

**SYLLABUS
OF
M.Sc. ICA**

(2011-2013)

***DEPARTMENT OF ENVIRONMENTAL CHEMISTRY
JIWAJI UNIVERSITY
GWALIOR***

STRUCTURE OF CURRICULUM

M.Sc. Instrumentation & Commercial Methods of Industrial Analysis

| Code No. | Paper | Exam | Int.Asses. | Total |
|------------------------|--|------|------------|-------|
| First Semester | | | | |
| ICA-101 | Fundamentals of Quantitative Analysis and Separation Methods | 35 | 15 | 50 |
| ICA-102 | Stereo-chemistry & Thermo-analytical Methods | 35 | 15 | 50 |
| ICA -103 | Spectro-analytical Methods of Analysis – I | 35 | 15 | 50 |
| ICA -104 | Electro-analytical Methods of Analysis | 35 | 15 | 50 |
| ICA -105 | Practical-I | | | 50 |
| ICA-106 | Practical-II | | | 50 |
| | Total | | | 300 |
| Second Semester | | | | |
| ICA-201 | Environmental and Pollution Control | 35 | 15 | 50 |
| ICA-202 | Spectro-analytical Methods of Analysis– II | 35 | 15 | 50 |
| ICA-203 | Computer in Chemical Analysis | 35 | 15 | 50 |
| ICA-204 | Elementary Electronics in Chemical Instrumentation | 35 | 15 | 50 |
| ICA-205 | Practical-I | | | 50 |
| ICA-206 | Practical-II | | | 50 |
| | Total | | | 300 |
| Third Semester | | | | |
| ICA-301 | Industrial Analysis - I | 35 | 15 | 50 |
| ICA-302 | Total Quality Management & ISO 9000 | 35 | 15 | 50 |
| ICA-303 | Industrial Analysis - II | 35 | 15 | 50 |
| ICA-304 | Advanced Instrumental Methods of Chemical Analysis | 35 | 15 | 50 |
| ICA-305 | Practical-I | | | 50 |
| ICA-306 | Practical-II | | | 50 |
| | Total | | | 300 |
| Fourth Semester | | | | |
| ICA-401 | Industrial Analysis - III | 35 | 15 | 50 |
| ICA-402 | Concepts of Industrial Management and Intellectual Property Rights | 35 | 15 | 50 |
| ICA – 403-406 | 12 to 16 Weeks Industrial Training, Report and Viva-voce | | | 200 |
| | Total | | | 300 |

SYLLABUS OF M.SC. INSTRUMENTATION & COMMERCIAL METHODS OF INDUSTRIAL ANALYSIS (2011-2013)

First Semester

M.M.: 35

ICA-101: Fundamentals of Quantitative Analysis and Separation Methods

Unit-I: Concepts involved in Analysis

Role of analytical chemistry, classification of analytical methods-classical and instrumental, types of instrumental analysis, selecting analysis method, neatness and cleanliness, laboratory operations and practices, good laboratory practices, techniques of weighing, errors, volumetric glassware-cleaning and calibration of glassware, sample preparation – dissolution and decompositions, selecting and handling reagents, laboratory notebooks, safety in the analytical laboratory, calibration and detection limits, proficiency testing.

Unit-II: Titrimetric and Gravimetric Methods of Analysis

General principles: Solvents in analytical chemistry, acid-base equilibria, concentration systems, stoichiometric calculation, acid-base titration, titration curves, acid base indicators, applications of acid-base titration, complexometric titration, metal-ion indicators, precipitation titration, Mohr's titration, Volhard's titration, adsorption indicators, Fajan's titration, titration curves in oxidation-reduction titration, redox indicators, applications of redox titrations.

Unit-III: Separation Techniques -I

(A) Solvent Extraction: Fundamental treatment, theoretical principle, classification, and factors favouring extraction, extraction equilibria, applications.

(B) Solid phase extraction and solid phase micro extraction, applications.

(C) Ion- Exchange: Theories, use of synthetic ion exchange in separation, chelating ion exchange resins, liquid ion exchangers, experimental technique.

Unit-IV: Separation Techniques -II

An introduction to chromatographic methods, paper, thin layer and column chromatography, theory of chromatography, classification of chromatographic techniques, retention time, relationship between retention time and partition coefficient, the rate of solute migration, differential migration rates, band broadening & column efficiency, kinetic variables affecting band broadening, Electrophoresis and capillary electrophoresis.

Unit-V: GC and HPLC

Instrumentation of GC and HPLC, applications in qualitative and quantitative analysis, comparison of GC and HPLC, Ion chromatography, pyrolytic gas chromatography, size exclusion chromatography, super critical fluid chromatography, affinity chromatography.

Books Recommended

1. D.A. Skoog, F.J. Holler and T.A. Nieman, Principles of Instrumental Methods, 5th ed., Thomson Asia Pvt. Ltd., Singapore (2003).
2. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt. Ltd (1993).
- 3 G.D. Christian, Analytical Chemistry, 6th ed, John Wiley & Sons (2001).
4. S.M. Khopker, Environmental Pollution Analysis, 2nd ed., New Age International Pvt. Ltd.(2002).
- 5 A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Longman Singapore (1999) ¹
- 6 G. W. Eving, Instrumental Methods of Chemical Analysis, 5th ed.,Mc-Graw Hill Book Company (1985)
7. Willard, Merritt, Dean, and Settle, Instrumental Methods of Analysis, 7th ed., C B S Publishers & Distributors (1986).

Unit-I: Stereochemistry-I

(a) Conformational analysis: Conformation of n-butane and cyclohexane, stability of conformers and energy profile diagram.

(b) Optical activity: Criteria for optical activity, stereoisomers, enantiomers and diastereomers, erythro and threo isomers, a general idea of symmetry elements.

Unit-II: Stereochemistry-II

(a) Racemic Modifications: Conglomerate, racemate and racemic solid solutions, a general idea of stereo selective synthesis.

(b) Resolution of Racemic modifications: by Chemical separation, chromatography, preferential crystallization and asymmetric transformation (a brief idea only).

Unit-III: Statistical Treatment of Data

Types of errors, accuracy and precision, rounding off, significant figures, normal distribution of errors, statistical treatment of finite samples (mean, median, range & average deviation), t-test, confidence interval of the mean, standard error of a mean, test of significance, comparison of two means, F-test, rejection of data, Q-test, bivariate data, Quality control charts, relationship between variables, correlation & regression, principle of least squares. Standardization of analytical methods.

Unit-IV: Thermo-analytical Methods

Thermogravimetry, factors affecting thermogravimetric curves, derivative thermogravimetry (DTG), thermobalances, applications of thermogravimetry, differential thermal analysis, factors affecting DTA curve, instrumentation, applications of DTA.

Differential scanning calorimetry, theory, instrumentation, applications of DSC, thermometric titration, principle, classification, instrumentation and applications of thermometric titration.

Unit-V: Principles of Gravimetric Analysis

Stoichiometry of gravimetric reactions, formation and properties of precipitates, precipitation from homogeneous solution, nucleation, organic precipitations, applications of gravimetric analysis.

Books Recommended

1. D.A. Skoog, F.J. Holler and Nieman, Principles of Instrumental Methods, 5th ed., Thomson Asia Pvt. Ltd., Singapore (2003).
2. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt. Ltd. (1993).
3. G.D. Christian., Analytical Chemistry, 6th ed, John Wiley & Sons (2000)
4. A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Longman Singapore Ltd. (1999)
5. G. W. Eving, Instrumental Methods of Chemical Analysis, 5th ed., Mc-Graw Hill Book Company (1985)
6. Ernest L. Eliel and Samuel H. Wilen, Stereochemistry of Organic Compounds, John Wiley & Sons (2003).

Unit-I: Colorimetry and Spectrophotometry

An introduction to spectrophotometric methods, a brief idea of wave properties of electromagnetic radiation, theory of spectrophotometry and colorimetry, limitations of Beer's Law, classification of methods of colour measurement, instrumentation single beam and double beam, photometric error, applications of spectrophotometry to inorganic and organic compounds (quantitative calculations), near IR spectrophotometry, spectrophotometric titration.

Unit-II: Other Spectro-analytical techniques

(A) Introduction, general principle, instruments for nephelometry and turbidimetry, applications of nephelometry and turbidimetry to analytical chemistry.

(B) Dispersion Refractometry and Flame photometry

(C) Polarometry, circular dichroism (CD) and optical rotatory dispersion (ORD).

Unit-III: Emission Spectroscopy

Elementary idea of emission spectroscopy, introduction, elementary theory, instrumentation, types of flames, interferences, factors affecting flame photometry, applications to qualitative and quantitative analysis, limitations.

Unit-IV: Fluorescence and Phosphorescence Spectrophotometry

Theory of fluorescence and phosphorescence, quantum yield, factors affecting fluorescence and phosphorescence, relation between concentration and intensity, instrumentation, applications, an elementary idea of chemiluminescence.

Unit-V: Kinetic of Slow and Fast reactions (An elementary study keeping in view its applications in analytical chemistry)

(A) Rates of chemical reaction, expression for reaction rate, rate constants, order of reaction, methods for determination of order of reaction, Arrhenius equation, Collision theory, failure of collision theory, Absolute reaction rate theory, unimolecular reactions, mathematical formulation of Lindemann's theory, catalysed reactions, Theory of homogenous catalysed reactions, kinetics of enzyme catalysed reactions, elementary idea of micellar catalysis.

(B) Study of fast reactions by stopped flow method, relaxation methods, flash photolysis method, photochemical reactions, kinetics of photochemical combination of hydrogen and chlorine, branched chain reactions, oscillatory reactions, applications of kinetic methods in finding out optimum conditions for different reactions

Books Recommended

1. John. R. Dyer, Applications of Absorption Spectroscopy of Organic compounds, 9th ed.. Prentice Hall of India Pvt. Ltd. (1994).
2. Dudley H. Williams and Ian Fleming, Spectroscopic Methods in Organic Chemistry, 4th ed., Tata Mc-Graw Hill Book Company (1998).
3. R.M. Silverstein, G. Clayton Bassler and Terence C. Morrill, Spectroscopic Identification of Organic compounds, 6th ed, John Wiley & Sons (1998).
4. D.A. Skoog, F.J. Holler and Nieman, Principles of Instrumental Methods, 5th ed., Thomson Asia Pvt. Ltd., Singapore (2003).
5. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt. Ltd. (1993).
6. G.D. Christian., Analytical Chemistry, 6th ed, John Wiley & Sons (2000)
7. A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Longman Singapore (1999) ____ **Syllabus M.Sc. ICA..... (2011-2013)**

Unit-I: Fundamentals

Electrochemical cells, solution structure, potential in electroanalytical cells, Nernst equation, electrode potential the ideal polarized and non-polarized electrodes, faradiac reaction, variables in electrochemical cells, factors affecting electrode reaction rate and current, decomposition potential, back potential and voltage.

Unit-II: Potentiometry

Introduction, reference electrodes, indicator electrodes, ion-selective electrodes and their applications in chemical analysis, instrumentation and measurement of cell unit, direct potentiometry, potentiometric titration, applications.

Unit-III: Polarography

Direct current polarography, basic principle, instrumentation, advantages and disadvantages of dropping mercury electrode, different kinds of limiting currents, components of polarographic waves, reversible and irreversible waves, pulse and A.C. polarography, applications of polarography to inorganic and organic compounds, elementary idea of stripping voltammetry, amperometric titrations.

Unit-IV: Conductometry and Coulometry

Conductometry as an analytical tool, applications of direct conductometric measurements, basis of conductometric titrations, applications of conductometry titration, constant current and controlled potential electro-gravimetry, separation of metals, coulometry at controlled potential, coulometry at constant current, applications.

Unit-V: Voltammetry

AC polarography, current sampled (TAST) polarography, normal pulse and differential pulse polarography, stripping voltammetry, linear sweep and cyclic voltammetry, chonopotentiometry, chronoamperometry.

Books Recommended

1. Allen J. Bard and Larry R. Faulkner, Electro-chemical Methods, 2nd ed., John Wiley & Sons (2001).
2. G.D. Christian, Analytical Chemistry, 6th ed, John Wiley & Sons (2001).
3. A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Long man Singapore Ltd. (1999)
4. Galen W. Eving, Instrumental Methods of Chemical Analysis, 5th ed., Mc-Graw Hill Book company (1985).
5. Willard, Merritt, Dean, and Settle, Instrumental Methods of Analysis, 7th ed., C B S Publishers & Distributors (1986).

Second Semester

ICA -201: Environmental and Pollution Control

M.M.: 35

Unit-I: Air Pollution

Atmospheric pollution, classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols, sampling of gaseous pollutants, analysis of SO_x, NO_x, CO-CO₂, hydrocarbons, effects of air pollutants on animals, ozone layer, chlorofluorocarbons, acid rain, green house effect.

Unit-II: Water Pollution

Sampling and preservation of water, physical examination of water-colour, alkalinity, TDS, conductivity, temperature, odour, turbidity, hardness, chemical examination of water-determination of carbonates and bicarbonates, sulphate, chloride and fluoride, nitrite and nitrate, iron, manganese, silica, cadmium, arsenic, chromium, lead, mercury, biological examination of water-dissolved oxygen, BOD, COD, MPN. Organic pollutant analysis-phenols and detergents.

Unit-III: Water treatment

Quality of water, standards of raw and treated water, objectives of waste water treatment, A brief idea of sedimentation, coagulation and flocculation, filtration, disinfection of water, activated sludge process, trickling filters, sludge treatment and disposal.

Unit-IV: Softening of water, corrosion and its control, removal of nitrogen and phosphorus. Removal of toxic compounds and refractory organics, removal of dissolved inorganic substances, Reverse osmosis.

Unit-V: (A) Soil Pollution

A brief idea of chemistry of soil. Trace element analysis in soil-B, Cd, Cu, Fe, Mn, Mo, Zn, Pb, Pesticides and pollution, classification and degradation of pesticides, methods of pesticides analysis.

(B) Noise Pollution

Sources, measurement, effects and control.

Books Recommended

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 3rd ed. Prentice Hall of India Pvt. Ltd.(1998)
2. C.S.Rao, Environmental Pollution Control Engineering, 3rd ed., Wiley Eastern Ltd. New Age International Pvt.Ltd. (1995).
3. Metcalf & Eddy, Waste Water Engineering, Tata McGraw Hill, New Delhi (2003).
4. C.Harold Wright, A Hand book of Soil Analysis, 4th ed., Logas press New Delhi –
5. Thomous S. Spiro and William M. Stiglicini, Chemistry of the Environment, Prentice Hall of India Pvt. Ltd. (2002).
6. Nicholas P. Cherimisinoff, Biotechnology for Waste and wastewater treatment, Prentice Hall of India Pvt. Ltd. (2001).
7. Jarry A. Nathanson, Basic Environmental Technology, 4th ed., Prentice Hall of India Pvt. Ltd. (2003).
8. Raymond W. Miller and Roy L. Donalvee, Soil in Our Environment, 7th ed, Prentice Hall of India Pvt. Ltd. (1997).
9. Nylie C. Brady, The Nature and Properties of Soil, 10th ed., Prentice Hall of India Pvt. Ltd. (1996).

Unit-I: Atomic Absorption and Emission Spectroscopy.

Theory of atomic spectroscopy, the origin of spectral transition, the populations of energy levels, the factors influencing spectral width, atomic absorption spectroscopy, instrumentation, interferences, applications, various non-flame emission sources, applications, comparison of atomic emission and atomic absorption methods.

Unit-II: Infrared Spectroscopy

Theory of Infrared absorption, vibrational modes, vibrational coupling, instrumentation, dispersive and non-dispersive instrument, qualitative applications and interpretation of spectra, quantitative applications. A brief idea of Raman spectroscopy.

Unit-III: Nuclear Magnetic Resonance Spectroscopy

Theory of NMR, chemical shift and spin-spin splitting, relaxation process of saturation, environmental effects on NMR spectra, instrumentation, CW or FT NMR instrument, Rules governing the interpretation of first order spectra, applications to quantitative analysis.

Unit-IV: Carbon-13 NMR

Historical development, proton decoupling-broad band, Off-resonance and pulsed or gated decoupling, nuclear overhauser enhancement, polarization transfer experiments-DEPT and INEPT chemical shifts, spin-spin coupling impacts, application of ^{13}C NMR to structure determination, two-dimensional NMR spectroscopy, principle, the COSY experiment, the COSY experiment with double quantum filter (COSY-DQF), the NOESY experiment, three-dimensional NMR experiment.

Unit-V: Mass Spectrometry

Theory of mass spectrometry, practical considerations, ion production, depletion of ions, ion detector, calibration, other ionization techniques: chemical ionization, fast atom bombardment (FAB), and electrospray, interpretation of the mass spectrum of the compound, applications of mass spectrometry.

Books Recommended

1. John. R. Dyer, Applications of Absorption Spectroscopy of Organic compounds, 9th ed., Prantice Hall of India Pvt. Ltd. (1994).
2. Dudley H. Williams and Ian Fleming, Spectroscopic Methods in Organic chemistry, 4th ed., Tata Mc-Graw Hill Book company (1998).
3. R.M. Silverstein, G. Clayton Bassler, and Terence C. Morrill, Spectroscopic Identification of Organic Compounds, 6th ed., John Wiley & Sons (1998).
4. C.N. Ban well, Fundamentals of Molecular Spectroscopy, Tata Mc-Graw Hill Book company (1998).
5. Manas Chanda, Atomic Structure and Chemical Bond, Tata Mc-Graw Hill Book company (1998).

Unit-I: Fundamentals of Computers

An introduction, uses of computer in modern society, computer generation, classification of computers, block diagram of computer, components of computer, hardware & software of computer, input and output devices, memory (storage)- primary and secondary, exposure to number system: binary, octal, decimal, hexadecimal, conversion of numbers, A brief idea of the role of computer and microprocessors in analytical chemistry.

Unit-II: Operating Systems

Introducing operating System - Definition and functions, microsoft disk operating system (MS-DOS) internal and external commands, brief introduction to WINDOWS and UNIX. Protecting software and computer-related innovations.

Unit-III: Ms Office (MS - Word 97 and MS Excel 97)

MS Word 97: Introduction, components of screen, opening a file, typing, editing, copying, moving, inserting and saving the document, formatting features for font and characters, others features - page breaks, page set up, borders and shading, preview and printing of documents. Creating tables and columns in MS- Word 97.

MS Excel 97: Introduction to worksheets and charts, components of a worksheet, opening a new worksheet, working with a worksheet, saving, printing, editing and formatting of worksheet. Creating, modifying, saving and printing a chart in MS-Excel 97.

Unit-IV: Introduction to 'C'

Low level and high level languages, programming languages, getting started with 'C', programme structure in 'C', exposure to input/output, variables, constants, operators and control statements if, Else.....if, while, for, do.....while and switches.

Unit-V: Instrument and multimedia

Internet: Concept and definition, types of internet connection, modem.

E-mail: Introduction, WWW and different browsers

Multimedia: Introduction and application.

Books Recommended

1. Jim Keogh, Solving the Year 2000 problems, A P Professionals (1997).
2. E.Balagurusamy, Programming in Basic, 3rd ed., Tata Mc-Graw Hill Book company (1997).
3. Yashvant P. Kanetkar, Let Us C, 4th ed., B P B Publications (2002).
4. Alexis Leon, Methews Leon, Fundamentals of Information Technology, Leon press Chennai and Vikash Publishing house Pvt. Ltd.(1999).
5. F.W.Fifield and D. Kealey, Principles and practices of analytical chemistry, Blackwell Science, (2004)

ICA -204: Elementary Electronics in Chemical Instrumentation

Unit-I: Fundamentals

M.M.: 35

Idea of potential difference, current, resistance and resistivity, idea of fixed and variable resistors, colour code, Ohm's law, Kirchoff's law, principle of Wheatstone bridge, electrical capacity, parallel plate capacitor, self inductance, mutual inductance, transformer - introduction to its construction. Frequency, time period, phase and average values of alternating currents, motion of charged particle in electric and magnetic fields.

Unit-II: Transducers and Measuring Instruments

Principles of moving coil galvanometer (dead beat type), voltmeter, ammeter and ohmmeter, basic principle of electronic analogue voltmeter, thermocouple, thermister, LED, LCD, photo-conductivity and photo-cell, concept of piezoelectricity, principle of scintillation, basic design of CR tube, photo emission and PMT. Principle of electrical oscillations, Hartley and Colpitts oscillators.

Unit-III: Semiconductor Devices -I

Qualitative ideas about free electron model. Intrinsic and extrinsic semiconductors. Conductivity and mobility and their temperature dependence. P-N junction diode. I-V characteristics and rectification.

Unit-IV: Semiconductor Devices -II

Zener diode and voltage regulation. Bipolar transistor, characteristics, load line and biasing in CE configuration. Current gain and basic CE amplifier, operational amplifier-ideal characteristics. Inverting and non-inverting amplifiers, summing amplifiers, integrator and differentiator.

Unit-V: Few Basic Circuits

Regulated constant voltage and constant current power supply, chopper stabilized DC amplifier, idea of invertors, interfacing a resistive transducer to an electrical circuit, idea of temperature measurement, schematic of a lamp regulator, direct reading spectrophotometer, conductivity meter, pH meter, basic gates, flip-flop, registers and counters.

Books Recommended

1. Albert Paul Malvino, Electronic Principles, 5th ed., Tata Mc-Graw Hill Book Company (1995).
2. R.S. Sedha, A Text Book of Applied Electronics, 1st ed, S.Chand & Company Ltd (1998).
3. B.L. Thareja and A.K. Thareja, A Text Book of Electrical Technology, 1st ed., S.Chand & Company Ltd (1998).
4. R.S. Khandpur, Handbook of Analytical Instruments, 3rd ed., Tata Mc-Graw Hill Book Company (1997)

Third Semester

ICA-301: Industrial Analysis-I

M.M.: 35

Unit – I: Profile of a quality control laboratory for chemical division in pharmaceutical unit, routes of drug administration, structure activity relationship, adverse drug effect, LD₅₀ and ED₅₀ (a brief idea only).

Unit - II: General Chemistry, mode of action and method of analysis of drugs belonging to following classes :

- (a) **Antipyretics & analgesics**: Paracetamol, Aspirin and Ibuprofen
- (b) **Antibiotics**: Ampicillin, Amoxicillin and Cloxacillin
- (c) **Antifungal agents**: Clotrimazole and miconazole

Unit – III: (a) **Sulpha drugs**: Sulphanilamide, Sulphaguanidine and Sulphadiazine

- (b) **Antitubercular drugs**: Isoniazide and Rifampicin
- (c) **Expectorants**: Codeine phosphate and Papaverine hydrochloride

Unit – IV: (a) **Bronchodilators**: Ephedrine, Salbutamol and Theophylline

- (b) **Hypnotics and Sedative**: Phenobarbitone
- (c) **General Anesthetic**: Benzocaine

Unit – V: A brief chemistry and mode of action of following drugs (**method of analysis excluded**)

- (a) **Cardiac glycosides**: Digoxin and Digitoxin
- (b) **Antihypertensive**: Clonidine and Methyldopa
- (c) **Antileprotic drugs**: Dapsone and Clofazimine
- (d) **Anticancer agents**: Alkylating agents only

Books Recommended

1. Foye's principles of medicinal chemistry. David A. Williams, Thomas L. Lemke, Fifth Edition. Lippincott Williams & Wilkins.
2. Essentials of medicinal Pharmacology, K.D.Tripathi, 4th Edition . Jaypee Brothers Medical Publishers Ltd.
3. Medicinal chemistry Vol. I & II. A. Burger, Willey interscience, 1970
4. Pharmacology & Pharmacotherapeutics, Vol. I & II. R.S. Satoskar & S.C. Bhandarkar, Popular Prakashan 1978.
5. A Textbook of medicinal chemistry. P. Parimoo.

Unit - I

Management of quality systems, ISO-9000-An overview, clauses/ requirement of ISO-9000, significance and scope. Steps for ISO- 9000 implementation, series of ISO, case studies of ISO.

Unit - II

Elements of TOM, total employee involvement (TEI), total waste elimination (TWE), total productive maintenance (TPM), total quality control (TQL), cost of quality, cutting the cost of quality, Quality manual.

Unit –III

(A) Kaizen: Concept and implementation, Types of Kaizen vs. Innovation

(B) Quality Circle: Concept, 4-M and 5-S concept, problem solving tools and implementation, case studies.

Unit - IV

Implementation of TOM, management of change (MOC), faces of resistance, approach to TOM, case study of total quality management (changing the company culture), control charts.

Unit – V

Quality assurance and TQM for analytical laboratories, accreditation or certification for laboratories, motivation of the analytical laboratory for TQM, quality in analytical laboratory, method validation: an essential tool in TQM, implementation of quality programmes in multifunctional laboratories , reference materials.

Books Recommended

1. G.Gardon,F.James and I .Mcmanus, Total Quality Management for Software, 1st ed. Comdex Computer Publishing (1998).
2. Dr. Sunil Sharma, TQM in Indian Engineering Industries, 1st ed., Business Publication (1997).
3. Ron Collard, Total Quality Success Through People, 2nd ed., Jaico Publishing House (2002).
4. A.K. Sinha and Pankaj Srivastava, Earth Resources and Environmental Issues.
5. David Hoyle, ISO9000, 1st ed., Butter Wolter (1996).
6. Gary E. Maclean, Documenting Quality for ISO 9000 and Other Industry Standerds, Tata Mc Graw Hill (1996).
7. J.M. Juran, Quality Planning & Analysis, 3rd ed., Tata Mc Graw Hill (1996).
8. N.Logothetis, Managing for the Total Quality, Prentice Hall of India (P) Ltd. (1997).
9. M. Parkany, Quality Assurance and TQM for Analytical Labs, 1st ed., Royal Chemical Society (1995)
10. B.W. Wendawiar

Unit - I: Analysis of Ores and Alloys

Principle of ore dressing, analysis of the following:

- (i) Bauxite, Haematite (ii) Steel, Brass
- (iii) Coal, Portland cement (iv) Lubricants and Oils

Unit – II: Analysis of Polymers and Cosmetics

(i) Polymers: General idea of polymers, analysis of plastics, fibers and rubbers with reference to Nylon 6, polyethylene phthalate (PET), polyester resin, phenol-formaldehyde resin, epoxy resin, polyethylene, natural rubber, styrene-butadiene rubber, analysis by IR, pyrolytic gas chromatography.

(ii) Cosmetics. General introduction, analysis of shampoo, hair spary, deodrants, sunscreen, creams and lotions.

Unit – III: Analysis of Soaps and Detergents

General idea of soaps and detergents, sampling, separation and identification of surfactants in detergent bases, determination of surfactants: anionic e.g. alkyl aryl sulphonates, cationic, non-ionic, determination of abrasives, ammonia, carbonates, carboxymethyl cellulose, ethanol and isopropyl alcohol, glycerine, silicates, sulphates, phosphates, moisture, saponification value, iodine value, acid value.

Unit –IV: Analysis of Paints, Varnish and Lacquer

General introduction, tests on the total coating; non-volatile and volatile contents, water content of paint and paint products, flash point, isolation and determination of pigment, isolation of vehicle, isolation of thinner, isolation and determination of the binder content, identification of polymers, resins and oils, identification of plasticizer, analysis of the vehicle, analysis of drying oils, epoxide analysis.

Unit – V: Analysis of Glass

General introduction, constitution of glasses, methods of analysis: sampling and sample preparation, composition, analysis, chemical analysis of silicon, barium, arsenic, antimony, total (Fe_2O_3 , Al_2O_3 , TiO_2 , MnO), calcium, magnesium, total alkalies ($\text{Na}_2\text{O} + \text{K}_2\text{O}$), boron, analysis of colouring additives [Cr, Co, Cu, Fe, Mn, Ni, Ti, (Pb & Ba)]. Application of flame and emission spectroscopy to glass analysis. A brief idea of microscopy. Blisters in glasses

Books Recommended

1. A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Long man Singapore Ltd. (1999)
2. P.C. Dele, Soaps and Detergents, 2nd ed., CBS Publication (1996).

ICA 304: Advanced Instrumental Methods of Chemical Analysis

M.M.: 35

Unit - I – Diffraction Techniques

General theory and instrumentation of neutron diffraction and X-rays diffraction. Application of X-rays diffraction for polymer characterization and structure of complexes. Applications of neutron diffraction to structure of magnetic materials.

Unit - II – Photoelectron Spectroscopy

General theory and applications of ultra violet and X-ray photoelectron spectroscopy (UVPES & ESCA). Determination of kinetic energy of an electron by using different methods .A general idea of Auger photoelectron spectroscopy.

Unit - III: ESR Spectroscopy

General theory, instrumentation and important applications of ESR spectroscopy

Unit – IV: Massbauer Spectroscopy

General theory, instrumentation and important applications of Massbauer spectroscopy

Unit - V - Industrial Process Instruments and Automatic Analysis

Overall analytical procedures for analysis of an organic and inorganic material, industrial process analyzer, infrared process analyzer. On-line potentiometric analyzer, process gas chromatography, on-line GC/Mass and GC/IR, continuous on-line process control, automatic chemical analysis, automatic elemental analyzer.

Books Recommended

1. D.A. Skoog, F.J. Holler and Nieman, Principles of Instrumental Methods, 5th ed., Thomson Asia Pvt. Ltd., Singapore (2003).
2. R.A. Day and A.L. Underwood, Quantitative Analysis, 6th ed., Prentice Hall of India Pvt. Ltd. (1993).
3. G.D. Christian., Analytical Chemistry, 6th ed, John Wiley & Sons (2001).
4. Willard, Merritt, Dean, and Settle, Instrumental Methods of Analysis, 7th ed., C B S Publishers & Distributors (1986).

Fourth Semester

ICA-401: Industrial Analysis – III

M.M.: 35

Unit - I - Analysis of Dyes

Introduction to dyes, classification and relation between colour and chemical constitution.

- (i) General methods for analysis of colours used in foods, drugs and cosmetics.
- (ii) Brief idea about synthesis and analysis of following classes of dyes: azo dyes: indigoid dyes, triphenyl methane dyes.

Unit - II: Analysis of Food and Food products

The chemical and nutritional composition of foods. Analysis of trace elements such as As, Cd, Pb in food. Analysis of tea, wines, milk, butter, cheese. Approximate analysis of honey. A general idea about preservatives.

Unit - III - Analysis of Pesticides and Fertilizers

- (a) Pesticides: General introduction, brief classification and mode of action of pesticides. Analysis of pesticides in general with reference to DDT, dieldrin, diphacinone, heptachlor, malathion, parathion, sevin.
- (b) Fertilizers: Sampling and sample preparation, determination of water, total phosphorus, potassium, total nitrogen, urea.

Unit - IV: Analysis of Petroleum and Petroleum Products

- (i) Introduction, determination of flash and fire point, API Gravity, distillation of petroleum products, specific gravity of petroleum, cloud and pour points, water in petroleum products. Aniline point, neutralization value of petroleum products, lead anti-knock compounds in gasoline, sulphur in petroleum products.
- (ii) A General idea of (a) Embalming chemicals (b) Dry cleaning agents and (c) Materials used in match composition.

Unit – V: Analysis of Wood and Pulp

- (i) Analysis of Wood: Sampling, determination of methoxyl group in wood. A brief idea of analysis of moisture in wood chips and saw dust by toluene methods, cellulose in wood.
- (ii) Analysis of Pulp: General introduction, sampling, determination of cellulose in pulp, permanganate number of pulp, copper number of pulp.
- (iii) Analysis of Paper: General introduction, sampling of paper, determination of reducible sulphur in paper and paper boards, moisture in paper, ash in paper, starch in paper, cellulose in paper, copper number of paper, acid-soluble iron in paper.

Books Recommended

1. A.I. Vogel, Textbook of Quantitative Chemical Analysis, 5th ed., Addison Wesley Long man Singapore Ltd. (1999)
2. P.D. Sethi, Quantitative Analysis of Drugs, 2nd ed. CBS Publications, New Delhi (1993).

_____ **Syllabus M.Sc. ICA..... (2011-2013)**

ICA – 402: Paper – II: Concepts of Industrial Management and Intellectual Property Rights

M.M.: 35

UNIT – I: Concepts of Industrial Management

Nature and significance of management, functions of management, social responsibilities of management. New industrial policy. Multinationals. Nature, scope and significance of personnel functions in modern organizations. Human resource planning, recruitment and selection process, employees training.

UNIT – II: Intellectual Property Rights

TRIPs – Its scope and options, the changing R & D processes and IPR, The IPR tool kit, patents, the patenting process, patent cooperation treaty.

UNIT – III: Intellectual Property Protections of Living Species

Compatibility between conventions, protecting inventions in biotechnology, protections of traditional knowledge, biopiracy and documenting traditional knowledge, some case studies: The basmati rice issue, revocations of turmeric patent, revocation of neem patent.

UNIT – IV: Exercising and Enforcing of Intellectual Property Rights

Rights of an IPR owner, licensing agreements, criteria for patent infringement, case studies of patent infringement, IPR – a contract, unfair competitions and control, provisions in TRIPs, some case studies.

UNIT- V: Role of Patents in the Pharmaceutical Industry

Recent changes in IPR laws impacting pharmaceutical industry, intellectual cooperation in the pharmaceutical industry, some case studies

Books Recommended

1. Fisher, Schoenfeldt, and Shaw, Human Resources Management, 3rded. , All India Publishers and Distributors, Chennai (1997).
2. P.B. Ganguli, Intellectual Property Rights: Unleashing the Knowledge Economy, Tata Mc Graw Hill (2001)
3. Steve Smith, The Quality Revolution, 1st ed., Jaico Publishing House (2002).
4. T.R. Bhanga and N.K. Agrawal, Industrial Engineering and Management Science, 10th ed., Romesh Chandra Khanna ,Khanna Publishers (2002).
5. Harold Koontz and Heinz Weihrich, Essential of Management, 5th ed., Tata Mc graw Hill Publishers
6. P.C. Tripathi and Reddy, Principle of Management 2nd ed., Tata Ltd. Company, New Delhi (1996).
7. M..Adhikary, Economic Environment of Business, 6th ed., Educational Publishers, New Delhi (1996).
8. Derek Biddle and Robin, Human Aspects of Management, 2nd ed., Delhi (1997).
9. Jean F. Hartley and Geoffrey, Employee Relations, 1st ed., Efficient Offset Delhi (1998).
10. C.B. Mamoria, Personal Management, 12th ed., Himalaya Publishing Mumbai (1994)

MICA – 105 and 106
Ist semester
Practical Examinations

M.M.: 50

One day 6-8 hrs. (Each course)
Two exercises to be given in examination

CLASSICAL

1. Neutralization titration
 - (a) Determination of Acidity.
 - (b) Determination of free carbon dioxide.
 - (c) Determination of alkalinity.
2. Complexometric titration
 - (a) Determination of temporary and permanent hardness.
 - (b) Determination of total, calcium and magnesium hardness.
3. Precipitation titration
 - (a) Determination of chloride.
4. Redox titration
 - (a) Determination of ferrous iron.
 - (b) Determination of copper.

INSTRUMENTAL

1. Spectrophotometric/ Colorimetric determination
 - (a) Determination of nickel.
 - (b) Determination of hexavalent chromium.
2. Conductometric determination
 - (a) Determination of strength of acid against standard alkali.
 - (b) Find out the strength of mixture of acids in an unknown mixture.
3. pH metric determination
 - (a) Determination of strength of acid against standard alkali.
 - (b) Find out the strength of mixture of acids in an unknown mixture.

MICA – 205 and 206
2nd semester
Practical Examinations

M.M.: 50

One day 6-8 hrs. (Each course)
Two exercises to be given in examination

CLASSICAL

1. Physio-chemical analysis of water
 - (a) Determination of total dissolved and suspended solids.
 - (b) Determination of residual chlorine.
 - (c) Determination of chlorine demand.
 - (d) Determination of bicarbonate and carbonate alkalinity.
 - (e) Find out the concentration of sulphite.

2. Measurement of organic pollutant in the water
 - (a) Determination of Dissolved Oxygen (DO).
 - (b) Determination of Biological Oxygen Demand (BOD).
 - (c) Determination of Chemical Oxygen Demand (COD).

INSTRUMENTAL

1. Spectrophotometric/ Colorimetric determination
 - (a) Determination of nitrite.
 - (b) Determination of phosphate.
 - (c) Determination of sulphide.

2. Conductometric determination
 - (a) Determination of strength of alkali against standard acid.
 - (b) Find out the strength of mixture of acids in an unknown mixture against N/10 NaOH.

3. pH metric determination
 - (a) Determination of strength of alkali against standard acid.
 - (b) Find out the strength of mixture of acids in an unknown mixture against N/10 NaOH.

MICA – 305 and 306
3rd semester
Practical Examinations

M.M.: 35

One day 6-8 hrs. (Each course)

Two exercises to be given in examination

CLASSICAL

1. Find out the partition coefficient of iodine between CCl_4 and water.
2. Find out the COD of given industrial effluent.
3. Find out the DO of given industrial effluent.
4. Determination of adsorption isotherm of acetic acid from aqueous solution of activated charcoal.
5. Determination of saponification value of oil sample.
6. Determination of iodine value of given sample.

INSTRUMENTAL

1. Spectrophotometric/ Colorimetric determination
 - (a) Find out the composition of binary mixture calorimetrically.
 - (b) Simultaneous determination of Mn and Cr spectrophotometrically.
2. Conductometric determination
 - (a) Determination of solubility and solubility product of sparingly soluble salts.
 - (b) Find out the strength of mixture of acids in an unknown mixture against N/10 NH_4OH .
3. pH metric determination
 - (a) Find out the degree of dissociation of weak acid/weak base.
 - (b) Find out the strength of mixture of acids in an unknown mixture against N/10 NH_4OH .
4. Cyclic voltammetric determination
 - (a) To determine i_p , E_p and test of reversibility of the reaction of an organic compound.
5. Polarographic determination
 - (a) To determine the $E_{1/2}$ of the sample using d.c. Polarograph.
6. Chromatographic determination
 - (a) Identification of a sample compound and its separation from a binary mixture by
 - (i) Paper chromatography (ii) Thin layer chromatography and (iii) Electrophoresis.
7. Polarimetric determination
 - (a) Study of mutarotation of sugar solution by polarimetry.

MICA – 403
3rd semester
Practical Examination

M.M.: 35

One day 6-8 hrs. (Each course)
Two exercises to be given in examination

CLASSICAL

1. Determination of pharmaceutical compounds titrimetrically.
2. Determination of the percentage of 'Available Chlorine' in a given sample of bleaching powder by Bunsen's method.
3. Determination of ash content of a coal/coke sample.

INSTRUMENTAL

1. Spectrophotometric/ Colorimetric determination
 - (a) Find out the concentration of active ingredient present in pharmaceutical tablets.
 - (b) Determination of pesticides (organochlorine, organophosphorous and parathyroid).
2. Conductometric determination
 - (c) Determination of purity of water.
3. Chromatographic determination
 - (a) Separation of sulphadiazine, amino acids by
 - (i) Paper chromatography and (ii) Thin layer chromatography.