

University of Kota, Kota (Rajasthan)

Syllabus

**Scheme of Examination and
Courses of Study**



Faculty of Science
M.Sc. Industrial Chemistry
Previous Examination - 2013
Final Examination - 2013

Edition : 2012

M.Sc. Industrial Chemistry-2013

SCHEME OF EXAMINATION

1. The number of papers and the maximum marks for each paper/Practical shall be shown in the syllabus for the subject concerned. It will be necessary for a candidate to pass in the theory as well as practical separately.
2. A candidate for a pass at each of the previous and the final examination shall be required to obtain (i) at least 36% marks in the aggregate of all the theory papers prescribed for the examination and (ii) at least 36% marks in practical wherever prescribed at the examination. Provided that if a candidate fails to secure at least 25% marks in each individual paper at the examination and also in the field work/project work wherever prescribed, he shall be deemed to have failed at the examination notwithstanding his having obtained the minimum percentage of marks required in the aggregate for the examination.
3. No division will be awarded at the previous examination. Division shall be awarded at the end of the final examination on the combined marks obtained at previous and the final examination taken together as noted below.

First division 60%

Second division 48%

All the rest will be declared to have passed the examination.
4. If a candidate clears any paper (s)/ Practical (s), Dissertation/Project report prescribed at the previous and /or final examination after a continuous period of three years, then for the purpose of working out his division, the minimum pass marks only viz 25% (36% in the case of practical) shall be taken into account in respect of such papers/ practical (s)/project report as are cleared after the expiry of the aforesaid period of three years. Provided that in case where a candidate required more than 25% marks in order to reach the minimum aggregate as many marks out of those actually secured by him will be taken into account as would enable him to make up the deficiency in the requisite minimum aggregate.
5. The project work/field work shall be typewritten and submitted in triplicate so as to reach the office of the Registrar at least 3 weeks before the commencement of the theory examination.

M.Sc. Industrial Chemistry - 2013

(2 year P.G. Course)

Structure of Course

M.Sc. (Final)

S.No.	Paper No.	Course No.	Course	Total period	Examination		
					M.M.	Min.M.	Duration
1	Paper- I	IC-501	Principles of Chemical Engineering	90 Hrs(3Hrs/week)	100	36	3 Hrs
2	Paper-II	IC-502	Environmental Chemistry and Industrial Management	90Hrs(3Hrs/week)	100	36	3 Hrs
3	Paper- III	IC-503	Chemical Process Industries	90 Hrs(3Hrs/week)	100	36	3 Hrs
4	Paper- IV	IC-504	Technology of Petrochemicals, Polymers & Plastics	90 Hrs(3Hrs/week)	100	36	3 Hrs
5	Paper- V	IC-505	Chemistry of Drugs and Dyes	90 Hrs(3Hrs/week)	100	36	3 Hrs
6	-	IC-506	Practical	18 Hrs./Week	200	72	14 Hrs
7	-	IC-507	Project work	-	100	36	-

Total Marks: 800

G. Total Marks = 700+800 = 1500

M.Sc. (Final) - Industrial Chemistry-2013

Paper - I - IC - 501 : Principles of Chemical Engineering

Time : 3 Hrs.

Max. Marks : 100

Note : This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit -1 : Unit Operation and Unit Process

- (a) Basic concept of unit operations and unit processes.
- (b) Application of thermodynamics in unit process, Combustion reaction, Theoretical air, excess air, air- fuel ratio, Analysis of products of combustion, Internal energy and Enthalpy of reaction, Heating value of fuels, Enthalpy of formation, Adiabatic flame temperature, Entropy changes for reaction mixture.

Unit - 2 : Chemical Process

Kinetics, Types of chemical reactions, Catalytic rate equations, Adsorption equations, Factors affecting a chemical process, Reactor shape and effect of back mixing on products distribution, Selection and sizing of homogeneous and heterogeneous catalytic reactor.

Unit - 3 : Heat Transfer

Basic concept of heat transfer. The nature of Heat flow, relation of heat flow to thermodynamics, modes of heat transfer in homogeneous body - conduction, convection and radiation. Thermal resistance and overall heat transfer coefficients. Heat exchangers: introduction, classification, common problems in Heat transfer design.

Unit - 4 : Separation Process and Mass Transfer

- (a) Separation process - Characteristic of separation process, Phase equilibrium, Separation of two and three components, Separation factors, Selection of separation process.
- (b) Mass Transfer - Different modes of mass transfer, Concentration, Transport properties and fluxes, Ficks law of diffusion.

Unit - 5 : Flow Sheet and Flow Diagram

Flow sheet preparation and elements of process, Flow diagram symbol, Abbreviations and rules for flow sheet preparation of following unit process.

- (i) Alkylation (ii) Halogenation (iii) Nitration (iv) Sulphonation (v) Oxidation.

Reference Books

- 1 Principles of Industrial chemistry : Clausen, Mausiten - J. Wiley. Inter Science.
- 2 Unit operations : Alan Shiver foust - CBS Pub.
- 3 Unit Operations of Chemical Engineering : Warren - McGraw Hill.
- 4 Heat transfer: Martin Beaker - Plenum
- 5 Unit process in organic synthesis: P.H. Grog gins - TMH
- 6 Introduction to chemical Engineering : Budger, Bancharo - McGraw Hill
- 7 Unit operation of chemical Engineering: Mecabe, Smith, Parriot - McGraw Hill
- 8 Mass Transfer operation : Treybal - McGraw Hill.
- 9 Fundamentals of Engineering Heat and Mass transfers.
- 10 Chemical process principle vol I : Hodgen.
- 11 Basic Principle and calculations in Chemical. Engineering : D.N. Bhamn - Prentic Hall Co.
- 12 Elementary Principles of Chemical Process : Rich Ronald, W. Rousscau - John Wiley & Sons.

Paper - II - IC - 502 : Environmental Chemistry and Industrial Management.

Time : 3 Hrs.

Max. Marks : 100

Note : This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit - 1 : Environmental Chemistry

(a) Aquatic Pollution : Inorganic, Organic pesticides, Agricultural, Industrial and Sewage, Detergents and Oil pollutants. Water quality parameters - Dissolved oxygen, Biochemical oxygen demand, Chemical oxygen demand, Analytical methods for measuring DO, BOD and COD, Heavy metals, Purification and treatment of water.

(b) Air Pollution - Chemical and photochemical reactions in atmosphere, Smog formation, Oxides of N, C, S, and O (O₃) and their effect, Analytical methods for measuring air pollutants.

Unit - 2 : Industrial waste

Problem and Prevention, Introduction, Some problem caused by industrial waste, Sources of waste from chemical industries, Waste minimization techniques, Team approach to waste minimization, Minimizing waste from existing process, On site treatment, Physical and chemical treatment and biotreatment plants

Design for degradation, Degradation and surfactants, DDT, Polymer, Some rules for degradation, Polymer recycling, Separation and sorting, Incineration, Mechanical recycling, Chemical recycling to monomers.

Unit - 3 : Environmental Protection

Sources and control of pollution in chemical industries like Fertilizers, Petroleum refineries and Petrochemical units, Dyes and Pharmaceutical units, Paints, Oil and detergent, Sampling and analysis of pollutants, Environmental protection, Environmental audit, Indian standards and Legislation.

Unit - 4 : Industrial Management and Quality control

(a) Basic concept of management, Management and administration,

(b) Function of management - Planning, Organizing, Directing, Control, Decision making, Budgeting,

(c) Inventory management and quality control-Meaning and importance of Inventory management, Inventory models, Economic control, Quantity models, Meaning and importance of quality control, Steps to improve quality with reference to ISO and TQM.

Unit - 5 : Safety

General occupational safety, Flammable material handling and fire fitting equipments, Control measures for toxic chemicals, Safety with chemical engineering operations, Hazardous chemical process, Industrial hygiene, Safety in laboratories and pilot plants, Safety in transportation and storage of chemicals.

Reference Books

1. Environmental chemistry : Colin Baird - W.H. Freeman
2. Environmental pollution : H.N. Dix - J.W & Sons
3. Pollution control in process industries : S.P. Mahajan - Tata Mc Graw Hill
4. Chemistry for environment Engineering : C.N. Swayer and PL Mccarty - Mc Graw Hill.
5. Standard methods of chemical analysis vol. 2 part B : Welcher
6. Principle and Practice of management : V.S.P. Rao and S.P. Narayan-Conarc Publication.
7. Hand Book of Industrial Management : K. Grantireson.
8. Business organisation and management : Y.K. Bhusan - S. Chand & Sons.
9. Pilot plant models and scale up methods in chemical engineering: R.E.Johnstone & Thring - MGH
10. Safe Handling of chemicals in industries vol 1 & 2 : Carson and Mumford.

Paper - III - IC - 503 : Chemical Process Industries

Time : 3 Hrs.

Max. Marks : 100

Note : This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit -1 : Glass and Ceramics Industries

Glass manufacture and different types of glasses, Manufacture of fused, silica, safety and optical glasses, Glass fibers. Manufacture of ceramics and refractories, Super refractories, Insulating and pure oxide refractories, Modern ceramics, White wares and porcelain.

Unit - 2 : Mineral based Chemical Industries

(a) Cement industries - Types of cement, Manufacture of Portland cement, Composition, setting and hardening of cement, mortars and concrete, Gypsum, Plaster of Paris, Estimation of Silica, Alumina, Calcium oxide and Soleplate in Portland cement.

(b) Silicates and mineral resources - Feldspar, Asbestos, Mica, Talc, Pyrophyllite and Steatite.

Unit - 3 : Pulp and Paper, Soap and Detergent Industry

(a) Pulp and paper industry - Manufacture of Pulp, Raw material for pulp industry, Classification and properties of fibrous raw materials, Fiber morphology and chemical composition of wood and grass species, Preparation of raw material for pulping, General principles of mechanical and chemical (acid, neutral and alkaline) pulping processes, Pulp bleaching, Bleaching sequence. Stock preparation, Paper making and coating, Dissolving grade pulps, Special papers, Paper grades.

(b) Soap and Synthetic Detergents - Manufacture of soap, Liquid soaps, Manufacture of detergent, Type of detergents, Analysis of anionic, cationic, nonionic and amphoteric detergents.

Unit - 4 : Agro Chemical Industries

(a) Fertilizers - Primary, secondary and micronutrient elements. Important nitrogenous, phosphorous and potassium fertilizers (Urea, Calcium ammonium nitrate, Ammonium sulphate, Single super phosphate (SSP), Triple super phosphate (TSP), Murit of Potash), Phosphatic mixed compound and other fertilizers (NPK, UAP, DAP) Biofertilizers.

(b) Pesticides - Introduction to insecticides, fungicides and herbicides, Chlorinated derivatives of organic acids, Organo phosphates and inorganic pesticides, Analysis of pesticides, insecticides and herbicides.

Unit - 5 : Lubricants and Synthetic Perfumes.

(a) Lubricants : Properties and classification of Lubricants, Viscosity index, Cloud and pour points, Flash and fire points, Aniline point Value, Iodine and saponification value, Neutralization number, Lubricating greases, Emulsification, Selection of lubricants.

(b) Synthetic perfumes :- Introduction of perfumes, Ingredients of perfumes, Structures of the following synthetic perfumes, Lorealdehyde, Phenyl saldehyde, Anisaldehyde, Acetone, Cyclopenta decanone, Ionones Carbones, Lactones.

Reference Books

1. A text book of chemical technology vol.1, 2 and 5 : S.D. Shukla and G.N. Pandey.
2. Ullman's Encyclopedia of industrial chemistry.
3. Industrial organic chemistry : K. Weissmehl and H.J. Arpe.
4. Chemical Technology part - 2 : Venkateswarulu
5. Out lines of chemical Technology : Dryden
6. Chemical process industries : Shrives.
7. Industrial Chemistry : B.K. Sharma.

Paper IV : 1C - 504 : Technology of Petrochemicals, Polymers & Plastics

Time : 3 Hrs.

Max. Marks : 100

Note : This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit -1 : Petrochemicals

Building block for Petrochemicals, Their separation and purification, Manufacturing process of aromatics and naphthenes.

Unit - 2 : Production of Synthetic Gas Acetylene, Butylene, Acetone, Phenol, Isopropanol, Carbon black, Hydrogen oxoprocess, Ziegler Natta catalysis, Fischer Tropsch process, Petrochemicals in India.

Unit - 3 : Polymer and Polymerization

Addition, Condensation and copolymerization, Ring opening polymerization, Stereoselective polymerization, Electrochemical polymerization, Solid state polymer and kinetic length.

Unit - 4 : Manufacturing of Important Polymers

Polyolefins, Vinyls, Acrylics, Polyamides, Polyesters, Polyurethanes, Polycarbamates.

Synthetic Resin

Alkyds, Phenolics, Amino, Epoxy, Fluoroepoxy, Silicones, Freons, Fluorocarbons, and unsaturated polyesters.

Unit - 5 : Plastics

Introduction, Identification of plastics, thermoplastic and thermosetting materials, techniques of processing of plastics, applications, recycling of plastics.

Reference Books

1. Advanced in petroleum chemistry and refining vol. 3 and 4 : Interscience publication.
2. Fundamental of petroleum chemical Technology : P. Belvov - Mir publication.
3. Chemicals from petroleum : Wardms - ELBS
4. Chemistry and technology of basic organic and petro chemical synthesis : Libed - Mir Pub.
5. Polymer technology : Niles & Priston - Chemical Pub. Com.
6. Plastics ; Dobils, John Nostrand - Reenhold co.
7. Technology and applications of resines : D.G. Soni - SBP New Delhi.
8. Properties of polymers : Van Kneveel - Ven Elseviers.
9. Plastic Materials : J. A. Brydson; Butterworth-Heinemann
10. Plastic Materials Handbook (Vol. I & II, 3rd Edition) A. S. Athalye; Multi-Tech Publishing Co.
11. Polymer Processing Technology : B. R. Gupta; Asian Books Pvt. Ltd.

Paper - V - IC - 505 : Chemistry of Drugs and Dyes

Time : 3 Hrs.

Max. Marks : 100

Note : This paper is divided into five units. Two questions will be set from each unit. The candidates are required to attempt one question from each unit.

Unit - 1 : Drug Design

Rational approach to drug design, Methods of variation, Tailoring of drugs. Factors governing the biological activities of drugs, Physical properties, Dissociation constant, Chemical properties. Drug metabolism, Approaches to drug design, Concept of Isosterism and bioisosterism.

Unit - 2 : Chemistry of the following Classes of Chemotherapeutic Agents - I

- (i) Antipyretics and analgesics - Salol (Asprin), Cinchophen, Aminopyrine, Livorphanol, Pethidine, Ibuprofen, Paracetamol, Novalgin.
- (ii) Anaesthetics - Local and general anaesthetics and their mode of action, Procaine hydrochloride, Cinchocaine, Quinisocaine, Methohexital sodium
- (iii) Antihistamine or antiallergenic drugs : Synthesis of the following drugs - Diphenyldramin (Benadryl), Antazoline, Chlorphenamine, Pyrilamine, Promethazine, Phenindramine.

Unit - 3 : Chemistry of the following Class of Chemotherapeutic Agents - II.

- (i) Hypnotics and sedatives - Barbiturates, Phenobarbitone, Nitrazepam, Gluethimide and their mode of action.
- (ii) CNS Stimulants - Caffeine, Ethamivan, Phentermine and their mode of action.
- (iii) Antianxiety drug and Tranquilizers - Diazepam, Metaxalone, Tybamade, Choloropromazine hydrochloride and their mode of action.

Unit - 4 : Anti infective Drugs

- (i) Antivirals - Methisazone, Idozuridine.
- (ii) Anti materials - Chloroquine, Primaquine, Mefloquine, Daraprim (Pyrimethamine), Santoquine and their mode of action.
- (iii) Antituberculosis and antileprotic agents - Isoniazid (INH), Ethionamide, Ethambutol, DDS (Dasone)
- (iv) Anti HIV and Anti Cancer agents

Unit - 5 : Chemistry of Dyes

Introduction, Classification of dyes on the basis of structure and mode of application to the fibre, Colour and chemical constitution of dyes, Synthesis, mode of application to fibre, Colour shades and uses of the following dyes. Congored, Malachite green, Rosaniline, Crystal violet, Indigo.

Reference Books

1. Burger's Medical Chemistry : ME Wolff - John Wiley
2. Principles of medical chemistry : W.O. Foye, Lea and Feblyer - Philadelphia.
3. The organic chemistry of Drugs synthesis : D Lednicar and L.A. Mitscher - John Wiley
4. Medicinal chemistry : A. Kar - Wiley Eastern
5. Introduction to Medicinal chemistry 2nd edition : Graham L. Patrick - Oxford University Press.
6. The chemistry of synthetic dyes vol I to VII : Venkataraman - Academic Press.
7. Chemistry of synthetic dyes and pigments : Lubs.
8. Dyes and their intermediates : L.N. Abrahath
9. Principles of colour technology : Fred W. Billmeyer & Max. Saltzman - John Wiley & Sons
10. Test book of organic Medicinal and Pharmaceutical chemistry (5th edition) : Robert F. Doerge -Philadelphia and Tokyo.

IC - 506 : PRACTICALS

Time : 14 Hrs. In two days

Max. Marks : 200

A. Pollution :

1. Determination of COD, DO, BOD, of water effluent.
2. Determination of temporary, permanent and total hardness of water.
3. Determination of silica in water.
4. Determination of fluoride in water using ion selective electrode.

B. Petrochemicals and Polymers :

1. Proximate analysis of coal.
2. Determination of carbon residue in the given sample of petroleum by Conradson method.
3. Determination of aniline value of a given petroleum sample.
4. Determination of flash point of a given petroleum sample.
5. Determination of acid value of a plastic material
6. Determination of hydroxyl value of a plastic material.
7. Determination of Iodine value of a plastic material.
8. Preparation of Phenol formadehyde and Urea formaldehyde - resin.

C. Agro Chemicals :

1. Determination of nitrogen content in nitrogenous fertilizer.
2. Determination of total phosphorous in a given sample of fertilizer spectrophotometric molybdovanado phosphate method.
3. Determination of total Arsenic in pesticides formulation by Ion exchange method.
4. Detection of contamination of pesticide formulation in water by TLC method.

D. Pharmaceutical / Drugs/Dyes :

1. Determination of saponification value of a given drug (Substance)
2. Determination of percentage of sulphate ash in crude drug.
3. Determination of Tannins in crude drug.
4. To find the sensitivity of a drug by cup plate method.
5. Determination of acid value / chlorine value of a drug.
6. Analysis of Sulphadrag using potentiometric titration.
7. Analysis of dye intermediate containing - NH₂ group by potentiometric titration.

Note: At least four experiments should be performed from each group. Four experiments from different group shall be given in the examination. The marks distribution is as below.

- | | | |
|-----|---|-------|
| (1) | Two experiments of 50 Marks each - 50x2 | = 100 |
| (2) | Two experiments of 25 Marks each - 25x2 | = 50 |
| (3) | VIVA - VOCE | = 30 |
| (4) | Record. | = 20 |

Total = 200

Reference Books :

IC - 507 : Project

Max. Marks : 100 (80 + 20) Seminar (of any topic of syllabus)

Each candidate will have to work on independent project and prepare a report after working in at least one industry / institution. The report shall be typewritten and to be submitted in triplicate.