic drugs:** Mercaptopurines, 6-thioguanine, 5-fluorouracil, allopurinol, methotrexate. Alkylating agents, effect of alkylating agents on DNA, DNA intercalating agents. Antimitotic agents and other therapeutic agents.

### Unit– IV

15 hrs

#### a) Anti-AIDS:

Introduction & mechanism of HIV multiplication, Pathogenicity of HIV diagnosis, ELISA test, transmission and preventions of HIV, Anti-AIDS drugs

#### b) Cardiovascular drugs:

Introduction, synthesis of amyl nitrate, methyl dopa, sorbitrate.

#### c) Anti-diabetic drugs:

Introduction, synthesis of sequence of A and B chain of insulin, Glibenclamide, metformin.

### REFERENCE BOOKS

1. Burger: Medicinal Chemistry (I.W.)
2. W. O. Foye: Principle of Medicinal Chemistry (I.E)
3. Lendieer and Metscher: The Organic Chemistry of Drug Synthesis (I.W.)
4. Essentials of Medicinal Chemistry; Editors Korolkovas and J. H. Burkhalter, John Wiley & Sons
5. Wilson and Gisvold: Text Book of Organic Medicinal and Pharmaceutical Chemistry. 6 O. D. Tyagi: Synthetic Drugs.
7. Medicinal Chemistry G. R. Chatwal.
8. Principles of medicinal chemistry (4th edition) W.D. Foye, T.L. Lemke, and D. A. Williams.
9. Organic chemistry of drug action and design R. B. Siwerman
10. Synthetic Drug G. R. Chatwal.
11. Handbook of Industrial Chemicals (Vol.-I) K. M. Shah
12. Principles of Medicinal Chemistry Vol. I, S. S. Kadam and K.G. Bothara
13. A Text Book of Medicinal Chemistry P. Parimo

### Paper- IND 4.2-Inorganic Chemical Industries –II

#### Unit – I

15 Hrs

**Metallurgy:** Minerals in India, Mineral processing, Ellingham diagrams, manufacture and applications of metal alloys and salts, techniques for using low grade minerals. Iron and steel (Iron, Steel alloy, tool steel and stainless steel), Copper and its alloys, Zinc, Nickel and Aluminum.

#### Unit II

15 Hrs

**Metal finish technology:** Electro refining of metals, electroplating of nickel, chromium, copper, cadmium, silver and Gold, surface treatment technology, surface coats. Introduction, Electrodeposition, electroplating (Factors affecting, requirements and applications), hot dipping,

metal cladding, immersion plating, metal spraying, vapour deposition and chemical and organic coating.

**Chloralkali Industries:** Soda Ash, Caustic Soda, Chlorine

### Unit III

15 Hrs

**Applications of Inorganic compounds in Pharmaceutical chemistry:** Introduction, impurities in pharmaceutical substances and their limit test, antioxidants, gastrointestinal agents, topical agents, dental products, inhalants, expectorants, respiratory stimulants. Compounds of iron, iodine and calcium, antidotes in poisoning, pharmaceutical aids

### Unit IV

15 Hrs

**Glass and Refractory materials:** Raw materials, Soda glass, borosilicate glass, Lead Glass, Colored Glass, Refractory: Raw materials, clay pots, Zeolites.

**Industrial Gases:** Manufacture and industrial uses of  $H_2$ ,  $O_2$ ,  $N_2$ ,  $CO_2$  & acetylene. Liquefaction of gases, production of low temperatures,

**Chemicals of Utility:** Inorganic fine chemicals, magnesia, alumina,  $AlCl_3$ , calcium carbonate, sodium silicate,  $MnO_2$ ,  $FeSO_4$ ,  $PbO_2$ ,  $Na_2HPO_4$  and  $NaOH$ .

### REFERENCE BOOKS

1. Lowenheim F A (1974) Modern Electroplating III Ed Chapman & Hall, London.
2. Gable, D: Principal of metal Treatment and protection. Pergamon, Press Oxford (1978)
3. G.A. Keneth: Electroplating for Engineering's A Hand Book IIIrd Edn Van Nostrand Reinhold Co London
4. F A Lowinbein: Modern Electroplating, Electroplating Publication New Jersey 5. Burke Progress in ceramic science Vol. IV
6. R.R. Iash: afromulary of paints and other coating Vol. I
7. J.D. Gilchrist: Extraction Metallurgy (Pergamon)
8. W.H. Dennis: Foundation of steel and iron Metallurgy (Elsevier)
9. S.D. Shukla & G N Pandey: A text book of chemical technology Vol. 1
10. F A. Henglein: Chemical Technology (Pergamon)

### Paper IND 4.3 Selected Topics in Industrial Chemistry

#### Unit – I Polymer Preparation:

15 Hrs.

Polyethylene (HDPE, MDPE, LDPE, LLDPE, UHMWPE, chlorinated PE), Polypropylene (PP), Polyisobutylene (PIB)), Acrylics (PMMA & PAN) Polyvinyl (PVC, PVDC & CPVC), Polystyrene & copolymer (HIPS, SBR, SAN & ABS), Poly (vinyl acetate) , Poly ethylene terphalate, (PET) High temperature polymers, Bakelite and other polymers

#### Unit-II

15 Hrs

**Science of corrosion and corrosion control:** Introduction, economic aspects of corrosion, theories of corrosion, factors affecting corrosion, kinetics of corrosion, Evans diagram, thermodynamics of corrosion, Fourbaix diagram, corrosion testing techniques, Evaluation of corrosion effect: XRD, ESCA, FTIR surface techniques.

**Corrosion Prevention:** Corrosion inhibitors, protective coating, cathodic and anodic protection. Corrosion problem in India.



### Unit – III

15 Hrs

**Mechanical and Rheological Properties of polymers:** Mechanical Properties, tensile strength, stress and strain curves, Maxwell voigt model, Boltzmann superposition principle, Impact strength, compressive strength, ultimate polymer properties and structure relationship, Elastomers, Fibers, and Plastics. Rheological Equation of state (RES) fluid – ideal, non- Newtonian, viscous flow, viscoelastic behavior, creep, stress relaxation, dynamic mechanical behavior, Maxwells model, mechanical spectra.

### Unit – IV

15 Hrs

Sensor Technology: Introduction, recent trends, classification of sensors, Elector analytical sensors, sensor, electrodes, Metal Membrane electrode sensors, Ionic Conductors, Thin film and thick Film Sensors, Nano - sensors, Application of sensors in Industry.

### REFERENCE BOOKS

1. Adamson: Surface Chemistry
2. D.D. Deshpande: Polymer science
3. Bilmayer: Polymer Science
4. N.B.Hanny: Solid state chemistry
5. S. Glastone: Physical chemistry
6. J.O.M..Bokries& A.K.N. Reddy: Modern Electrochemistry Vol – I & II
7. J.D.Lee: Inorganic Chemistry.
8. N.N.Greenwood: Chemistry of Elements9. D. Patranabis: Sensor and Tranducers.

### IND EO4 Environmental Chemistry

#### Unit I: Water pollution and wastewater management

15 Hrs.

Introduction, use and conservation of water resources, water quality management, rainwater harvesting, water management in agriculture rain fed systems, irrigated systems, industries. Water pollution: Definition, types of water pollution (Physical, Chemical, biological and physiological), water pollutants. Ground water pollution and its protection, Surface, river, sea and lake water pollution, effect of excess nutrients and oil on water pollution, Sea water for agriculture, remedial measures for water pollution.

**Industrial waste treatment:** Characteristics and types of industrial waste, principles of industrial waste treatment and disposal, protection of biosphere and surface water form industrial pollution.

#### Unit 2 Soil Pollution

Introduction, industrial, agricultural, radioactive, sewage, domestic, chemical and metallic wastes, soil pollution by mining, by sediments and biological agents, Effect of heavy metals,diseases caused by soil pollution and impact of soil pollution on airquality

#### Control of soil pollution:

Control of sewage, domestic and industrial waste, eco-farming and ecotechnology, biotechnology, integrated nutrient, pest, genetic resource and water management, land use systems

#### Unit 3: Air pollution

Defintion, composition and reactions occurring in atmosphere, Sources of air pollution, units of

measuring air pollutants. Classification and effect of air pollution; oxides of nitrogen, Sulphur and carbon, Hydrocarbons, organic and inorganic particulates and ozone as pollutants, WHO Standards, Indoor air pollution, occupational air pollution, outdoor air pollution, Air pollution episodes; Bhopal gas, Seveso, Chernobyltragedies.

#### **Noise pollution:**

Sources of Noise, Units and Measurements of Noise, Characterization of Noise from Construction, Mining, Transportation and Industrial Activities, Airport Noise, Auditory Effects, Non-Auditory Effects, Control of Noise Pollution.

#### **Unit 4:**

##### **Removal of Heavy toxic metals:**

Chromium, mercury, lead, cadmium, arsenic, analytical methods of determination of small amounts of metal pollutants, copper recovery, treatment of waste water to remove heavy metals, recovery techniques.

##### **Polymer Recycling:**

Environment and polymer industry, recycling of polymer wastes

#### **Reference:**

1. F. A. Henglein: Chemical safety Management and Engineering (Pergamon).
2. B. K. Sharma Environment Chemistry,
3. M. K. Hill; Understanding Environmental Pollution A Primer, Cambridge University Press, 2004.
4. I. L. Pepper, C. P. Gerba, M. L. Brusseau, Environmental & Pollution Science, Elsevier, 2006.
5. G. M. Masters, Introduction to Environmental Engineering and Science, Pearson, 2004.
6. Antony Milne, "Noise Pollution: Impact and Counter Measures", David & Charles PLC, 1979.
7. Peterson And E. Gross Jr., "Hand Book Of Noise Measurement", 5 Th Edition, 1963

### **Paper- IND E05-Pharmaceutical Chemistry**

#### **Unit – I**

**15 Hrs**

**Drug Design:** Development of new drugs, procedures followed in drug design, concepts of lead compound and lead modification, concepts of prodrugs and soft drugs, structure- activity relationship (SAR), factors affecting bioactivity, resonance, inductive effect, isosterism, non-isosterism, special considerations. Theories of drug activity: occupancy theory, rate theory, induced fit theory. Quantitative structure activity relationship. History and development of QSAR. Concepts of drug receptors. Elementary treatment of drug receptor ionization constants, steric, Shelton and surface activity parameters and redox potentials. Free-Wilson analysis, Hansch analysis, relationships between Free-Wilson and Hansch analysis. LD-50, ED-50 (Mathematical derivations of equations excluded).

#### **Unit – II**

**15 Hrs**

**Pharmacokinetics:** Introduction to drug absorption, disposition, elimination using pharmacokinetics, important pharmacokinetic parameters in defining drug disposition and in therapeutics. Mention of

uses of pharmacokinetics in drug development process. Pharmacodynamics: Introduction, elementary treatment of enzyme stimulation, enzyme inhibition, sulphonamides, membrane active drugs, drug metabolism, xenobiotics, biotransformation, significance of drug metabolism in medicinal chemistry. Antineoplastic Agents: Introduction, cancer chemotherapy, special problems, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards, and 6-mercaptopurine. Recent development in cancer chemotherapy. Hormone and natural products.

### **Unit – III**

**15 Hrs**

**Cardiovascular Drugs:** Introduction, cardiovascular diseases, drug inhibitors of peripheral sympathetic function, central intervention of cardiovascular output. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyl dopa, atenolol. Local Antiinfective Drugs: Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, griseofulvin, chloroquine, primaquine.

### **Unit – IV**

**15 Hrs**

**Psychoactive Drugs-** The Chemotherapy of Mind: Introduction, neurotransmitters, CNS depressants, general anaesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazepines, buspirone, neurochemistry, of mental diseases. Antipsychotic drugs-the neuroleptics, antidepressants, butyrophenones, serendipity and drug development, stereochemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximide, trimethadione, barbiturates, thiopental sodium, glutethimide. Antibiotics: Cell wall biosynthesis, inhibitors,  $\beta$ -lactam rings, antibiotics inhibiting protein synthesis. Synthesis of penicillin G, penicillin V, ampicillin, amoxicillin, chloramphenicol, Cephalosporin, tetracycline and streptomycin.

### **REFERENCE BOOKS:**

1. Introduction to medicinal chemistry, A Gringuage, Wiley- VCH.
2. Wilson Gisvold's Text book of organic Medicinal and pharmaceutical Chemistry, Ed. Robert F. Dorge.
3. An introduction to drug design, S. S. Pandeya and J. R. Dimmock, New age International.
4. Burger's Medicinal Chemistry and Drug Discovery Volume 1 (Chap. 9 and Chap.14), Ed. M.E. Wolff, John Wiley.
5. Goodman and Gilman's Pharmacological Basis of Therapeutics, Mc Graw-Hill.
6. The organic Chemistry of Drug Design and drug action, R.B. Silverman, Academic press.
7. Strategies for Organic Drug synthesis and Design, D. Lednicer, John Wiley.

## **Paper- IND E06- Chemistry of Industrially Important Materials**

### **Unit – I**

**15 Hrs**

**Industrial Materials:** Glasses, Ceramics, Composites and Nonmaterial's Glassy state, glass formers and glass modifiers, applications. Ceramic structures, mechanical properties, clay products. Refractories, characterizations, properties and applications. Microscopic composites; dispersion-strengthened and particle-reinforced fibre-reinforced composites, macroscopic composites. Nanocrystalline phase, preparation phase, preparation procedures, special properties, applications. Thin Films and Langmuir-Blodgett Films: Preparation techniques, evaporation/sputtering, chemical processes, MOCVD, sol-gel etc., Langmuir-Blodgett (LB) film, growth techniques, photolithography properties and applications of thin and L-B films. Liquid crystals: Mesomorphic behaviour, thermotropic liquid crystals, positional order, bond orientational order, nematic and smectic mesophases, smectic-nematic transition and clearing temperature-homeotropic, planar and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic B phases optical properties of liquid crystals, Dielectric susceptibility and dielectric constants. Lyotropic phases and their description of ordering in liquid crystals.

### **Unit- II**

**15 Hrs**

**Polymeric Materials:** Molecular shape, structure and configuration, crystallinity, stress-strain behaviour, thermal behaviour, polymer types and their applications, conducting and ferro-electric polymers. Ionic Conductors: Types of ionic conductors, mechanism of ionic conduction, interstitial jumps (Frenkel); vacancy mechanism, diffusion superionic conductors; phase transitions and mechanism of conduction in superionic conductors, examples and applications of ionic conductors.

### **Unit – III**

**15 Hrs**

**High Tc Materials:** Defect perovskites, high Tc superconductivity in cuprates, preparation and characterization of 1-2-3 and 2-1-4 materials, normal state properties; anisotropy; temperature dependence of electrical resistance; optical phonon modes, superconducting state; heat capacity; coherence length, elastic constants, position lifetimes, microwave absorption-pairing and multigap structure in high Tc materials, applications of high Tc materials.

### **Unit – IV**

**15 Hrs**

**Materials for Solid State Devices:** Rectifiers, transistors, capacitors-IV-V compounds, low-dimensional quantum structures; optical properties. Organic Solids, Fullerenes, Molecular Devices: Conducting organics, organic superconductors, magnetism in organic materials. Fullerenes-doped, fullerenes as superconductors. Molecular rectifiers and transistors, artificial photosynthetic devices, optical storage memory and switches-sensors. Nonlinear optical materials; nonlinear optical effects, second and third order-molecular hyperpolarisability and second order electric susceptibility, materials for second and third harmonic generation.

### **REFERENCE BOOKS:**

1. Solid State Physics, N.W. Ashcroft and N.D. Mermin, Saunders College.
2. Material Science and Engineering, An Introduction, W.D. Callister, Wiley.
3. Principles of the Solid State, H.V. Keer, Wiley Eastern.
4. Materials Science, J.C. Anerson, K.D. Leaver, J.M. Alexander and R.D. Rawlings. ELBS.

5. Thermotropic Liquid crystals, Ed., G.W. Gray, John Wiley.
6. Handbook of Liquid Crystals, Kelker and Hatz, Chemie Verlag.

#### **M.Sc. Part-II, Semester – IV (Practical VII/VIII) Physical Chemistry Practicals**

1. Potentiometry: To determine Solubility of  $PbI_2$  with Ag/AgI electrode by using potentiometry.
2. Potentiometry: To determine the dissociation constant of tribasic acid ( $H_3PO_4$ ) potentiometrically
3. Conductometry: To determine the critical micelle concentration of sodium lauryl sulphate in aqueous solution conductometrically.
4. Fluorometry: To estimate the Quinine sulphate in given sample by Fluorometry.
5. pH – metry: To determine hydrolysis constant of aniline hydrochloride by pHmetry
6. pH – metry: To determine isoelectronic point and dissociation constant of amino acid (Glycine) by pHmetry
7. Spectrophotometry: To determine stability constant of Ferric thiocyanate complex by Frank Ostwald method spectrophotometrically
8. Polarography: To determine unknown concentrations of  $Cd^{+2}$  ion in given solution by standard addition method

#### **Organic Chemistry Practicals**

1. Identification and separation of ternary organic mixtures by physical and chemical methods.
2. Preparation of benzanilide from benzophenone by use of Beckmann's rearrangement
3. Preparation of p- Bromo aniline from acetanilide
4. Estimation of Vit – C
5. Estimation Sulfur from Sulfur Fungicide
6. Preparation of Anthranilic acid
7. Preparation of p-iodoazobenzene.

#### **Inorganic Chemistry Practicals**

1. Analyse the given sample of Magnalium alloy, determine the percentage of,
  - i) Aluminium gravimetrically
  - ii) Magnesium complexometrically.
2. Analyse the given sample of pyrolusite ore, determine the percentage of,
  - i) Silica gravimetrically.
  - ii) Iron volumetrically.
  - iii) Manganese volumetrically.
3. Analyse the given sample of Bronze metal alloy, determine the percentage of,
  - i) Tin as tin oxide gravimetrically.
  - ii) Lead as lead sulfate gravimetrically.
  - iii) Copper Iodometrically
  - iv) Zinc complexometrically.
4. Find out the amount / percentage of **Iron** per gram of soap sample colorimetrically
5. To prepare **potash alum** & find out the percentage of **Aluminium** in the alum.
6. Find out the percentage of '**Magnesium**' in a given sample of Talcum powder complexometrically.
7. Determine the concentration in mg/lit of sulphate ion in the given sample of water nephelometrically.

## Department of Industrial Chemistry Programme Outcome

The main objective of the course is to provide students with the general criteria useful for an industrial chemical process planning and with the fundamental concepts that must be taken into account in designing a plant. To this aim, some industrial chemical processes are described and analyzed in terms of thermodynamic and kinetic aspects and are also highlighted the most important technology. Problems associated with the cost, sustainability and safety of an industrial process are also discussed.

Shivaji University , Kolhapur

Industrial chemistry is the link between the research and industrial-scale chemical engineering. Industrial chemists make use of their broad understanding of chemistry and environmental sustainability in areas like pharmaceutical companies, polymer manufacturing, petrochemical processing, food science, and manufacturing industries.

Industrial chemists can be found in the most unexpected places. They could be challenging the norm at the cutting edge of research, or taking responsibility for successful operations of some of Australia's largest companies in the chemical industry. In a general sense, industrial chemists are involved in:

**Safety and efficiency** – industrial chemists are constantly striving to improve the safety and efficiency of making important chemicals and materials.

**Product development and innovation** – industrial chemists create new chemical ‘recipes’ that meet identified needs. They will scrutinise the chemical composition of substances and then study the chemical changes which occur under different conditions and apply this to their end result.

**Process optimization** – an industrial chemist plays a part in optimising production to produce large amounts of a substance as cheaply as possible – but, unlike with engineers, they do so by making the ‘chemistry’ better and more efficient.

**Environmental monitoring and control** – industrial chemists work on the management and control of the environment during industrial processes, to ensure everything is being done to minimise the impact and work towards a clean and safe future.

**Production plant design** - in the construction of a new production plant, industrial chemists work in teams with other engineers like chemical engineers or control engineers to ensure the optimal outcomes.

**Ideas, design, testing – making a product as good as it can be**

Industrial chemistry is part of the long chain in the design and manufacturing process. Industrial chemists deal with the ideas, the design, the testing, and prototyping of new industrial products. In

order to design something entirely new to help solve the major problems of the world their essential skills are, in-depth knowledge and application of chemistry and creativity with chemicals.

Whereas a chemical engineer deals with the whole process of changing raw materials into a useful, marketable product, an industrial chemist would look specifically at the nitty gritty science stuff, scrutinising the chemical components and designing a 'method' for the product then work out the best way to make it. The industrial chemist precedes the chemical engineer in the process of bringing something to market.

Basically, if you want to know exactly where a product comes from, you should ask an industrial chemist.

### **Where do industrial chemists work?**

Industrial chemists work in many different industries – including petrochemicals, polymers, plastics food, cosmetics, pharmaceuticals, minerals and new materials.

You could find an industrial chemist wearing a number of different career titles including, research scientist, development chemist, technical representative, plant manager, development chemist, production process manager, operations manager, fuel development chemist, research scientist, production process manager or operations manager. You might also find an industrial chemist working in marketing or management in the chemical industry.

### ***Outcomes of Programme:***

The Industrial Chemistry Department has also identified specific objectives and outcomes for both the Masters and Ph.D. Graduate programs.

#### ***M.S. in Industrial Chemistry***

1. Students should have an advanced level understanding of at least three of the following areas of Chemistry - Analytical, Inorganic, Organic, and Physical Chemistry. They should have a graduate level understanding of their major area(s) of research.
2. Students should broaden their professional foundations through activities such as teaching, internships, and fellowships
3. Students should be able to communicate scientific results in writing and in oral presentation.
4. Students should acquire the basic tools needed to carry out independent chemical research. Students should become proficient in their specialized area of chemistry and successfully complete an advanced research project.