SHIVAJI UNIVERSITY, KOLHAPUR

Accredited By NAAC
Syllabus for
Master of Science in Industrial Chemistry
(Part I/II)
(Choice Based Credit System)

(Subject to the modifications to be made from time to time)

Syllabus to be implemented from June 2013 on wards.

June: 2013

SHIVAJI UNIVERSITY, KOLHAPUR

DEPARTMENT OF INDUSTRIAL CHEMISTRY

M.Sc. COURSE IN "INDUSTRIAL CHEMISTRY"

CONTENTS

1. About the Course: The Indian Chemical Industries occupies a unique position in the Indian economy in terms of its 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 man power 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

5. Strength of the students:
5.1 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 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. One-Co-ordinator, two- lecturers, one – teaching assistance.

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 (80 marks Experimental work + 20 marks Seminars on experimental work).

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

#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 chose 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 chose 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 semester 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.

8.1. 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 like sports, N. S. S., N.C.C., etc. = **100 credits.**

8.2. Minimum credits to be chosen from Industrial Chemistry

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

8.3. 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

8.4. Grades and average grade point calculation

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

i) Semester grade point average(SGPA): Semester wise index grade of a student
SGPA = (g_1 x c_1) + (g_2 x c_2) + ------- (g_6 x c_6)/ Total credits of a semester.

ii) Cumulative grade point average(CGPA): Cumulative index grade point average.
CGPA = (g_1 x c_1) + (g_2 x c_2) + ------- (g_6 x c_6)/ 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 = ($\sum g_i$ x c_i) / (n c_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

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

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

9.0 Structure and Detailed Syllabus of the Course

9.1. M.Sc. Part I, Semester I, Industrial Chemistry

Total credits = 16 Theory + 8 Practical = 24,
Minimum Credits to be chosen = 16 Theory + 08 Practical = 24

No	Paper Code		Title of the paper	Hours	L	T	P	C
1	IND C01	Core	Introduction to Chemical Engineering-I	60	4	-	-	4
2	IND C02	Core	General Chemical Technology – I	60	4	-	-	4
3	IND C03	Core	Selected Topics in Organic Chemistry	60	4	-	-	4
4	IND C04	Core	Introduction to Environmental Pollution	60	4	-	-	4
5	IND P01	Core	Practical I	60			8	4
6	IND P02	Core	Practical II	60			8	4

9.2. M.Sc. Part I, Semester II, Industrial Chemistry

Total credits = 16 Theory + 8 Practical = 24,
Minimum Credits to be chosen = 16 Theory + 08 Practical = 24

No	Paper Code		Title of the paper	Hours	L	T	P	C
1	IND C05	Core	Introduction to Chemical Engineering-II	60	4	-	-	4
2	IND C06	Core	General Chemical Technology-II	60	4	-	-	4
3	IND C07	Core	Selected Topics in Inorganic Chemistry	60	4	-	-	4
4	IND C08	Core	Instrumental Methods of Analysis	60	4	-	-	4
5	IND P03	Core	Practical III	60			8	4
6	IND P04	Core	Practical I V	60			8	4

9.3. 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 C09	Core	Organic Chemical Industries-I	60	4	-	-	4
2	IND C10	Core	Inorganic Chemical Industries-I	60	4	-	-	4
3	IND C11	Core	Methods of Analysis in Industries	60	4	-	-	4
4	IND E01	Elective	Water Pollution	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

9.4. 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

No	Paper Code		Title of the paper	Hours	L	T	P	C
1	IND C12	Core	Organic Chemical Industries-II	60	4	-	-	4
2	IND C13	Core	Inorganic Chemical Industries-II	60	4	-	-	4
3	IND C14	Core	Selected Topics in Industrial Chemistry	60	4	-	-	4
4	IND E04	Elective	Soil and Radiochemical Pollution	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

9.5. Examination Pattern

M. Sc. Part I, Semester I

Paper No.	Title	Internal Marks	External Marks	Total Marks	Duration of Theory Examination
IND C01	Introduction to Chemical Engineering-I	20	80	100	3 Hrs
IND C02	General Chemical Technology – I	20	80	100	3 Hrs
IND C03	Selected Topics in Organic Chemistry	20	80	100	3 Hrs
IND C04	Introduction to Environmental Pollution	20	80	100	3 Hrs
IND P01	Practical I	-	-	100*	3 Hrs
IND P02	Practical II	-	-	100*	3 Hrs
	Total	80	520	600	

M. Sc. Part I, Semester II

Paper No.	Title	Internal Marks	External Marks	Total Marks	Duration of Theory Examination
IND C05	Introduction to Chemical Engineering-II	20	80	100	3 Hrs
IND C06	General Chemical Technology-II	20	80	100	3 Hrs
IND C07	Selected Topics in Inorganic Chemistry	20	80	100	3 Hrs
IND C08	Instrumental Methods of Analysis	20	80	100	3 Hrs
IND P03	Practical III	-	-	100*	3 Hrs
IND P04	Practical I V	-	-	100*	3 Hrs
	Total	80	520	600	

M. Sc. Part II, Semester III

Paper No.	Title	Internal Marks	External Marks	Total Marks	Duration of Theory Examination
IND C09	Organic Chemical Industries-I	20	80	100	3 Hrs
IND C010	Inorganic Chemical Industries-I	20	80	100	3 Hrs
IND C011	Methods of Analysis in Industries	20	80	100	3 Hrs
IND E01	Water Pollution	20	80	100	3 Hrs
IND E02	Advanced Analytical Techniques in Industry	20	80	100	3 Hrs
IND E03	Chemical Analysis in Agro, Food and Pharmaceutical Industry	20	80	100	3 Hrs
IND P05	Practical V	-	-	100*	3 Hrs
IND P06	Practical VI	-	-	100*	3 Hrs
	Total	80	520	600	

M. Sc. Part II, Semester IV

Paper No.	Title	Internal Marks	External Marks	Total Marks	Duration of Theory Examination
IND C10	Organic Chemical Industries-II	20	80	100	3 Hrs
IND C011	Inorganic Chemical Industries-II	20	80	100	3 Hrs
IND C012	Selected Topics in Industrial Chemistry	20	80	100	3 Hrs
IND E04	Soil and Radiochemical Pollution	20	80	100	3 Hrs
IND E05	Pharmaceutical Chemistry	20	80	100	3 Hrs
IND E06	Chemistry of Industrially Important Materials	20	80	100	3 Hrs
IND P07	Practical VII	-	-	100*	3 Hrs
IND P08	Practical VIII	-	-	100**	3 Hrs
	Total	80	520	600	

*Includes 20 marks for Seminar
**Includes 50 Marks for Project

10. Semester wise Syllabus

10.1. M.Sc. Part-I, Semester-I

Paper IND C01 : Introduction to Chemical Engineering-I

Unit-I **15 Hrs**

Themodynamics: Entropy, thermodynamic definition, molecular interpretation, variation of entropy with pressure, volume and temperature, Trouton's rule, Gibb's energy, (Maxwell relations) equilibrium constants and their calculation, Effect of pressure and temperature on equilibrium, van't Hoff equation, solutions, nonideality, and partia1 molar properties.

Chemical Kinetics: Kinetics of complex reactions (Equilibrium, Parallel, sequential with examples), Enzyme Catalysis, Kinetics, rate law, turnover number and examples

Unit-II **15 Hrs**

Material and energy balance: Material balance: Process classification, Choice of system and basis of molecular processes with chemical reactions, Material balance calculations, Multiple unit processes, Recycle and bypass.

Energy balance: Forms of energy, Energy balance, Energy changes in physical processes, Energy changes in reactions, Energy balance Calculations.

Unit-III **15 Hrs**

Equipment Design: Material of constructions: Mechanical properties, Corrosion resistance. Plastics.

Ceramics: Metals and alloys, Stainless steel, Special material for food and pharmaceutical equipment. Protective coatings, Surface treatment to metals for corrosion resistance.

Design of Vessels: Classification of chemical reactors, pressure vessels for internal or external pressure, Maintenance, Storage vessels for liquids and gases. Design of chemical reactors, Reactors with chemical addition, agitation, heating, removal of vapours, gas addition.

Unit-IV **15 Hrs**

Industrial Instrumentation: Measurement of temperature, Thermo couples and pyrometers, High temperature thermometers, Optical pyrometers.

Measurement of pressure and vacuum, Manometric and Bourdon gauges, Vacuum gauges, Ionization and pirani gauges. Flow measurement, Pitot tube, Rotameters.

Liquid level indicators. Hook Type, Sight glass, Float type, Capacitance level indicator, Radiation level indicator.

REFERENCE BOOKS

1. F. A. Henglein; Chemical technology (Pergamon)
2. J. M. Coulson, J. F. Richardson: Chemical Engineering, Vol. I, II, III (Pergamon)
3. R. N. Shreve: The Chemical Process Industries (MGH)
4. W. I. Badger and J. T. Bandchero: Introduction to Chemical Engineering (MGH)
5. O. A. Hougen, R. M. Watson and R. A. Ragetz: Chemical Process Principles (Vol. I, II (JW))

6. P. H. Groggins: Unit processes in organic synthesis (MGH)
7. A. A. Frost and R. G. Pearson: Kinetics and Mechanism
8. P. W. Atkins and Julio de Paule: Physical Chemistry, VIIth Edn. (Ostord Union press, 2002)
9. S. Glasstone: Textbook of Physical Chemistry, IInd Edn. (McMillan India LTD. 1996)
10. W. J. Moore: Physical Chemistry, Xth Edn(Orient Longmans, 1993)
11. Thermodynamics, A core course, by R. C. Srivastava, S. K. Saha, A. K. Jain Prentice Hall of India Pvt. Ltd, 2004
12. Industrial Instrumentation and Control by S. K. Singh
Tata McGraw-Hill Publishing Company Limited, New Delhi.
13. Chemical Kinetics by K. J. Laidler
14. Chemical Kinetics by G. L. Agarwal

Paper IND C02 : General Chemical Technology-I

Unit-I **15 Hrs**

Introduction to Unit Processes

Nitration: Nitrating agents, Kinetics and mechanism of nitration of aromaticcompounds, 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 Work-up procedures. Industrial equipment and technique, Batch and continuous processes, Manufacturing processes for detergents, dye intermediates, turky red oil etc.

Unit-III **15 Hrs**

Halogenation: Kinetics and mechanism. Survey of methods, Catalytic chlorination, photohalogenation, Manufacturing processes for chlorohenzene, BHC, Chlorinated methanes, monochloroacetic acid, chloral, Vinyl chloride.

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, Cellulose acetate, xanhate and nitroglycerin.

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.).

Paper IND C03 : Selected Topics in Organic Chemistry

Unit-I **15Hrs**

Introduction to Reaction Mechanism, Study of the reagents: Lithium diisopropylamide (LDA), Dicyclohexyl carbodiimide (DCC), Lead tetraacetate (LTA), Tributyltinhydride (TBTH), Polyphosphoric acid (PPA), Trimethyl silyl iodide (TMSI), Lithium dialkyl cuprate (LDC).

Unit II **15Hrs**

Applications of following in synthesis: Birch reduction, Clemmensen reduction, Wolff-Kishner reduction, Sodium borohydride ($NaBH_4$), Lithium aluminium hydride($LiAlH_4$), Oppenauer oxidation, MVP reduction, use of sodium and ethanol, Phase transfer catalysts, Polymeric reagents, Electro-organic synthesis, Hydroboration.

Unit. III **15Hrs**

Designing of Organic Synthesis: Disconnection approach, Introduction to synthesis, synthetic equivalent, types of disconnections Regio-selectivity, Chemoselectivity, Protection of groups, reversal of the polarity (Umpolung), retrosynthesis involving synthesis of hydrocarbons, alkenes, alcohols, ethers, aldehydes, ketones, acids, esters, monocyclic, bicyclic compounds, examples of pharmaceuticals, agrochemicals, perfumery chemicals, examples.

Unit IV **15Hrs**

Rearrangements: Beckmann, Hofmann, Benzidine, Fries, Baeyer-Villiger, Benzilic Acid, Favorskii, Claisen, Pinacol-penacolon, Dienone-phenol.

Stereochemistry: Concept of chirality, optical isomerism. R & S- nomenclature, Resolution of racemic modifications, geometrical isomerism, E & Z- nomenclature, stereoselective synthesis.

REFERENCE BOOKS

1. E. S. Gould: Structure and Mechanism in Organic Chemistry (Holt-Reinhart Winston)
2. Peter Sykes: A guide book to Mechanism in Organic Chemistry (Orient-Longman)
3. E. L. Eliel: Stereochemistry of Carbon compounds (McGraw Hill)
4. P. S. Kalsi : Organic Stereochemistry (Wiley Eastern)
5. R.T. Morrison and R. N. Boyd: Organic Chemistry (Frentice Hall)
6. H.O. House: Modern Synthetic reactions (Benjamin)
7. K. K. Carey and R. J. Sundbarg: Advanced Organic Chemistry Vol. I & II.
8. Fieser and Fieser: Reagents for Organic Synthesis (J.W.)
9. R. E. Ireland : Organic Synthesis (Prentice Hall)
10. R. Adams: Organic Reactions : Various volumes
11. S. Warren : Designing Organic Synthesis
12. J. Fuhrhop and G. Penzlin : Organic Synthesis (VCH)
13. J. March: Advanced Organic Chemistry

Paper IND C04 Introduction to Environmental Pollution

Unit I **15Hrs**

Environment: Concept of Environmental Chemistry, Our Planet Earth, Definition of Environment its change and influences. Composition of atmosphere; troposphere, stratosphere, mesosphere, ionosphere, structure of atmosphere. Factors affecting weather and climate; earth's albedo, solar flux, thermal IR region. Air; composition, reactions of atmospheric oxygen. Reactions in troposphere and stratosphere. Segments of environment; atmosphere, hydrosphere, lithosphere, biosphere. Hydrosphere; solubility of gasses in water, hydrological cycle characteristic of fresh water. Lithosphere; composition and texture. Definition of pollution, pollutants and their classification, types of pollution.

Unit II **15hrs**

Biogeochemical Cycles: Types of biogeochemical cyles, sulphur, phosphorous, carbon and hydrogen, oxygen and nitrogen cycles. Biological control; production and decomposition in nature, biodistribution of elements. Biological Oxygen Demand, nitrogen fixation, denitrification and non-essential elements.

Unit III **15Hrs**

Air Poolution: Definition, 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. Hydrocabons, 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, Chernobyl tragedies.

Unit IV **15hrs**

Green house effect and global warming: Green house gasses and their sources, radiative forcing. Climate change, green house effect and climate change, consequences of global warming. Domino effect, Effect of global warming on ocean temperatures, forests, water cycle, carbon cycle and glaciers. Technologies to control global warming, Kyoto protocol.

REFERENCE BOOKS

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, Perason, 2004.

10.2. M.Sc. Part-I, Semester-II

Paper IND C05 Introduction to Chemical Engineering-II

Unit –I **15Hrs**

Evaporation: Types of evaporators, jacketed, horizontal and vertical tube evaporators, forced circulation evaporations, entrainment separators (upturned, deflector type, tangential type), effect of scale formation, multiple effect evaporators

Distillation: Boiling and distillation, vapor-liquid equilibria, Rault's law & Henry's law, relative volatility, azeotropic mixtures, flash distillation, steam distillation, vacuum distillation, fractional distillation, plate columns (Bubble cap, Sieve plate & Valve plate)

Extractions: Liquid equilibria, Extraction with reflux, Extraction with agitation, equipment, it's use and performance, continuous contact equipment, agitator extractors, packed spray extractors, Leaching, flow sheets of solid-liquid extraction, continuous leaching, counter current extraction.

Unit -II **15Hrs**

Filtration: Classification of filters, Sand filters, filter press, plates & frame press, filter aids, principles of leaf filters.

Flow of Heat: Introduction, Conduction (Fourier law, Thermal conductivity, thermal insulation & problems), Convection (rate of heat transfer and heat transfer coefficients), Radiation (Absorptive, Reflectivity, & Transmissivity, Kirchoff's law concept of black body & examples)

Heat Exchange Equipments:Introduction, Double Pipe, Shell& tube, Fixed tube, U tube heat exchangers.

Drying: General Principles (Significance, moisture content), Rate of drying (Constant & falling rate period, factors affecting drying), Drying equipments, Tray dryers, Rotary dryers, Single Drum dryer & Spray dryers.

Unit -III **15Hrs**

Crystallization: Growth of Crystal, saturation, nucleation supersaturation, (Mier's theory), Caking of crystals, effect of impurities, Classification of crystallizers, Agitated tank, Swenson walkers, Krystal, Oslo, continuous vaccum crystallizers.

Unit IV **15Hrs**

Gas Absorption: Definition, examples, comparison of absorption and distillation, conditions of liquid- gas equilibrium, solution criteria for gas absorption, mechanically agitated vessels. Packed columns, and plate columns, (Characteristics of tower packing, Types of packing) merits of plate & packed tower.

REFERENCE BOOKS

1.F. A. Henglein: Chemical Technology (Pergamon).
2. J. M. Coulson, J. F. Richardson: Chemical Engineering, Vol. I, II, III (Pergamon).
3. R.N. Shrove: The Chemical Process Industries (MGH).
4. W.L. Badger and J.T. Bandchero: Introduction to Chemical Engineering (MGH).
5. O.A. Hougen, K.M. Watson and R.A. Ragetz: Chemical Process Principles, Vol. I, II (JW).
6. P.H. Groggins: Unit Processes in Organic Synthesis (MGH)
7. G.H. Morrison & H. Freiser: Solvent extraction in Analytical Chemistry (John Wiley)
8. K.A. Gavhane: Unit operations II (Nirali Prakashan, Pune)

Paper- IND C06 General Chemical Technology-II

Unit I **15Hrs**

Name reactions: Aldol, Knoevenagel, Claisen, Perkin, Reimer-Tiemann reaction, Mannich, Michael, Wittig, Diels-Alder, Grignard, Stobbe condensation, Reformatsky reaction, Dieckmann reaction, Robinson annulation, Benzoin condensation, Chichibabin reaction.

Unit II **15Hrs**

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

Hydrogenation: Catalytic hydrogenation and hydrogenolysis, Different types of catalysts, Hydrogenation equipment, Industrial hydrogenation processes.

Unit III **15Hrs**

Hydrolysis: Definition and Scope, Kinetics and mechanism, Manufacture of soap, fatty acids, furfural Dextrose, Ethanol, ethylene glycol, glycerol and phenol

Alkylation and acylation: Alkylation and acylation at carbon, oxygen and nitrogen, Friedel-Crafts reaction, Applications of active methylene compounds like diethyl malonate, ethyl acetoacetate etc. Industrial processes

Unit IV **15Hrs**

Petrochemicals: petroleum refining, outline of chemicals derived from ethylene, xylene and naphalene.

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
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9. J. K Stille: Industrial Organic Chemistry (P.I I.).
10. E. S. Gould: Structure and Mechanism in Organic Chemistry (Holt-Reinhart Winston)
11. Peter Sykes: A guide book to Mechanism in Organic Chemistry (Orient Longman)
12. H.O. House: Modern Synthetic reactions (Benjamin)
13. R.T. Morrison and R. N. Boyd: Organic Chemistry (Frentice Hall)

Paper- IND C07 Selected Topics in Inorganic Chemistry

Unit-I **15 Hrs**

Industrial Applications of Organometallic Compounds: Importance of Organometallic compounds as catalysts, Conditions to be satisfied by a metal to act as catalysts, Hydrogenation of Olefins, Importance of Wilkinson's catalyst, Preparation of the Catalyst, $[RhCl(PPh_3)_3]$, Role of Rhodium Metal in the Catalytic Process, Mechanism of Hydrogenation of Olefins using Wilkinson's Catalyst, Modification over the original catalyst, Hydroformylation of olefins-The Oxo process, Mechanism of Hydroformylation of Olefins using the original catalyst, $HCo(CO)_4$, Modification the original catalyst, Mechanism of the Modified catalysis, Isomerisation of Olefins, Mechanism of Olefin Isomerisation, Oxidation of Olefins- Wacker's Process, Step involved Wacker's Process, ß- elimination,

Factors retarding the ß- elimination process, Role of palladium in Catalysing the oxidation of Ethene to Ethanal, Polymerisation of olefins Ziegler-Natta Catalysis, Heterogenous Catalysis, Homogeneous Catalysis, Importance of Ziegler-Natta Catalysis, Mechanism of Ziegler-Natta Catalysis, Cyclo-oligomerisation of Acetylenes- Reppe's Catalysis, Fischer- Tropsch Synthesis, Mecanism of Fischer- Tropsch Synthesis, Water gas Shift Reaction, Mechanism of Water gas Shift Reaction.

Unit-II **15 Hrs**

Synthesis and characterization of solid state materials: Synthesis of solid state materials, Conventional methods, electro-deposition, spray pyrolysis, sol-gel, hydrothermal synthesis, Chemical deposition, magnetic sputtering, Photo enhanced CVD, Plasma, LASER CVD, Low pressure CVD. Material characterization, electrical, optical, magnetic and thermal properties and chemical compositional analysis EDAX, AAS, Spectrophotometric, Crystal growth from vapor, melt and solution, Purification methods, concept of ultrapurity preparation of ultrapure elements Ga, In, Si, Ge and As for semiconductor.

Unit- III **15 Hrs**

Nanotechnology and its applications: Introduction to nanoscience and technology, terminology and history, optical and semiconducting properties of nanoparticles, metallic nanoparticles, top-down and top-up fabrication, solution based and vapour phase synthesis, synthesis of frameworks, supports and substrates, physical and chemical vapour deposition, artificially layered materials, quantum wells, self-assembled nanostructers, supramolecular chemistry and morphosynthesis, dimensional control; carbon nanotubes, mesoporous meterials and metal organic frameworks.

Unit –lV **15 Hrs**

Bio-lnorganic Chemistry: Essential elements in biological systems, Classification of biomolecules containing metal ions, Biological roles of metal ions like Na, K, Ca, Fe, Co, Oxygen transport and storage, Acid and redox catalysis biological system, Co-enzymes, Vitamin B_{12} Nitrogen fixation and photosynthesis.

REFERENCE BOOKS

1. J. E. Huheey : Inorganic Chemistry (Harper & Row)
2. J. D. Lee: New Concise INORGANIC Chemistry (ELBS).
3. F. A. Cotton and J. Wilkinson: Inorganic Chemistry (JW).

4. J. Mukhlyonov : Catalyst Technology (M1R).
5. N. B. Hannay : Solid State Chemistry (PH).
6. Z. Wife, R. Speights : Ultrapurity (MDI).
7. J. M. Thomas and W.J. Thomas: Introduction to Principles of Heterogenneous Catalysis (A.P.)
8. F.A. Kroger: Chemistry of Imperfect Crystals.
9. C. Satteefield: Heterogenneous Catalysis in Practice (MGH).
10. F. Basolo and R. G. Pearson: Inorganic Reaction Mechanism (JW).
11. M. L. Tobe: Inorganic Reaction Mechanism (Nelson, London).
12. H. Taube: Electron Transfer Reaction of Complex Ions in Solution (AP).
13. Benson: Inorganic Reaction Mechanism in Solution (MGH).
14. H. Gopanov: Optical and Electronic Properties of Nanocrystalline Materials.
15. R. Gopalan and V. Ramalingam: Concise Co-ordination Chemistry: Vikas Publishing House, Pvt. Ltd.
16. D. Banerjee: Co-ordination Chemistry, IInd Edition, Asian Books Private Limited.
17. Daniel Minoli: Nanotechnology Applications to Telecommunication Networking.
18. P. Atkins, T. Overton, J. Rourke, M. Weller, F. Armstrong, Shriver and Atkins Inorganic Chemistry, Oxford University Press, 2009.
19. T. Pradeep: Nano: The Essentials of Understanding, Nanosciences & Nanotechnology, McGraw-Hill Education.

Paper –IND C08 Instrumental Methods of Analysis

Unit-I **15 Hrs**

UV-Visible Spectroscopy : Introduction to spectroscopy, Electromagnetic spectrum, Interaction of electromagnetic radiation with molecular system, Electronic excitation, Beer- Lambert law, molar extinction coefficient, Chrophores and auxochromes, Absorption of simple chromophores. Instrument, applications to quantitative analysis.

IR Spectroscopy: Modes of vibrations, instrument, sampling techniques, selection rules, Absorption frequencies of common functional groups, Application to structure determination, monitoring reactions.

Unit II: **15 Hrs**

Atomic Absorption Spectroscopy (AAS): Introduction, principle, instrumentation, detection limits, sensitivity, interferences, comparison of AAS with flame photometry, applications.

Fluorescence and Phosphorescence: Basic principles filter fluorometer and double beam monochromator instruments, working, analysis of rare earths, pharmaceuticals, optical brightness, ultra trace analysis, new materials.

Mass Spectrometry: Introduction, Ion formation, Mass spectral fragmentation of organic molecules, Mac-Lafferty, rearrangement of isotope ions, nitrogen rule the moss spectral fragmentation of organic molecule for structure determination.

Mössbauer Spectroscopy: Introduction, principle, Mössbauer nuclides, parameters required for evaluation, instrumentation, applications.

Unit-III. **15 Hrs**

Electroanalytical Methods: Ion-selective electrodes: Principle, equation for potentials, glass membrane electrodes, gas sensing electrodes, advantages and applications

Polarography: Basic principles, current-voltage relationships, residual, migration, diffusion and limiting currents. Dropping mercury electrode, half wave potential, Ilkovik equation, Instrumentation, Applications in qualitative and quantitative analysis. Amperometric titrations.

Unit-IV. **15 Hrs**

Advanced Chromatographic Techniques: Gas Chromatography; theory and instrumentation, Column types, Solid/liquid stationary phases, column swithching techniques, basic and specialized detectors, elemental detection, chiral separations, pyrolysis gas chromataography, high temperature techniques, Apllications(Clinical and petrochemical) and problems.

High performance Liquid Chromatography; Theory and instrumentation, adsorption chromatography, liquid-liquid partition techniques, Microbore, capillary and affinity techniques, size exclusion, ion-pair, chiral and isotope separations, Applications and problems.

REFERENCE BOOKS

1. A. I. Vogel: A Textbook of Quantitative Inorganic Analysis (Longmans).
2. H. H. Willard, L.L. Merritt, J.A. Dean and Settle: Instrumental Methods of Chemical Analysis (DVN/AEWP).
3. H. F. Walton: Principles and Methods of Chemicals Analysis (PH).
4. G. H. Morrison and H. Freiser: Solvent Extraction in Analytical Chemistry (JW).
5. T. Sekine and Y. Hasegawa: Solvent Extraction Chemistry (Marcel Dekker).
6. F.J. Welcher: Standard Methods of Chemical Analysis (DNV).
7. S. Glasstone: Electrochemistry (D.Van Nostrand).
8. V. M. Parikh: Absorption Spectroscopy of Organic Molecules (D.Van Nostrand).
9. I. M. Kolthoff: Treatise in Analytical Chemistry Vol. I-VII.
10. A. I. Vogel: Quantitative Organic Analysis (Longmans).
11. S. M. Khopkar: Basic Concepts of Analytical Chemistry (JW).
12. D. Skoog and D. West: Principles of Instrumental Analysis (Holt Sounders).
13. H. Kaur: Instrumental Methods of Chemical Analysis: Pragati Prakashan, Meerut.
14. H. Kaur " Spectroscopy' Pragati Prakashan
15. H. Kaur Introduction to Chromatography.
16. Willium Kemp ' Organic Spectroscopy' Palgrave.
17. G. R. Chatwal, S. K. Anand. Instrumental Methods of Chemical Analysis, Himalaya Publishing House.
18. D. H. Williams & I. Fleming, Spectroscopic Methods in Organic Chemistry. Tata McGraw Hill

10.3. M.Sc. Part-I, Semester-III

Paper IND C09 Organic Chemical Industries – I

Unit – I **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, Special dyes: Photosensitive dyes, dyes as food additives, natural dyes.

Unit – II **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. Food quality; senory evaluation, objective methods, non-nutritional constituents and food safety.

Unit – III **15 Hrs**

Permitted food additives and their role; Antioxidants, coluring agents, flavours, emulsifiers, curating agents, non-curative sweeteners, flour improvers, leavening agents, stabilizers, thicckners and preservatives.

Unit – IV **15 Hrs**

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

Paints, 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. Shadakhsara Swamy, Foods-Facts and Principles.
14. John M. deMan, Principles of Food Chemistry.

Paper IND C010 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 15 Hrs

Industrial Catalysis – Principles and applications : Basic principles of catalysis: adsorption isotherms, surface area pore size and acid strength measurement. Enthalpy and entropy of adsorption: interpretation of chemisorptions based on the structure and the nature of the solid – solid state theories – role of defects in catalysis. Kinetic of surface reactions: rate determining step, various type of reaction, simple, parallel and consecutive reactions.

Selection, preparation and evaluation of catalysts – test reaction, promoters, carriers and stabilizers. Mechanism of selected reactions: hydrogenation, decomposition of nitrous oxide, oxidation of CO- etonization of carboxylic acids, cracking of hydrocarbons. Applications: Petrochemical industry – reforming and refining – value added chemicals environment protection auto exhaust catalyst Novel catalytic material clusters, zeolites, mesoporous materials.

Electro catalysis and Photo catalysis**,** Solid Liquid interfaces, Techniques in catalysis.

Unit – III 15 Hrs

Phosphorus industries: Calcium phosphate, manufacture of phosphoric acid, single and triple super phosphate, baking powder and DAP.

Sulphur and Sulphuric acid: Mining and manufacture of sulphur and manufacture of sulphuric acid by contact process.

Nitrogen Industries: Manufacture of Urea, calcium cyanamide, ammonium nitrate, nitric acid.

Unit – IV 15 Hrs

Soil Chemistry: Introduction, formation, classification and reactions of soil, soil acidity, alkalinity, productivity and fertility, chemical fertilizers and their effect, organic manures, micronutrients, biofertilizers and agrochemicals.

REFERENCE BOOKS

1. F A Henglein: Chemical Technology (pergamon)
2. R.W. Thomas and P. Farago: Industrial Chemistry (HEB)
3. R.N. Shreve: Chemical processes Industrial, McGraw Hill Book Company Inc, New York 1956.
4. K. Bhogavathi Somdavi: Applied Chemistry, MJP Publications, 2006
5. Riegels: Industrial Chemistry (Reinhold)
6. B. K. Sharma: Industrial Chemistry, Goel PublishingHouse,Meerut, 2011

Paper IND C11-Methods of Analysis in Industries

Unit – I **15 Hrs**

Non–Instrumental Methods: Volumetric analysis: Acid – Base titration, analytical standards, redox titration, visual indications, complexometrioc titration, precipitation titration – MnO_2 in pyrolucite Na_2CO_3, and NaOH, Na_2CO_3, mixture analysis.

Gravimetric analysis: Correct procedure of precipitation, filtration, washing, drying, ignition, and washing of the precipitate, Fe^{3+}, Zn^{2+} ions, ash content of food stuff.

Unit – II **15 Hrs**

NMR Spectroscopy :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; ammines; 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 **15 Hrs**

Thermal and Radiochemical Methods: TGA: Chemical changes versus weight loss plots, TGA and DTA analysis, use in characterization of raw materials, minerals, polymers, hydrate analysis, DSC, Principal, instrumentation and application.

Radiochemical Methods*:* Nuclear reactions and radiation, radioactivity, detection of radiations, G.M.counter,scintillation counter, applications of radio – nuclides, neutron activation analysis (NAA) & applications of this technique.

Unit – IV **15 Hrs**

Gas and Fuel analysis: Orsat apparatus and its use in gas analysis, bomb calorimetry, coal analysis, calorific value of fuels.

Chemical Analysis of surfaces : 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.

REFERENCE BOOKS

1. F.J.Welder: standard Methods of chemical analysis Voil. III Part A&B
2. H.A. Strobel chemical instrumentation (AW)
3. Willard, Merrit & 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 compound.
10. Silverstein and Basallar, Spectroscopic identification of organic compounds V.M.
11. Parikh ORPTION SPECTROSCIPY OF ORGANIC MOLECULES (J. Wiley)

12. P.S. Kalsi Spectroscope 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.

Paper IND E01- Water Pollution

Unit I **15 Hrs**

Properties of water: Introduction, chemistry, uses, sources and quality of water, water for industry, water in human body, effect of water on rocks and minerals, organic, humic and colloidal matter in water. 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, Marine pollution and episodes, measures against oil spills.

Sewage, domestic, agricultural thermal, radioactive, industrial pollutants and siltation. Effect of toxic metals, fertilizers and detergents on water pollution.

Inorganic and organic pollutants and their effects on pollution, eutrophication and pesticide pollution.

Unit II **15 Hrs**

Water Management: Introduction, use and conservation of water resources, water quality management, rainwater harvesting, water management in agriculture rain fed systems, irrigated systems, industries. 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 III **15 Hrs**

Purification of water: portability of water, removal of coarse, dispersed and colloidal impurities, clarification and coagulation(Contact and electrochemical) of water, determination of hardness, Flocculants, Sterlization(Chemical and physical methods) fluoridation, defluoridation and disinfection of water, softening of water(Clark's, lime soda, modified lime soda, permitit and ion exchange process) Demineralization, desalting(electro dialysis and reverse osmosis methods) and deoxygenation of water, removal of slime, algae, smack, iron, manganese, silicic acid and odour from water, Magnetic treatment of water.

Unit IV **15 hrs**

Prevention and analysis of water pollution: Prevention, control of water pollution and its best use, Chemical and physical examination and measurement of quality of water, chemical substances affecting potability, odour, taste, temperature and electrical conductivity of water, suspended and dissolved solids, acidity and alkalinity of water, free carbon dioxide and chlorine, chlorine demand.

Analysis of calcium, magnesium, iron, manganese, silver and zinc in water. Determination of ammonia, nitrate, nitrite, cyanide, sulphate, sulphide, chloride and fluride. Dtermination of arsenic, beryllium, chromium, copper, lead, selenium and mercury.

REFERENCE BOOKS

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, Perason, 2004.

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 Arnikar: 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 4^{th} and 5^{th} 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: Moister, 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 cool , liquid fuels , flasks 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 , principals of radiimmunoassy and applications. The blood- gas analysis – trace elements in the body.

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

Unit – III **15 Hrs**

Food analysis : Moister, ash, crude protein, fat, crud 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, Bxdraction 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, flurophors 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. Honer, W. B. Saunders.

2. Chromic phenomenon , The Technological application of color chemistry Peter Bamfield .

10.4. M.Sc. Part-II Sem –IV

Paper- IND C12- Organic Chemical Industries – II

Unit – I **15 Hrs**

Drugs, Pharmaceuticals and Pharmaceuticals analysis: Classification of drugs based on activity. Synthetic procedure for the present commonly used drugs of each type, Manufacturing of few important drugs.

Unit – II **15 Hrs**

Drugs Acting on infectious deseases: Anthelmintic agents; synthesis of diethyl carbazine, niclosamide. Antitubercular drugs; synthesis of isonazide, p-amino salicylic acid and thiacetazone. Antilepral drugs; synthesis of dapsone and clofazimine. Sulpha drugs; classification, structure activity relationship, mode of action, synthesis of sulhadiazine, sulphaisoxazole, sulpha dimethoxine.

Unit – III **15 Hrs**

Antineoplastics: Classification,synthesis of chloroambucil and mecaptopurine. Anti-AIDS and Anti-viral agents; A brief study and medicinal importance. Antimalarials; clasiification and synthesis of chloroquine.

Unit – IV **15 Hrs**

Agrochemicals: Organophosphorus pesticides: Malathion, Monocrotophos, dimethoate, chloropyriphos, Dichlorpyriphos, Dichlororous, phenthoate. Carabamates: Carbonyl, Bygon, Zirman, Zineb, Maneb, Alaicarb. Pyrenthroids: Natural pyrenthrins: Isolation and structures, synthetic Pyrethroids; Allethrin, cypermethrin, Phenvalerate.

Insect Peromones and Repellants: peromones, general introduction and applications in integrated pest management (No Synthesis). Repellents: Survey and synthesis and synthesis of the repellents: N,N, Diethyl - 3methyl Benzamide, N,N,Diethyltoluamide, 2 – Ethyl -1,3 hexanedial, Butopytranexyl. Dimethylcabonate, Dimethylphthalate. Use Pheromones in post management.

Plant growth regulaters and Herbicides: General survey of IAA, β – Napthoxyacetic acid, 2,4, - D Malic hydrazide, Daminozide, paraguat, glyphosine.

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. N. N. Melnikow:Chemistry of Pesicides, Springer
5. M. B. Green, G. S. Hartley West: Chemicals for Crop Protection and Pest Management, Pergamon.
6. R. Cremlyn: Pesticides
7. K.H. Buchel: Chemistry of Pesticides.
8. H.B.Scher: Advances in pesticides formulation Technology (ACS)
9. Kirk and other: Encyclopedia of chemical Technology
10. S.D.Shukla and G.N. Pandey: Text Book of Chemical technology. Vol. II
11. Essentials of Medicinal Chemistry; Editors Korolkovas and J. H. Burkhaltar, John Wiley & Sons
12. Wilson and Gisvold: Text Book of Organic Medicinal and Pharmaceutical Chemistry.
13. O. D. Tyagi: Synthetic Drugs.

Paper- IND C13-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 Alluminium.

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, imprities 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, AlCl3, 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, Landon.
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 Nastrad Reinbold Co London
4. F A Lowinbein: Modern Electroplating, Electroplating Publication New Jersey
5. Burke Progess 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 C14- Selected Topics in Industrial Chemistry

Unit – I **15 Hrs**

Adsorption and catalysis: General properties of catalysis, physical adsorption and chemical adsorption, kinetics of chemisorption, theories of adsorption, catalysis kinetics of heterogeneous catalysis, absolute reaction rate theory, preparation catalyst, catalyst and shape, Poisoning and catalyst fouling, Determination of surface area.

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 voit 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 Elements
9. D. Patranabis: Sensor and Tranducers.

Paper IND E 04- Soil and radioactive Pollution

Unit I **15 Hrs**

Introduction: Importance of soil, Definition and life on soil, composition and mineral matter in soil, organic matter in soil, soil water, soil respiration, surface and sub soil, process of soil formation, factors affecting soil formation. Soil pollution(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 air quality.

Unit II **15 Hrs**

Control of soil pollution: Control of sewage, domestic and industrial waste, ecofarmig and ecotechnology, biotechnology, integrated nutrient, pest, genetic resource and water management, land use systems.

Environmentally friendly technologies: Introduction, ecotechnology, organic farming and its advantages.

Unit III **15 Hrs**

Radiation chemistry: Introduction, radioactive substances, classification of radiaoactive isotopes, state of radioactive isotopes in solid, gas and solution medium, units of radiation, radiation doses, and analysis of radionuclides.

Radioactive pollution: Introduction, sources of radioactive pollution, medical X-rays, nuclear tests, fallouts, reactors and installations. Industrial, medical and research use of radioactive materials.

Unit IV **15 Hrs**

Effects of radioactive pollution: Introduction, classification of radiation effects, the risks and benefits of radiation, effects of radiofrequency, fallout, microwave, ionizing and non-ionizing radiations, biological effects of radiation, adverse effects of radiations, effect of X-rays, effect of plutonium as a carcinogen, radiation effects on plants and polymers, Dangers from nuclear plants and reactors.

Protection from and control of radiation: Radiation safety standards, means of individual protection, decontamination, preventive measures, control of occupational radiation exposure, minimization of X-ray hazards, patient protection from radiation, protection form teletherapy.

Disposal of radioactive waste: Types and methods of disposal.

REFERENCE BOOKS

1. F A Henglein: Chemical Technology (pergamon)
2. R.W. Thomas and P. Farago: Industrial Chemistry (HEB)
3. R.N. Shreve: Chemical processes Industrial, McGraw Hill Book Company Inc, New York 1956.
4. K. Bhogavathi Somdavi: Applied Chemistry, MJP Publications, 2006
5. Riegels: Industrial Chemistry (Reinhold)
6. B. K. Sharma: Industrial Chemistry, Goel PublishingHouse,Meerut, 2011

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 bioavtivity, resonance, inductive effect, isosterism, non-isosterism, special considerations. Theroies of drug activity: occupuancy theory, rate theory, induced fit theory. Quantiative 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. Sysnthesis of mechlorethamine, cyclophophamide, 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 ooutput. Direct acting arteriolar dilators. Synthesis of amyl nitrate, sorbitrate, diltiazem, quinidine, verapamil, methyldopa, atenolol.
Local Antiinfective Drugs: Introduction and general mode of action. Synthesis of sulphonamides, furazolidone, nalidixic acid, ciprofloxacin, norfloxacin, dapsone, amino salicylic acid, isoniazid, ehtionamide, ethambutal, fluconazole, griseofulvin, chlroquin primoquin.

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, benzodiazipines, 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, trimthadione, barbiturates, thiopental sodium, glutethimide.
Antibiotics: Cell wall biosynthesis, inhibitors, β-lactum 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 Glasssy 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(L-B) 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, planer and schlieren textures, twisted nematics, chiral nematics, molecular arrangement in smectic A and smectic B phasesopoptical properties of liquid crystals, Dielectric susceptibility and dielectric constants. Lytropic phases and their description of ordering in liquid crystals.

Unit- II **15 Hrs**

Polymeric Materials: Moleculr 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-dopped, 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.

11. Practical course in Industrial Chemistry

M.Sc. Part-I Sem-I (Practical I/II)

Physical Chemistry Practicals

1. Potentiometry.

a. To determine normality of each acid in given mixture of strong acid (A) and weak acid (B)

b. To determine solubility and solubility product of sparingly soluble salt of silver(AgCl, AgBr, AgI)

2. Conductometry

a. To determine normality of acids from mixture of strong acid and weak acid using conductometry.

b. To determine relative strength of chloroacetic acid ($CH_2ClCOOH$) and acetic aid (CH_3COOH) conductometry.

3. Colorimetry

To verify the Beer – Lambert law for the copper – ammonia comples and to determine unknown copper ion concentration in given solution

4. Heat of solution

To determine heat of solution (ΔH) of sparingly soluble acid (benzoic acid) by solubility measurement.

5. Thermometry

To determine heat of solution (ΔH) for NaCl, Kcl, & $MgCl_2$ in 1 M solution thermometry

Organic Chemistry Practicals

1. Preparation

a. p – bromoacetanilide

b. Benzene azo β – Napthol c. Nerolin.

2. Estimation

a. Ibuprofen b. Caffine

c. Isoniazide

Inorganic Chemistry Practicals

1. Analyse the given sample of **iron ore** & Determine **Silica** –Gravimetrically, Iron-**Volumetrically** and find out their percentages in the given sample.
2. Analyse the given sample of Copper Ferrite ($CuFe_2O_4$) & Determine the amount and Percentage of copper Iodometrically, Iron Volumetrically .
3. Determine the capacity of **cation exchange resin** of given sample of cation exchange resin in terms of milliequivalent/g of dry resin.
4. Determine the capacity of **anion exchange resin** of given sample of anion exchange in terms of milliequivalent/g of dry resin.
5. Prepare **Copper Ferrite ($CuFe_2O_4$)** & Find out percentage practical yield of the Copper Ferrite ($CuFe_2O_4$)

M.Sc. Part-I, Semester – II (Practical III/IV)

Physical Chemistry Practicals

1. Phase Rule

To construct phase diagram for three component system contain C_2H_5OH, C_6H_6 & H_2O

2. Colorimetry

To determine concentration of ammonia in given unknown solution colorimetry

3. Potentiometry

a. To determine formal redox potential (E^0) of Fe^{+3}/Fe^{+2} system potentiometrically.

b. To determine amount of halide in given mixture of KCl and KBr by using Potentiometry

4. Solubility.

a. To determine solubility of PbI2 in presence of different concentration of KNO_3

b. To determine solubility of PbI2 in presence of different concentration of KCl

5. Conductometry.

a. To determine solubility of sparingly soluble salt (e.g. PbSO4, AgIO3, Ag2CrO4) conductometry

b. To verify validity of onsagar equation at low concentration for a 1:1 type electrolyte conductometrically

Organic Chemistry Practicals

1. Preparation

a. p- nitroacetanilide

b. N-N dimethyl aniline c. Aryloxy acetic acid

2. Estimation.

a. Acetyl salicylic acid

b. Estimation of sulpha Drug from given pharmaceutical tablet

Inorganic Chemistry Practicals

1. Analyse the given sample of zinc ferrite ($ZnFe_2O_4$) & Determine the amount and percentage of

i) Iron- Volumetrically

ii) Zinc - complexometrically in the given sample of zinc-ferrite

2.Determine the influence of surface area on rate of corrosion

3.Determine the influence of time on rate of corrosion

4. Estimate the amount of cadmium and zinc from mixture by anion exchange chromatographic method.

i) Zinc - complexometrically

ii) Cadmium - complexometrically.

5. Prepare zinc ferrite & Find out percentage practical yield of the zinc ferrite

6. Prepare Pentathiourea dicuprous nitrate find its percentage purity.

7. To estimate phosphoric acid in cola drink by molybdenum blue method.

M.Sc. Part-II, Semester – III (Practical V/VI)

Physical Chemistry Practicals

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 Practicals

1. Preparation of p – amino benzoic acid from p – toludine
2. Preparation of NBS (N – bromo Succinamide)
3. Preparation of p – iodo nitrobenzene
4. Estimation of cu from copper fungiside
5. Estimation of Endosulfan

Inorganic Chemistry Practicals

Alloy Analysis

1. Chrome -steel alloy
   Analyse the given sample of chrome - steel alloy & determine the percentage of
   i) Chromium ----- Colorimetrically.
   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:
   Analyse the given sample of cement for its following constituents. i) SiO_2 - 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; colorimetrically.
7. Determine the percentage of phosphorus present in terms of $\mathbf{P_2O_5}$ from a given fertilizer sample volumetrically.

M.Sc. Part-II, Semester – IV (Practical VII/VIII)

Physical Chemistry Practicals

1. Potentiometry: To determine Solubility of PbI2 with Ag/AgI electrode by using potentiometry.
2. Potentiometry: To determine the dissociation constant of tribasic acid (CH_3PO_4) potentimetrically
3. Conductometry: To determine the critical micelle concentration of sodium lauryl sulphate in aqueous solution conduct metrically.
4. Fluorometry: To estimate the Qunine sulphate in given sample by Flurometry.
5. pH – metry: To determine hydrolysis constant of aniline hydrochloride by pH metry
6. pH – metry: To determine isoelectronic point and dissociation constant of amino acod (Glycine) by pH metry
7. Spectrophotometry: To determine stability constant of Ferric thiocynate 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. Preparation of benzanilide from bromephenone by use of Beckmann's rearrangement
2. Preparation of p- Bromo anil9ine from acetanilide
3. Estimation of Vit – C
4. Estimation Sulfur from Sulfur Fungiside
5. Preparation of Anthranilic acid

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.

12. Nature of Question Paper

• The semester examination will be conducted at the end of each term (both theory and practical examination)

• Theory paper will be of 80 marks each and 20 marks for internal evaluation test conducted in the mid of the term. Two practicals will be of 100 marks each.
• Question papers will be set in the view of the entire syllabus and preferably covering each unit of the syllabus.

13. Standard by Passing
As per rules and regulation of M.Sc. course.

14. Nature of question paper and scheme of marking
Theory questions paper: Maximum marks -80
Total No. of question – 7
All questions carry equal marks.
Question no.1 . Compulsory and objective
Total no. of bits – 16, Total marks – 16 (covers multiple choice, fill in the blanks, definition, true or false)
All questions should be solved in same answer book .
Any four questions are to be attempted from Section I and II such that not more than two questions from any of the section.

15. Laboratory Safety Equipments:
15.1 Personal Precautions:
1. All persons must wear safety Goggles at all times.
2. Must wear Lab Aprons/Lab Jacket and proper shoes.
3. Except in emergency, over – hurried activities is forbidden.
4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

15.2. Use of Safety and Emergency Equipments:
1. First aid Kits
2. Sand bucket
3. Fire extinguishers (dry chemical and carbon dioxide extinguishers)
4. Chemical Storage cabinet with proper ventilation
5. Material Safety Date sheets.
6. Management of Local exhaust systems and fume hoods.
7. Sign in register if using instruments.

16. Credit System:
Students can earn credit towards their post graduation by the way of credit allotted to the paper or to the course.
Type of credit:
a) Credit by examination
b) Credit by non examination

The student will be admitted and given permission to earn credit of papers from options only on merit basis as limited number of seats are available for these papers. In addition to this students can receive credits by Non – Examination

Mechanism of Credit System:
1. Minimum Credits For M.Sc. course for each semester:
Theory 16 and Practical 08 = Total 24
2. Total Credit for four semester: 24 x 4 96
   Additional Credits 4 by non – examination
   Total Credit 100
3. One Credit should be of 15 contact hours for each paper 4 x 15 = 60 contact hours
4. Practicals: Maximum 8 credits
   Total contact hours : 120

17. Distribution of Credits for Practicals:

M.Sc. Part – I

Organic Chemistry practicals	2 Credits
Inorganic Chemistry practicals	2 Credits
Physical Chemistry practicals	2 Credits
Practicals on Analysis of Industrially important Materials	2 credits

M.Sc. Part – II

Organic Chemistry practicals	2 Credits
Inorganic Chemistry practicals	2 Credits
Physical Chemistry practicals	2 Credit
Project	2 Credit
Total contact hours of practicals (8 x 15)	120 Hrs

Per Day – 3 contact hours for practical, Practical 4 days per weeks.

Contact hours per week	12 hours
Total number of weeks	10 weeks
Total no. of student for each class 40	

Batch of 10 students each

No. of Batches 3 (A, B, C) Minimum three rotation to be completed for each section.

There shall be a ceiling of 4.0 minimum credit requirements of cumulative grade point averages for continuation of the corresponding semester course.

18. M. Sc. Industrial Chemistry equivalence of pre revised and revised papers.

Sr. No.	Number and Name of the pre revised Paper	Number and Name of the revised Paper	Remarks
01.	IC 101 Introduction to Chemical Engineering-I	IND C01 Introduction to Chemical Engineering-I	M.Sc.I Semester-I
02.	IC 102 General Chemical Technology-I	IND C01 General Chemical Technology-I	M.Sc.I Semester-I
03.	IC 103 Selected Topics in Organic Chemistry	IND C03 Selected Topics in Organic Chemistry	M.Sc.I Semester-I
04.	IC 104 Industrial Management	IND C04 Introduction to Environment Pollution	M.Sc.I Semester-I
05.	Practical IC 111 and IC 112	Practical I and Practical II	M.Sc.I Semester-I
06.	IC 201 Introduction to Chemical Engineering-II	IND C05 Introduction to Chemical Engineering-II	M.Sc.I Semester-II
07.	IC 202 General Chemical Technology-II	IND C06 General Chemical Technology-II	M.Sc.I Semester-II
08.	IC 203 Selected Topics Inorganic Chemistry	IND C07 Selected Topics in Organic Chemistry	M.Sc.I Semester-II
09.	IC 204 Instrumental Methods of Analysis	IND C08 Instrumental Methods of Analysis	M.Sc.I Semester-II
10.	Practical 211 and Practical 212	Practical III and Practical IV	M.Sc.I Semester-II
11.	IC 301 Organic Chemical Industries-I	IND C09 Organic Chemical Industries-I	M.Sc.II Semester-III
12.	IC 302 Inorganic Chemical Industries I	IND C10 Inorganic Chemical Industries I	M.Sc.II Semester-III
13.	IC 303 Methods of Analysis in Industries	IND C11 Methods of Analysis in Industries	M.Sc.II Semester-III
14.	IC 304(A) Pollution Monitoring and	IND E01 Water Pollution	M.Sc.II

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	Control I		Semester-III
15.	IC 304(B) Advanced Analytical Techniques in Industries	IND E02 Advanced Analytical Techniques in Industries	M.Sc.II Semester-III
16.	IC 304 (C) Chemical Analysis in Agro, Food and Pharmaceutical Industries.	IND E03 Chemical Analysis in Agro, Food and Pharmaceutical Industries.	M.Sc.II Semester-III
17.	Practical IC 311 and Practical IC 312	Practical V and Practical VI	M.Sc.II Semester-III
18.	IC 401 Organic Chemical Industries II	IND C12 Organic Chemical Industries II	M.Sc.II Semester-IV
19.	IC 402 Inorganic Chemical Industries II	IND C13 Inorganic Chemical Industries II	M.Sc.II Semester-IV
20.	IC 403 Selected Topics in Industrial Chemistry	IND C14 Selected Topics in Industrial Chemistry	M.Sc.II Semester-IV
21.	IC 404 (A) Pollution Monitoring and Control-II	IND E04 Soil and Radiochemical Pollution	M.Sc.II Semester-IV
22.	IC 404 (B) Pharmaceutical Chemistry	IND E05 Pharmaceutical Chemistry	M.Sc.II Semester-IV
23.	IC 404 (C) Chemistry of Industrially Important Materials	IND E06 Chemistry of Industrially Important Materials	M.Sc.II Semester-IV
24.	Practical IC 411 and Practical IC 412	Practical VII and Practical VIII	M.Sc.II Semester-IV

SHIVAJI UNIVERSITY, KOLHAPUR

DEPARTMENT OF INDUSTRIAL CHEMISTRY

A Course under Choice Based Credit System (CBCS)

1. Course Code: (To be allotted by the system) :
2. Title of the course : **Paper IND E01- Water Pollution**
3. Department at which course will be conducted: Department of Chemistry
4. Duration : 15 weeks
5. Contact session : Theory- 60 hours.
6. Credits : 04 Credits
   (01 credit for 15 theory hours)
7. Course coordinator : ProF. G. S. Gokavi
8. Elegibility : M. Sc. Part I completed
9. Intake: Min(10) Max(20)
10. Course offered during : Odd semester (Semester III)
11. Course fee : Rs. 3000/-
12. Course content : Unit I, Unit II, Unit III and Unit IV of 15 hours each.
13. Examination : (Method and details): examination to be conducted along with semester III/ IV examination and is of 80 marks(Question No 1 contains Objective type questions and is compulsory. Question No 2-7 are divided into two sections, Section I (Q. No. 2 to 4) and Section II (Q. No. 5 to 7). Overall five questions to be attempted including Q. No. 1 and minimum two questions from each section. Each question carries 16 marks. The examination will be of three hours duration and 20 marks for internal test.

REFERENCE BOOKS

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, Perason, 2004.

Paper IND E01- Water Pollution

Unit I **15 Hrs**

Properties of water: Introduction, chemistry, uses, sources and quality of water, water for industry, water in human body, effect of water on rocks and minerals, organic, humic and colloidal matter in water. 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, Marine pollution and episodes, measures against oil spills.

Sewage, domestic, agricultural thermal, radioactive, industrial pollutants and siltation. Effect of toxic metals, fertilizers and detergents on water pollution.

Inorganic and organic pollutants and their effects on pollution, eutrophication and pesticide pollution.

Unit II **15 Hrs**

Water Management: Introduction, use and conservation of water resources, water quality management, rainwater harvesting, water management in agriculture rain fed systems, irrigated systems, industries. 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 III **15 Hrs**

Purification of water: portability of water, removal of coarse, dispersed and colloidal impurities, clarification and coagulation(Contact and electrochemical) of water, determination of hardness, Flocculants, Sterlization(Chemical and physical methods) fluoridation, defluoridation and disinfection of water, softening of water(Clark's, lime soda, modified lime soda, permitit and ion exchange process) Demineralization, desalting(electro dialysis and reverse osmosis methods) and deoxygenation of water, removal of slime, algae, smack, iron, manganese, silicic acid and odour from water, Magnetic treatment of water.

Unit IV **15 hrs**

Prevention and analysis of water pollution: Prevention, control of water pollution and its best use, Chemical and physical examination and measurement of quality of water, chemical substances affecting potability, odour, taste, temperature and electrical conductivity of water, suspended and dissolved solids, acidity and alkalinity of water, free carbon dioxide and chlorine, chlorine demand.

Analysis of calcium, magnesium, iron, manganese, silver and zinc in water. Determination of ammonia, nitrate, nitrite, cyanide, sulphate, sulphide, chloride and fluride. Dtermination of arsenic, beryllium, chromium, copper, lead, selenium and mercury.

REFERENCE BOOKS

2. 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, Perason, 2004.

SHIVAJI UNIVERSITY, KOLHAPUR

DEPARTMENT OF INDUSTRIAL CHEMISTRY

A Course under Choice Based Credit System (CBCS)

1. Course Code: (To be allotted by the system) :
2. Title of the course : **Paper IND E 04 - Soil and radioactive Pollution**
3. Department at which course will be conducted: Department of Chemistry
4. Duration : 15 weeks
5. Contact session : Theory- 60 hours.
6. Credits : 04 Credits
   (01 credit for 15 theory hours)
7. Course coordinator : ProF. G. S. Gokavi
8. Elegibility : M. Sc. Part I completed
9. Intake: Min(10) Max(20)
10. Course offered during : Even semester (Semester IV)
11. Course fee : Rs. 3000/-
12. Course content : Unit I, Unit II, Unit III and Unit IV of 15 hours each.
13. Examination : (Method and details): examination to be conducted along with semester III/ IV examination and is of 80 marks(Question No 1 contains Objective type questions and is compulsory. Question No 2-7 are divided into two sections, Section I (Q. No. 2 to 4) and Section II (Q. No. 5 to 7). Overall five questions to be attempted including Q. No. 1 and minimum two questions from each section. Each question carries 16 marks. The examination will be of three hours duration and 20 marks for internal test.

REFERENCE BOOKS

1. F A Henglein: Chemical Technology (Pergamon)
2. R.W. Thomas and P. Farago: Industrial Chemistry (HEB)
3. R.N. Shreve: Chemical processes Industrial, McGraw Hill Book Company Inc, New York 1956.
4. K. Bhogavathi Somdavi: Applied Chemistry, MJP Publications, 2006
5. Riegels: Industrial Chemistry (Reinhold)
6. B. K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut, 2011

Paper IND E 04- Soil and radioactive Pollution

Unit I **15 Hrs**

Introduction: Importance of soil, Definition and life on soil, composition and mineral matter in soil, organic matter in soil, soil water, soil respiration, surface and sub soil, process of soil formation, factors affecting soil formation. Soil pollution(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 air quality.

Unit II **15 Hrs**

Control of soil pollution: Control of sewage, domestic and industrial waste, ecofarmig and ecotechnology, biotechnology, integrated nutrient, pest, genetic resource and water management, land use systems.

Environmentally friendly technologies: Introduction, ecotechnology, organic farming and its advantages.

Unit III **15 Hrs**

Radiation chemistry: Introduction, radioactive substances, classification of radiaoactive isotopes, state of radioactive isotopes in solid, gas and solution medium, units of radiation, radiation doses, and analysis of radionuclides.

Radioactive pollution: Introduction, sources of radioactive pollution, medical X-rays, nuclear tests, fallouts, reactors and installations. Industrial, medical and research use of radioactive materials.

Unit IV **15 Hrs**

Effects of radioactive pollution: Introduction, classification of radiation effects, the risks and benefits of radiation, effects of radiofrequency, fallout, microwave, ionizing and non-ionizing radiations, biological effects of radiation, adverse effects of radiations, effect of X-rays, effect of plutonium as a carcinogen, radiation effects on plants and polymers, Dangers from nuclear plants and reactors.

Protection from and control of radiation: Radiation safety standards, means of individual protection, decontamination, preventive measures, control of occupational radiation exposure, minimization of X-ray hazards, patient protection from radiation, protection form teletherapy.

Disposal of radioactive waste: Types and methods of disposal.

REFERENCE BOOKS

1. F A Henglein: Chemical Technology (Pergamon)
2. R.W. Thomas and P. Farago: Industrial Chemistry (HEB)
3. R.N. Shreve: Chemical processes Industrial, McGraw Hill Book Company Inc, New York 1956.
4. K. Bhogavathi Somdavi: Applied Chemistry, MJP Publications, 2006
5. Riegels: Industrial Chemistry (Reinhold)
6. B. K. Sharma: Industrial Chemistry, Goel Publishing House, Meerut, 2011