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 obtained (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 not withstanding 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 morethan 25% marks in order to reach the minimum aggregats 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. (Previous)

S.No.	Paper		Course No.	Course	Total period	Examination		
						M.M.	Min.M	Duration
1	Paper -I	I	C-401	General Chemistry	90 Hrs(3Hrs/week)	100	36	3 Hrs
2	Paper -II	I	C-402	Methods of Chemical Analysis	90 Hrs(3Hrs/week)	100	36	3 Hrs
3	Paper -III	I	C-403	Material Science, Energy technology and Process control	90 Hrs(3Hrs/week)	100	36	3 Hrs
4	Paper -IV	I	C-404	Statistical and computational methods of data Analysis	90 Hrs(3Hrs/week)	100	36	3 Hrs
5	Paper -V	I	C-405	Recent Trends in Chemistry	90 Hrs(3Hrs/weak)	100	36	3 Hrs
6	-	I	C-406	Practical	18 Hrs/ Week	200	72	14Hrs
								Total Marks 700

M.Sc (Previous) - Industrial Chemistry-2013
Paper - I - IC - 401 : General Chemistry

Max. Marks : 100 **Time : 3 Hrs.**

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 : Catalysis

(a) Homogeneous Catalysis - Study of some important homogeneous reactions catalysed by transition metal and their complexes.
- (i) Hydrogenation of unsaturated compounds.
- (ii) Carbonylation reactions - Methanol to acetic acid, Methyl acetate to acetic anhydride, Adipic ester synthesis.
- (iii) Oxidation reactions - Oxidative carbonylation, Palladium catalysed oxidation of ethene, Acryonitrile synthesis, Oxalic acid synthesis.

(b) Heterogeneous catalysis - Study of some important heterogeneous reactions catalysed by transition metals and their compounds.
- (i) Reduction of carbon monoxide. (ii) Hydrogenation of nitro compounds.
- (iii) Synthesis of ammonia.

Unit - 2 : Bio-Inorganic and Bio-Organic

(a) Bio-Inorganic - Metal ions in biology, Molecular mechanism of ion transport across membrane, Ionophores, Photosynthesis, PS-I & PS-II, Nitrogen fixation, Oxygen uptake, Proteins, Cytochromes and Ferrodoxins.

(b) Bio-Organic- Elementary structure and function of biopolymers such as Starch, Cellulose, Protein and Nucleic acid.

Unit - 3 : Metallurgy

Major and minor constituents of ores, Methods of sampling and dissolution of ores, Analysis of Copper, Lead, Zinc, Silver, Iron, Manganese and Tungsten.

Unit - 4 : Reagents in organic synthesis

Use of following reagents in organic synthesis and functional group transformation - Complex metal hydrides, Gilman's reagent, Lithium diisopropylamide (LDA), Dicyclohexyl carbodimide, Trimethyl silyIiodide, Tri-n-butylride, Osmium tetraoxide, DDQ, Selenium oxide, Crown ethers, Merrifield resin, Backer yeast.

Unit - 5 : Stereochemisty, Photochemistry and Pericylic reaction

(i) Stereochemistry - Introduction of configuration and conformation, RS and EZ configuration, Conformation of cyclohexane and its mono and diderivatives.

(ii) Photochemistry - Cis-trans isomerisation, Paterno-Buchi reaction, Norrish type I & II reactions, Photoreduction of ketones, Photochemistry of 1, 3 - Butadiene.

(iii) Pericyclic reactions - Selection rules and stereochemistry of Electrocyclic reaction, Cycloaddition and Sigmatropic shifts.

Reference Book -

1. Catalytic and Chemical Process : R. Pearce and W.R. Patterson - Leonand Hill.
2. Metal Catalysed oxidation of organic compounds : Sheldon and Kochi - Academic Press.
3. Homogeneous catalysis : G. Parsons - John Wiley
4. Principle and application of homogeneous catalysis : Nakamuna Tsutsui- John Wiley.
5. Introduction to the principle of heterogeneous catalysis : Thomas & Thomas - Academic Press.
6. Bio chemistry : Lehniger - North Publishers.
7. Biosynthesis of Natural products : Bulock - Mc Graw Hill.
8. Bio Inorganic chemistry : A Chemical approach of Enzyme action 2nd edition-Springer verlog.
9. Chemical and instrumental analysis of ores, minerals and ore dressing products : IBM Nagpur
10. Catalysis of Organic reactions : DW Blackburn - Marcel Dekker.
11. Current Topics in Organic Chemistry Vol- 1 : Fieser & Fieser - Reiniold.
12. Advanced Organic chemistry 3rd edition : Jerry March - Wiley Eastern Ltd.
13. Organic Chemistry 6th Edition : Morrison & Boyed - PHI.
14. Stereochemistry Conformation & Mechnism : P. S. Kalsi; New Age International
15. Stereochemistry of Organic Compounds : D. Nasipuri; New Age International
16. Elements of Stereochemistry : E. L. Eliel; Wiley New York
17. Pericylic reaction- Ameta, Sharma, Vardia, Vyas: Sadguru Publications

Paper - II - IC - 402 : Chemical Methods of Analysis

Max. Marks : 100 **Time : 3 Hrs**

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 : Chemical Analysis

Introduction, Application, Stages of chemical analysis, Selecting the method, Special technique, Quantitative analysis, Factors affecting the choice of analytical methods, Data handling, Instrumental and non instrumental methods, Sampling of Gases, Vapours, Liquids and Solids.

Unit - 2 : Separation Methods

(a) Chromatography -Introduction, Principle, Instrumentation and application of GLC, TLC and HPLC.

(b) Ion Exchanger - Introduction, Types and application.

(c) Solvent extraction-Principle, Calculation of number of stages for extraction, Ion association complexes.

Unit - 3 : Electro - Analytical Technique

(a) Principle, Technique and industrial application of (i) Potentiometry (ii) Conductometry (iii) Voltametry.

(b) D.C. Polarography : Principle, Types of current, Experimental technique, Ilkovic equation (no derivation) and application.

Unit - 4 : Molecular Spectroscopy

Introduction, Principle, Technique and industrial application of

(i) UV and visible spectroscopy
(ii) IR spectroscopy
(iii) NMR spectroscopy
(iv) Mass spectrometry

Unit - 5 : Photometry and Thermal Methods

Principle, Instrumentation and application of

(i) Atomic Absorption spectrophotometry
(ii) Flame photometry
(iii) Photoelectron spectroscopy
(iv) Thermogravimetric analysis (TGA)
(v) Derivative Thermogravimetry (DTG)
(vi) Differential Thermal Analysis (DTA)
(vii) Differential Scanning Calorimeter (DSC)

Reference Books

1. Chemical Analysis : Kenneth, Robinson, Harper - Collins.
2. Analytical Chemistry : S Koog & West - Saunders.
3. Separation methods in Analytical chemistry : Harman et al - Wiley Interscience.
4. Solvent extraction in analytical chemistry : Morrison and Freise - John Wiley
5. Ion Exchange separation in analytical chemistry : O Samuelson - John Wiley.
6. Modern Methods of Chemical analysis : Peesock & Shields - John Wiley.
7. Polarographic Technique : L. Mestes - Interscience.
8. Instrumental methods of chemical analysis : Ewing - Mc Graw Hill.
9. Chromatographic system : Walker, Jackson, James, Maynand- Academic Press.
10. Fundamentals of Molecular spectroscopy : G.M. Banwell - M.G. H.
11. Spectroscopy and Molecular Structure : King, Hol, Richart - Winston, NY
12. Thermal analysis : Bernhard Wunderlich
13. Instrumental methods of analysis : Willard Merit and Dean - CBS Pub.
14. Inorganic Thermogravimetric analysis - Dhuval.
15. Quantitative Analytical chemistry : Fritz and Schenk - Allyn & Bacon Inc.

Paper - III - IC - 403 :
Material Science, Energy Tech. & Process Control

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 : Mass and Energy Balance

Complex material balance, Calculation with and without chemical reaction, Recycle, Bypass and purge, Combustion calculations, Energy balance for batch and continuous processes, Reactive and non-reactive processes.

Unit - 2 : Material of construction for Chemical Plants

Metals, Alloys, Cement concrete, Ceramics, Glasses, Refractories, Graphite, Polymeric materials and their Mechanical, Physical, Dimensional and Chemical Properties, Non-Distructive testing, Zeolites, Clays.

Unit - 3 : Corrosion

Introduction, Principle of corrosion, Types of corrosion relevant to chemical industries, Mechanism of electrochemical corrosion, Factor influencing corrosion, Thermodynamic consideration and electrode kinetics, Corrosion testing methods, Prevention methods based on changing properties of materials, Changes in environment and minimizing or stopping the corrosion current.

Unit - 4 : Energy Technology

Properties and utilization of Fuels, Construction and working of furnaces, Thermal insulators, Energy from non conventional sources like Solar, Biogas, Biomass, Wind, Geothermal, Fuel cell, Ocean wave energy, Energy management, Capative power generation, Coal, Liquefactions and gasification, Heat transfer media.

Unit - 5 : Process Control

Process dynamics and responce of simple systems, Modes of control action, Measuring elements, Pneumatic and electric control valves, Transmitting and telematting devices, Feed-back control system, Suitability of control system and suitability of criteria, Controller settings, Advanced control techniques, Cascade controls, Radio control, Adaptive control, Feed-forward control and computer control, Maintenance and caliberation of process control equipments.

Reference Books

(1) Material Science : R.C. Kulkarni & R.S. Sedha - S. Chand.
(2) Material Science and Engineering : V. Raghavan - PHI
(3) Material Science : Narang, Khanna - CBS Pub.
(4) Science of Engineering Materials : C.M. Shrivastav and C Shrivastav.
(5) Basic principles and calculations in chemical Engineering : DH Blan - Prentice Hall
(6) Stoichiometry : H.T. Bhatt & SM Vora - Tata Mc Graw.
(7) Fuel and combustion : S.P. Sharma, Chandramohan - Tata Mc Graw.
(8) Conventional energy technology fuel and chemical energy : S.P. Pandya
(9) Process system analysis and control : Coughanour and Koppe - Mc Graw Hill.
(10) Process Instrument and control : Hand Book - Douglas M Considine.
(11) Fuel, Furnaces and Refractories : J.D. Gilchrist - Pergaman.
(12) Corrosion and corrosion control : H.H. Chling
(13) Corrosion and Oxidation of Metal : U.R. Evance, Edward Arnola.

Paper - IV - IC - 404 :
Statistical and Computational Methods of Data Analysis.

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 : Concept of statistics - Correlation and Regression

Measures of Location, Dispersion, Skewness, Kurtosis, Coefficient of variation, Elementary concept of probability, Coefficient of correlation, Rank correlation, Line of regression, Least square Methods, Fitting of non - linear curves, Multiple and partial correlation (3 variables only), Association of attributes

Unit - 2 : Tests of Significance and Applied Quantitative Methods

Basic idea of hypothesis, Tests based on normal, t and chi square distributions. Time series. Analysis of variance (ANOVA).Basic concepts of Inventory control, Replacement, Reliability and quality control.

Unit - 3 : Basic Programming Concepts

Elements of Programming Languages, Flow Chart, Functions and subroutines, Graphics, Commands, Commands for accessing hardware, Data acquisition, Elements of FORTRAN and C.Windows- Introduction and applications.

Unit - 4 : Report Generation and Presentation

MS Office : Introduction to Word, Excel and Power Point.

M.S. Word : Documentation and manipulation, Saving and printing, Incorporation of Graphs, Tables Pictures and Chemical structures into the documents.

M.S. Excel : Spread sheets, Report generation, Cell manupulation, Data based management, Graphical representation of tabulated data, Pi-chart, Bar and Line graphs, Surface and 3 D graphs.

Power Point : Application of Power Point for the presentation of reports and slides.

Unit - 5 : Computer for Industrial Chemists

(a) Introduction to CAD - A balance approach to computer aided process design.
(b) Computer interfacing with instruments and as laboratory information system.
(c) Computers in fault, true analysis
(d) Computers in Communication
(e) Internet - Basic concepts, Importance in chemical industries, Design and maintenance of a small web site.
(f) E-mail : Basics, methodology and uses.

Reference Books

(1) Fundamentals of Statistics : Elhane P.N.
(2) Elements of Practical Statistics : Kapoor. S.K.
(3) The Big Basic Book of Window 98 : Kraynak - PHI.
(4) Computational Chemistry : A.C. Norris.
(5) Programming in basic problems solving with the true and style : Stewant M. - Venit Jaico.
(6) Mastering Windows Special edition : Robert Cowart - BPB Publications.
(7) Computer Fundamental Architecture Organisation : B.Ram - New Age international.
(8) Computers in chemistry : K.V. Raman - TMH Pub.
(9) Computer Primer : D. Raja Raman and V. Raja Raman - Prentice Hall.

Paper - V - IC - 405 : Recent Trends in Chemistry

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

A. Principles and Concepts of Green Chemistry : Introduction.

(a) Atom economic reactions - Rearrangement reactions, Addition reactions.
(b) Atom un-economic reactions - Substitutions reactions, Elimination reactions, Witting reaction
(c) Reducing toxicity - Measuring toxicity.

B. Aqueous Phase Reactions

Introduction, Any two examples of : Diel's Alder reaction, Claisen rearrangement, Witting - Horner reaction, Michael reaction, Aldol condensation, Knoevenagel reaction, Pinacol coupling, Benzoin condensation, Claisen-Schmidt condensation, Worth reaction.

Unit - 2 :

Synthesis involving basic principle of Green Chemistry - Some examples.

Introduction, Synthesis of Styrene, Adipic acid, Catechol, Methyl methacrylate, Urethane, Aromatic amine, Selective alkylation of active methylene group, Free radical bromination, Synthesis of Acetaldehyde, Furfural from biomass, Synthesis of s-metalochlore (herbicide), Ibuprofane, Paracetamol, Green synthesis of 3- phenyl catechol, Epoxy styrene, Nicotinic acid.

Unit - 3

A. Catalysis in Green Chemistry

Introduction, Heterogeneous catalysis, Homogeneous catalysis, Greener Lewis acids, Phase transfer catalysis, Oxidation using hydrogen peroxide, Biocatalysis, Photocatalysis.

B. Green Technology and Alternate Energy Source

(a) Photochemical reactions
(b) Microwave assisted reactions.
(c) Sono chemistry.
(d) Electro-chemical synthesis.

Unit-4

Nano Technology

Nano Materials : Introduction, Definition and terminology, consequences of the nanoscale (Nanoparticle, Morphology, Geometric structure, Electronic structure, Optical properties), Nanolayers, Carbon nanotubes, Nanowires, Quantum dots.

Unit - 5

Supra Molecular Chemistry

Introduction, Cryptands, Cyclophanes, Crown ether, Calixerenes, Cyclodextrines, Molecular self assembly: Catenens and Rotaxenes, Supramolecular reactivity and catalysis, Supramolecular devices

Reference Books

(1) Green Chemistry and introduction text : M-Lancoster - Royal Society of Chemical Comp.
(2) Phase transfer catalysts : Charles M. Strurbs, Charles Liottan - Academic press.
(3) Unit Process in organic synthesis - Groggins - T.M.H.
(4) Homogenous catalysis : M.M. Taqvi Khan, A E Matel Vol I and II
(5) Organic Chemistry : Finar
(6) Reagents for organic synthesis : Fieser & Fieser.
(7) Chemistry and technology of basis Organic and Petrochemical synthesis : N.M. Labedev Vol I & II
(8) Introduction to the principle of heterogeneous catalysis : J.M. Thomas, W.J. Thomas- Academic Press.
(9) Introduction to Nanotechnology : Charles P. Poole, Frank J. Owens; Wiley India Edition
(10) Nanotechnology : Mark Ratner, Daniel Ratner; Pearson Education
(11) Supramolecular Chemistry : Nonathan W. Steed, Jerry L. Atwood; John Wiley & Sons

IC - 406 : PRACTICALS

Max. Marks : 200 **Time : 14 Hrs. in two days**

A. Analysis of mineral, Ores and alloys

(1) Analysis of Ores such as Hematite, Dolomite, Lime stone, Bauxite for their major constituents.

(2) Determination of the content of CaO, MgO, Fe_2O_3, Al_2O_3 and Silica in the supplied mixture.

(3) Determination of Manganese in Steel.

(4) Determination of Iron in Brass.

(5) Spectrophotometer analysis of Rock phosphate.

(6) Determination of total solid and organic carbon in given soil sample.

(7) Complete analysis of Portland cement.

(8) Complete analysis of marble.

B. Instrumental Methods of Analysis -

(1) Separation of cations in mineral water.

(2) Determination of Mg and Ca in tap water by AAS.

(3) Flame photometric determination of Na^+ and K^+.

(4) Polar graphic determination of Cd^{+2} and Zn^{+2} in a mixture.

(5) Separation of organic compounds using paper chromatography and thin layer chromatography technique.

(6) Determination of Caffeine in Beverages by HPLC.

(7) Separation and quantitative analysis of sugar and alcohal in foods by GC.

(8) Determination of Ethanol content of alcoholic liquer by NMR.

C. Organic Synthesis -

Preparation of following Organic compounds involving not more than two steps.

(1) m - Nitroaniline from nitrobenzene.

(2) p - Nitroaniline from acetanilide

(3) p - Acetophenone from resorcinol.

(4) Acid orange - II from sulphanilice acid.

(5) p - Bromo aniline from acetanilide.

(6) Green synthesis of chalcones.

(7) Microwave synthesis of Indole/pyrazole

D. Dry work - Computer Experiment.

(1) Programming in Computer.

(2) Designing Valence bond application.

(3) Hand Practice in MS-Office, Word, Excel, Power point.

(4) Hand Practice in CAD and use of internet.

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