

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH
M. Sc. First Semester
Industrial Chemistry
TRANSFER OPERATIONS (ICM 1001)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit I Momentum Transfer Operations

Introduction of fluid mechanics: Fluid Statics, Pascal and Hydrostatic law, Manometers, Velocity field, Velocity gradient and Rate of shear. Types of fluids, Boundary layer concept laminar and turbulent flow boundary layer separation. Fluid dynamics: Continuity equation, Euler equation Bernoulli's equation, Types of pumps: Centrifugal and Positive Displacement Pumps, Compressors, Fan and Blower.

Unit II Heat Transfer Operations

Basic Principle: Fourier's law of Conduction, Heat conduction through Plane wall, Hollow Cylinder and Composite walls, Heat transfer coefficient, Forced and Free Convection, Heat transfer by Radiation: Basic definition, laws of Radiation, Black body, Grey body.

Unit III Heat transfer Applications

Heat Exchanger: Various types, Heat exchanger mean temperature difference, heat exchanger effectiveness, Number of transfer units and design of heat exchanger. Heat transfer in Boiling and Condensation.

Unit IV Mass Transfer Operations

Species transfer, Definition of Concentrations, Velocities and Fluxes in Multi Species systems. Fick's law of diffusion, diffusion of species through stagnant species, Fick's 2nd law of diffusion.

REFERENCE BOOKS.

1. McCabe, W.L., Smith, Julian C. & Harriett, Peter, "Unit Operations of Chemical Engineering", McGraw Hill, New Delhi, 7/e, 2005.
2. Geankoplis, Christie J., "Transport Processes and Unit Operations", Prentice Hall of India, New Delhi, 3/e, 1997
3. Treybal, R.E., "Mass Transfer Operations", Mc. Graw Hills, New York, 3/e, 1983
4. Chapman, A.J., "Heat Transfer", Mc Millan Publishing Company, New York, 4/e, 1984.
5. Holman, J.P., "Heat Transfer", Tata McGraw Hill Publishing Company, New Delhi, 9/e, 2009

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. II Semester
Industrial Chemistry
Advance Analytical Techniques – I (ICM 1002)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

- Unit I **UV-Visible spectrophotometry.**
Beer Lambert's law, Limitations to Beer's law, Analysis of mixtures of absorbing substances, Instrumentation, diode array instrument, photometric accuracy, Differential spectrophotometry-high absorbance method, low absorbance or trace analysis procedure, method of ultimate precision, Derivative spectrophotometry, photometric titrations, spectrophotometric studies of complex ions – Job's method, mole ratio method, slope ratio method, problems.
- Unit II (a) **Molecular Luminescence spectrometry.**
Theory of fluorescence and phosphorescence, factors affecting fluorescence and phosphorescence, Relationship between concentration and fluorescence intensity, Emission and excitation spectra, Instruments for measuring fluorescence and phosphorescence, Fluorometric determination of inorganic and organic species, problems.
- (b) **Atomic fluorescence spectrometry:** Principle, methodology, instrumentation, applications.
- Unit III **Nuclear Magnetic Resonance spectroscopy (NMR)**
Theory of nuclear magnetic resonance, continuous wave NMR spectrometry, Precession of nuclei in a field, relaxation processes in NMR, Instrumentation: FT NMR spectrometer, sample handling, Chemical shift, NMR shift reagents, spin-spin coupling, elucidation of NMR spectra, quantitative analysis, problems.
- Unit IV **Atomic emission spectrometry**
Introduction, Inductively coupled plasma source (ICP), sample introduction, plasma appearance & spectra, analyte atomization and ionization, direct current plasma sources, plasma source spectrometers-slow-scan spectrometer, multi channel spectrometers, A charge injection instrument, A charge coupled instrument, Fourier transform spectrometer, application of plasma, sources sample proportion, elements determined, line selection, calibration curves, interference & detection limits: comparison of ICP vs AAS.

Books suggested:

1. Principles of Instrumental Analysis, D.A. Skoog, F.J. Holler, T.A. Nieman, 5th edn, Thomson, Brooks/Cole, 1998
2. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, Jr. J.A. Dean, F.A. Seale, Jr. 7th edn, 1986.
3. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, 8th edn, Thomson/Cole Singapore, 2004.
4. Instrumental Methods of Chemical Analysis, G.W. Ewing, 5th edn, Mc-Graw Hill Book Co, New Delhi, 1985.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. First Semester
Industrial Chemistry
Advanced Organic Synthesis (ICM 1003)
(w.e.f. 2015 – 2016)**

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit I Organic Synthesis Design

- (i) Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes.
- (ii) Functional groups inter-conversion
- (iii) Connection and Disconnection approach
- (iv) Protection-deprotection of functional groups such as –OH, –CHO, –C=O, –COOH and –NH₂

Unit II Reagents in Organic Synthesis

Synthesis and application of complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium diisopropylamide (LDA), dicyclohexylcarbodiimide, 1,3-dithiane (reactivity Umpolung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and perovost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, Phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

Unit III

(i) Molecular Rearrangements

Beckmann, Benzidine, Benzilic Acid, Claisen, Di-p-Methane, Favorskii, Fries, Hofmann, Pinacol, Stevens, Wagner–Meerwein and Wolff Rearrangement

(ii) Name Reactions:

Aldol Reaction, Baeyer–Villiger Oxidation, Heck Reaction, McMurry Reaction, Mitsunobu Reaction, Paterno–Büchi Reaction, Prins Reaction, Sharpless Epoxidation, Simmons–Smith Reaction, Stille Coupling Reaction, Stork Enamine Reaction, Suzuki Reaction, Wittig Reaction

Unit IV

(i) Total synthesis of biologically important molecules: Longifolene, Fredericmycine A, Eremophilone, Taxol, vitexin, oestrone and cortisone.

(ii) Manufacture of Industrial Organic Chemicals: Aniline, Acetone, Phenol, Glycerol, formaldehyde and formic acid

References:

1. J. March, Advanced Organic Chemistry, John Wiley & Sons.
2. J. Clayden, N. Greeves and S. Warren, Organic Chemistry, Oxford University Press.
3. W. Carruthers, Some modern Methods of Organic Synthesis, Cambridge University Press.
4. I. L. Finar, Organic Chemistry Vol. 2, Longmans Green & Co.
5. F. A. Carey and R. J. Sundberg, Advanced Organic Synthesis: Part A & B, Springer.
6. P. G. M. Wuts and W. T. Greens: Protective groups in Organic Synthesis, John Wiley & Sons.
7. [S. Warren](#) and [P. Wyatt](#), Organic Synthesis: The Disconnection Approach, John Wiley & Sons.
The Logic of Chemical Synthesis: E.J. Corey and Xue-Min Cheng, John Wiley & Sons

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. First Semester
Industrial Chemistry
Instrumental Methods of Analysis–I (ICM 1004)
(w.e.f. 2015 – 2016)**

Credits = 2

M.M.: 100 (30+70)

2 Periods/week

Unit I Electroanalytical Methods

(a) Separation by Electrolysis:

Basic principles of electrolysis, criterion of completeness of deposition, over potential, processes at the anode, electrogravimetry, constant current electrolysis, separation with controlled electrode potential, constant voltage electrolysis, potential buffers, mercury cathode, internal electrolysis, electrography.

(b) Coulometric Methods:

Fundamentals, current efficiency, measurement of charge transfer, different types of coulometers (silver, copper and gas coulometers), controlled potential coulometry, constant current coulometry, coulometric titrations, oxidation-reduction, residual linear current voltage-curve of an air free solution.

(c) Amperometric titrations:

Fundamentals, methodology, types of amperometric titration curves, amperometric titrations with one indicator electrode involving precipitation, neutralization, complexation and oxidation-reduction reactions, successive titrations, amperometric titrations with two indicator electrodes, biamperometric titrations, comparison with other titration methods.

Unit II Voltammetry and Polarography:

Polarographic principles, the dropping mercury electrode (DME), diffusion current, factors affecting the diffusion current, dependence of 'm' upon mercury height, effect of temperature, limiting current and residual current, potential range of the DME, interfering electrode reactions, polarographic maxima, Ilkovic equation, polarographic analysis, interpretation of polarographic wave equation, AC polarography, pulse polarography, differential pulse polarography, linear sweep and cyclic voltammetry.

Books recommended:

1. Introduction to chemical Analysis, R. D. Braun, Mc. Graw-Hill, International Book Co., 1983
2. Quantitative Chemical Analysis; Kolthoff, sandell Meehan and Bruckestein; Mcmillan Co., London, 1969
3. Instrumental methods of chemical Analysis, G.W. Wing, McGraw-Hill (London), 1975.
4. Instrumental Methods of Analysis, 7th edn. H.H. Willard, L.L. Merritt, Jr. and J.A. Dean and F.A. Settle, Jr. Publishers and Distributors, New Delhi, 1986.
5. Instrumental Analysis, G. D. Christian, (Second Edition) James E. Reilly, Allyn and Bcon, Inc., Bostan London.
6. Fundamental of Anlytical Chemistry, D.A. Skoog D.M. West and F.J. Holler, Saunders College Publishing, New York, 1988.
7. Principles of Instrumental Analysis by Skoog Holler, Neiman (2001). V. Edn.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. First Semester
Industrial Chemistry
Green Chemistry (ICM 1005)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

Unit I Introduction: Definitions of Green Chemistry. Brief introduction of twelve principles of Green Chemistry, with examples, special emphasis on atom economy, reducing toxicity, green solvents, Green Chemistry and catalysis and alternative sources of energy, Green energy and sustainability

Unit II The following Real world Cases in Green Chemistry should be discussed:

- Surfactants for carbon dioxide – Replacing smog producing and ozone depleting solvents with CO₂ for precision cleaning and dry cleaning of garments.
- Designing of environmentally safe marine antifoulant.
- Rightfit pigment: Synthetic azo pigments to replace toxic organic and inorganic pigments.
- An efficient, green synthesis of a compostable and widely applicable plastic (poly lactic acid) made from corn.

Reference Books:

1. Anastas, P.T. & Warner, J.K. Green Chemistry- Theory and Practical, Oxford University Press (1998).
2. Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker (2001).
3. Cann, M.C. & Connely, M.E. Real-World cases in Green Chemistry, American
4. Chemical Society, Washington (2000).
5. Ryan, M.A. & Tinnesand, M. Introduction to Green Chemistry, American
6. Chemical Society, Washington (2002).
7. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. Green Chemistry Experiments:
8. A monograph, I.K. International Publishing House Pvt Ltd. New Delhi, Bangalore.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. First Semester
Industrial Chemistry
Statistical Methods of Data Analysis (ICM 1006)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

UNIT I Elementary Concepts of Statistics

Measures of central tendency and dispersion, skewness, kurtosis, correlation, regression
Concept of probability, conditional probability, Bayes theorem with examples

UNIT II Applied Quantitative Methods

Inventory control, replacement problems, sequencing problems, reliability theory, statistical quality control

SUGGESTED READINGS:

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.
2. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B.: Fundamentals of Statistics, Volume I. The World Press, Calcutta.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B.: Fundamentals of Statistics, Volume II. The World Press, Calcutta.
5. Kanti Swarup, Gupta, P.K. and Man Mohan: Operations Research. Sultan Chand & Sons, New Delhi.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. First Semester
Industrial Chemistry
Design of Experiment (ICM 1007)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

UNIT I: Test of Significance

Statistical hypothesis, null and alternative hypotheses, types of errors, level of significance, procedure for testing of statistical hypothesis, tests based on normal, chi-square, t and F distributions

UNIT II: Experimental Design

Basic principles of experimental design (randomization, replication and local control), layout and analysis of completely randomized design (CRD), randomized block design (RBD), estimation and analysis of one missing observation for RBD

SUGGESTED READINGS:

1. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.
2. Gupta, S.C. and Kapoor, V.K.: Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.
3. Goon, A.M., Gupta, M.K. and Dasgupta, B.: Fundamentals of Statistics, Volume I. The World Press, Calcutta.
4. Goon, A.M., Gupta, M.K. and Dasgupta, B.: Fundamentals of Statistics, Volume II. The World Press, Calcutta.
5. Kanti Swarup, Gupta, P.K. and Man Mohan: Operations Research. Sultan Chand & Sons, New Delhi.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. First Semester
Industrial Chemistry
Industrial Chemistry Practical-I (ICM 1071)
(w.e.f. 2015 – 2016)**

Credit = 2
3 Periods/week
M.M.: 100 (30+70)

1. Flow through straight Circular Tubes.
2. Flow through Annulus.
3. Flow through Coiled tube.
4. Velocity profile and flow rate determination in circular closed channel.
5. Capillary flow Viscometer.
6. Flow through a convergent-divergent circular channel
7. Stefan's tube diffusivity measurement.
8. Plate and frame filter press filtration.
9. Flow through packed and fluidized bed.
10. Grinding characteristics of crushing machines.

**DEPARTMENT OF CHEMISTRY
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**M. Sc. First Semester
Industrial Chemistry
Industrial Chemistry Practical-II (ICM 1072)
(w.e.f. 2015 – 2016)**

Credit = 2
3 Periods/week
M.M.: 100 (30+70)

- (1) Analysis of pharmaceutical mixtures by UV-Visible spectroscopy.
- (2) Simultaneous determination of Fe(II) and Fe(III) by UV-visible.
- (3) Simultaneous determination of vitamin C and vitamin E.
- (4) Separation of several cations in mineral water pond water or low acid foods.
- (5) The Determination of sulfamthazine, sulfametrazine and sulfadiazine in.
- (6) Separation and Recovery of Dyes.
- (7) Separation of artificial colorants in confectionary.
- (8)
 - (a) Determination of pharmaceuticals by HPLC.
 - (b) Determination of caffeine in Beverages by HPLC.
 - (c) Determination of Antibiotics by HPLC.
- (9) Separation and qualitative analysis of sugar alcohols in foods by GC.
- (10) Determination of ethanol content of an alcoholic liquor by NMR.
- (11)
 - (a) Determination of Mg and Ca in Tap water by AAS
 - (b) Determination of vanadium in lubricating oil by AAS.
 - (c) Determination of Tin in canned fruit Juice by AAS.
- (12) Determination of alkali metal by S.P.

Note: The students are advised, before carrying out any experiments they should pay full attention to any safety warnings and make sure they adhere to national laboratory and safety regulations.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
UNIT OPERATION & PROCESS UTILITIES (ICM 2001)
(w.e.f. 2015 – 2016)**

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

- Unit I **Distillation:** Basic Principles and Applications, Flash operation, Continuous distillation, Batch Distillation, McCabe Thiele method, Plate efficiency.
Multi component Distillation: Phase equilibrium with multi component distillation, flash distillation of multi component mixtures.
- Unit II **Leaching and Extraction:** Leaching, Principles of continuous countercurrent leaching, Liquid Extraction, principles of extraction.
Gas Absorption: Principle of Absorption, Rate of absorption, Design of Packed towers.
Adsorption: Adsorption equipment, Adsorption Isotherms, Principle of Adsorption, Design of equipments.
- Unit III **Evaporation:** Introduction and Basic principle, Equipments, Short tube (standard) Evaporator, Forced circulation evaporators, Falling film evaporators, Climbing film (upward flow) evaporators, Wiped (agitated) film evaporator.
Drying: Introduction, Free moisture, Bound moisture. Drying curve, Drying equipments.
Crystallization: Introduction, Solubility, Super saturation, Nucleation, Crystal growth, Crystallization Equipments.
- Unit IV **Process Utilities in Chemical industries**
Water: Specification of Industrial use, Various Water Treatment methods.
Air: Specification of Industrial use, Processing of air.
Steam: Generation and Industrial Use.
Boilers: Types of boilers and their functioning.

REFERENCE BOOKS.

1. McCabe, W.L., Smith, Julian C. & Harriett, Peter, “**Unit Operations of Chemical Engineering**”, McGraw Hill, New Delhi, 7/e,2005.
2. Geankoplis, Christie J., “**Transport Processes and Unit Operations**”, Prentice Hall of India, New Delhi, 3/e, 1997
3. Max S. Peters, Klaus D. Timmerhaus and Ronal E. West, **Plant Design and Economics for Chemical Engineers**, McGraw-Hill, New York

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Advance Analytical Techniques – II (ICM 2002)
(w.e.f. 2015 – 2016)**

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

- Unit I (a) **Chromtography:** Intoduction, classification of chromatographic methods, Elution chromatography on columns, Migraton rates of solutes: distribution constants, retention time, retention time and distribution coefficient, retention factor, selectivity factor, zone broadening & column efficiency, van Deemte equation optimuzation of column performance: column resolution, effect of relative and selectiving factor on resolution, effect of resolution on retention time, variables that affect column performance, problems.
- (b) Thin layer chromatography: Introduction, the layer plate, sample application, plate development locating analyte on the plate, performance characteristics of this layer plates, application-qualitative and quantitative analysis.
- Unit II Gas Chromatography: Principle, Instruments for gas liquid chromatography, mobile phase, sample injection, gas chromatographic columns , Liquid phase and column selection, classification of station phases , Detectors-flameionization detector, thermal conductivity detector, Electron capture detector, thermionic detector and others, interpretation of gas chromatographs, Temperature Programming in GC, Qualitive and quantitative analysis, problems.
- Unit III High Performance Liquid Chromatography.
Liquid chromatographic methods, Principle of HPLC, Structural typs of column packing, column efficiency in liquid chromatography, Instrumentation, mobile phase, pumping systems, sample injection systems, liquid chromatographic columns, Detectors Absorbance detectors, fluorescence detectors, Refractive index detector, Electrochemical detectors, partition chromatography-column for bonded phase chromatography, normal phase & reversed phase packing , Method development in partition chromatography, column selection, mobile phase selection, Applications problems.
- Unit IV (a) Size Exclusion Chrometography:
Principle of separation, packing materials, theory of size exclusion chromatography, calibration pelot, exclusion limit, total and selective permeation regions, Determination of molecular weight and molecular weight distribution of polymers, Application.
- (b) Supercritical fluid chromatography
Properties of supercritical fluids, SF chromatography, Instrument and operating variables, comparison of SFC to other types of chromatography, Applications.

Books:

1. Principles of Instrumetal Analysis, D.A. Skoog, F.J. Holler, T.A. Nieman, Vth edn, Thomson, Brooks/Cole, 1998
2. Instrumental Methods of Analysis, H.H. Willard, L.L. Merritt, Jr. J.A. Dean, F.A. Seate, Jr. 7th edn, 1986.
3. Chromatography, Concept & Contrast, J.M. Miller, 2nd edn, John Wiley & sons, New Jersey, 2009
4. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, 8th edn, Thomson/Brooks/Cole, Singapore, 2004.

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. Second Semester
Industrial Chemistry
Organic Chemical Industries (ICM 2003)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit – I Dyes:

- a. Classification of dyes according to the mode of applications and according to the chemical constitution.
- b. Methods of preparation of commercial dyes of different classes with suitable examples, typical manufacturing processes of dyes.
- c. Fluorescent brightening agents.
- d. Dyes industries in India.

Introduction, varnishes and related products mechanism of Polymerization Deterioration of Applied Films constitution, Preparation and applications.

Unit – II

Production techniques, functions of ingredients and desirable characteristics of the following cosmetic products: Dentifrices, face creams, face powders Talcum Powders, hair dyes, shampoos, sharing creams, lipistics, nail polishes, deplitories etc.

Unit – III Agrochemical:

- a. Organo Chlorine pesticides: BHC, Aldrin, Dieldrin, Endosulphan.
- b. Organo phosphorus pesticides: Malathion, moocrotophos, Dimethoate, chloropyriphos.
- c. Carbamates: Carbaryl, Bygon, Ziram Zineb, Maneb.
- d. Insect pheromones and Repellants; Pheromone, general introduction and application in integrated pest management (no synthesis), Repellant: benzamide, N,N, Diethylenebenzamide, 2-ethyl-1,3, hexanediol, butopytranexyl, Dimethylcarbamate, Dimethylphthalate.
- e. Agrochemical industries in India.

Unit – IV

Introduction, Petroleum refining, outline of chemicals derived from methane, ethylene, propylene and butlenes; benzene, toluene and xylene; manufacture of petrochemicals, petrochemical industries in India.

Introduction, Manufacturing processes of Acetic Acid, oxalic acid, citric acid, acetic anhydride, furfural from bagasse, anhydrous alcohol, sugar based chemical industries in India.

Reference Books:

1. Burger: Medicinal Chemistry (I.W.)
2. W.O. Foye: Principles of medicinal chemistry (L.E.)
3. Zechmeister: Progress in chemotherapy (C.H.)
4. Lendicer and Mitscher: The Organic Chemistry of drug synthesis (I.W.)
5. N.N. Melnikov: Chemistry of pesticides (Springer)
6. M.B. Green, G.S. Hartley, T.E. West: Chemicals for crop protection and pest management (Pergamon).
7. R. Cremlyn: Pesticides.
8. K.H. Bechel: Chemistry of pesticides
9. H.B. scher: Advances in pesticides, formulation technology
10. Kirk and others: Encyclopedia of chemical technology
11. J.M. Paturan: Byproducts of cane sugar Industry (Elsevier)
12. S.D. Shukla and G.N. Pande: A text book of chemical technology vol II.
13. K. Venkataraman-The chemistry of synthetic dyes vol. 1-7 (A.P.)
14. Abranart: Dyes and their intermediates (Pergamon)
15. Prakash G. More, Comprehensive Industrial Chemistry, Pragati Prakashan, Meerut (Uttar Pradesh)
16. Bech:- Fiber reactive dyes (logos press)
17. Frig and David: Dyes intermediates
18. Allan: Colour Chemistry
19. Kent : Riegels Industrial Chemistry
20. M. Ash and I. Ash formulary of paints and other coatings.
21. P.H. Groggins: Unit process in organic synthesis (MGT)
22. Kirk R. Smith: Biofuels: Air pollution and Health: A Global Review (Kluwer Academic/Plenum publisher)
23. Plant oil as fuels-Present state of Science and future developments Edited by N. Martini and J.S. Sebeli Springer Verlag 1998.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Instrumental Methods of Analysis – II (ICM 2004)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

Unit-I Thermal and Calorimetric methods of Analysis :

Thermogravimetric analysis, apparatus, methodology, application; differential thermal analysis, apparatus, methodology; derivative thermogravimetry, instrumentation, methodology. Comparative study of TGA and DTA. Interpretation of TGA and DTA curves of important compounds e.g., calcium oxalate monohydrate, magnesium oxalate monohydrate. Analysis of silver-copper alloy and dolomite sample by TGA. Thermometric titrimetry and applications to acid-base and complexometric titrations.

Unit-II X-ray Methods:

Production of x-rays, x-ray spectra, absorption of x-rays, analysis by absorption, absorption edge analysis, absorption apparatus, determination of molecular structure by X-ray diffraction, crystal morphology, lattice and unit cells, kinds, space lattice, planes or faces of cubic systems, labelling the planes, the Miller indices, spacing of the planes, X-ray crystallography, the powder method, the rotating crystal methods, Problems.

Books recommended:

1. Instrumental Methods of Analysis, 7th edn., H.H. Willard, L.L. Merritt, Jr., J.A. Dean and F.A. Settle, Jr., C.B.S. Publishers and Distributor, 1986, Tata McGraw (New Delhi)
2. Instrumental methods of Chemical Analysis, 5th edn., G.W. Ewig, McGraw Hill Book Co., 1985.
3. Instrumental Methods of Analysis by G.D. Christian and C.N. Reilly
4. Principle of Instrumental Methods of Analysis; D.A. Skoog, D.M. West and F.J. Holler, Sounders College Publishing New York, 2001.
5. Ionic Equilibria in Analytical Chemistry; Freiser and Fernando.
6. Chemical Analysis, H.A. Laitinen.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Environmental Chemistry (ICM 2005)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

- Unit I (a) **Introduction to Environment and Atmosphere**
Introduction, Chemical Composition of Atmosphere – particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, pollution by chemicals, petroleum, chlorofluorocarbons. Biological cycles of C, N and P. Green House Effect, Acid rain, Air pollution- control and their chemistry. Analytical methods for measuring air pollutants.
- (b) **Environmental Toxicology**
Chemical solution to environmental problems, biodegradability, principles of decomposition, Bhopal gas tragedy, Chernobyl, Three miles island, Sewezo and Minamata disasters.
- Unit II (a) **Hydrosphere**
Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle. Aquatic pollution – inorganic, organic, industrial and sewage, detergents and oil pollutants. Water quality parameters – dissolved oxygen, biochemical oxygen demand, solids, metals, contents of chlorides, sulphate, phosphate, nitrate, and micro-organisms. Water quality standards- Purification and Treatment. Analytical methods for measuring BOD, DO, COD, Fluoride, metals (As, Cd, Cr, Hg, Pb, Se etc.).
- (b) **Industrial pollution: Reasons & Removal**
Cement, sugar, paper and pulp, drugs, thermal power plants, nuclear power plants etc. Disposal of wastes and their Management.

Books Suggested

1. Environmental Chemistry, A. K. De, Willey Eastern
2. Environmental Chemistry, G. S Sodhi, Narosa Publishing House
3. Environmental Chemistry, C. Baird and W. H. Freeman
4. Environmental Chemistry, S.E. Manahan, Lewis publishers
5. Environmental Chemistry, Sharma & Kaur, Krishna Publishers
6. Environmental Pollution Analysis, J.S. M. Khopkar, Willey Eastern

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Comp. Methods Data Analysis (ICM-2006)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

Unit – I (A) **Computer Programming:** Elements of C language, functions and subroutines, Graphics commands, commands for accessing hardware (data acquisition).

Introduction to Programming in Visual Basic: Introduction, different controls and their properties, application.

(B) **Application Package for Report Generation and Presentation:**

MS-Office: Introduction to MS-Office and its application in report generation.

MS-Excel: Spreadsheets, report generation, cell manipulation, data base management; Graphical representation of tabulated data-pie charts, bar & line graphs, surfaces and 3D graphs.

Unit – II **Computer for Industrial Chemists:**

(a) Introduction to CAD, a balance approach to computer aided process design.

(b) Computers interfacing with instruments and as laboratory information systems.

(c) Computers in Fault Tree Analysis

(d) Computers in Communication:

(e) **Internet:** Basic concepts, importance in chemical industry, design and maintenance of a small web site.

E-mail: Basics, methodology and usage.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Pulp and paper Technology (ICM2007)
(w.e.f. 2015 – 2016)**

Credits: 2
2 Periods/weeks
M.M.: 100 (30+70)

- Unit – I (a) History of paper making, pulp and paper industry in India, future prospects. Raw materials for pulp industry, classification and properties of fibrous raw materials, fiber morphology and chemical composition of wood and grass species. Chemistry of wood lignin, cellulose, hemicellulose and extraneous components, reaction of wood constituents.
- (b) Preparation of raw material for pulping, general Principles of mechanical and chemical (acid, neutral and alkaline) pulping processes, continuous and batch digestion material and energy balances in a pulp mill, pulping kinetics.
- Unit – II (a) Treatment of spent liquors and recovery of pulping chemicals and byproducts, pulp bleaching (single and multi-stage), new techniques in bleaching, bleaching sequence.
- Stock preparation, paper making and coating, modern paper machine, sizing, dyeing and wet strength additives. Air and steam pollution aspects.
- (b) Pulp and paper properties and testing, process instrumentation, Dissolving grade pulps, special papers, paper grades, lignin as a Chemical raw material.
- Introduction to modern pulping technology advances in pulping. Secondary fibres: Recycling and deinking of waste papers.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Industrial Chemistry Practical-I (ICM 2071)
(w.e.f. 2015 – 2016)**

Credit = 2
3 Periods/week
M.M.: 100 (30+70)

1. Batch sedimentation test.
2. Gravity Thickening.
3. Heat Transfer coefficient in a shell and tube heat exchanger.
4. Rate of evaporation in an open pan evaporator.
5. Pool boiling heat transfer coefficient.
6. Film and dropwise condensation.
7. Rate of drying in a batch drier.
8. Solid-Liquid Extraction of oil from oil seeds.
9. Rate of dehydration of vegetable products.
10. Distillation.

**DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH**

**M. Sc. Second Semester
Industrial Chemistry
Industrial Chemistry Practical-II A & B (ICM 2072)
(w.e.f. 2015 – 2016)**

Credit = 2
3 Periods/week
M.M.: 100 (30+70)

A: Analytical Techniques:

1. Qualitative analysis of APC Tablets by UV-Visible.
2. Determination of cations, Anions, organic compounds.
3. Determination of glycerol in fruit juice
4. Determination of cholesterol in Mayonaise.
5. Separation of iron and cobalt by I.E.C.
6. Determination of Quinine in toxic water by Floero.
7. Determination of Na and K in cement.
8. Determination of Hg in Air, water, and Fish.
9. Analysis of APC Tablets by NMR
10. Purity of commercial benzoid acid by IR.

B: Computer Practical

1. Programming in C
2. Designing VB applications
3. Hand Practice in MS-Office-MS word, MS-Excel & MS-Power Point
4. Hand Practice in CAD & use of internet.

Note: The students are advised, before carrying out any experiments they should pay full attention to any safety warnings and make rule. They adhere to national laboratory and safety regulations.

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. III Semester
Industrial Chemistry
CHEMICAL REACTION ENGINEERING (ICM – 3001)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

- Unit 1 Introduction to Chemical Reaction Engineering.**
Rate of reaction, Elementary and Non-elementary reactions, Molecularity and Order of reaction, Mechanism of reaction, Temperature dependency from thermodynamics, Arrhenius and Collision theories.
- Unit 2 Chemical Reactor Analysis.**
Integral and differential methods for analyzing kinetic data, Interpretation of constant volume batch reactor data for zero, first, second and third order reactions, Half life period, Auto catalytic reaction, Interpretation of variable volume batch reactor data for zero, first and second order reactions, enzyme catalyzed reactions.
- Unit 3 Introduction to Reactor Design.**
Industrial reactors, Space time and Space velocity. Design of single ideal reactor - Batch, CSTR, PFR using graphical procedure. Multiple reactor system and optimum reactor size, Recycle reactors, Temperature and Pressure effects, Optimum temperature progression in a chemical reaction, Adiabatic and Non adiabatic reaction conditions and conversion.
- Unit Multiple Reaction System and Design**
Multiple reactions: Independent, Parallel and Series reactions, Instantaneous and over all fractional yield, Choice of reactors for simple and complex reactions and multiple reactor system, Introduction to thermal stability of reactors, Product distribution in multiple reaction system, temperature dependence and vessel size for maximum production.

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. III Semester
Industrial Chemistry
Pharmaceuticals – II (ICM – 3002)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit I

Structure, stereochemistry, Mode of action, Structure activity relationships, specific clinical applications of following classes of pharmaceuticals with synthetic/commercial route to the indicated examples.

1. Antibacterials: Pencillines, Cephalosporine, Tetracyclines, aminoglycosides, Chloramphenicol, Macrolides, Lincomycine, polypeptides antibiotics, polyene antibiotics. Sulfonamides and sulfones fluoroquinolones, Trimethoprim and other unclassified antibiotics. Antimycobacterials: Sulfanilamides, p-Aminosalicylic acid derivatives, Thioamides, Thiourea, derivatives, Thiosemicarbazones, Isoniazid, Kanamycin Sulfate, Capreomycine, Rifaampin, Pyraazinamide, Anthionamide, Clofazimine, Cyclosporin, Dapsone, Sulfazem.

Commercial synthetic/Semi-Synthetic routes to: 6-aminopenicillanic acid, ampicilline, amoxycillin, production of penicillin, 7-aminocephalosporanic acid, cephalexin, ceftizoxime, cefaclor, cephalothin,

Tetracyclins: doxycycline, nalidixic acid, sulfadiazine, norflaxacin, ciprofloxacin, O-flaxacin, Amiflaxacin, Difloxacin, Chloramphenicol, Nitrofluranton, Sulfamethoxazole, Acetylsulfoxiazole, Trimethoprim.

Unit II

2. Cinchona alkaloids, 4-Aminoquinolines, 8-Aminoquinolines, Aminoacridines, Biguanides, Pyrimidines and Sulfones, Mefloquin, Sulfonamides.

Commercial Synthetic routes to: Chloroquine, pamaquine, primaquine, proguanil, Amodiaquine, mefloquine, Pyremethamine, Sontoquine.

3. **Antiamoebic and Antiprotozoal Drugs:** Emetine hydrochloride, 8-Hydroxyquinoline, Iodochlorohydroxyquinol, metronidazole, Diloxanide furoate, Bilamical hydrochloride, Hydroxystilbamidine isothionate, Pentamidine isothionate, Nifurtimox, Suramin sodium, Carbarsone, Glycobiarsol, melarsoprol, Sodium stibogluconate, Dimercaprol, Diethylcabamazine citrate, Centarson, Acetarson, Antimony Potassium tartarate, Bismuth sodium thioglycollate sulphonomide, stibiophen. Bismuth sodium thioglycollamate, Furazolidone.

Commercial Synthetic routes to: Metronidazole, ronidazole, flunidazole, iodoquinol, nifurfimox, benzindazole, tryparsamide.

Unit III

4. Anthelmintics: Introduction, Tetrachloroethylene, Piperazines, Gentain violet, Pyrvinium pamoate, Thiabendazole, Mabendazole, baphenium hydroxynaphthoate, dichlophene, Niclosamide, Levamisole hydrochloride, Tetramisole Niridazole, Biothional Antimonypotassium tartarate, Stibiophen, Sodium Stibiocaptate.

Unit IV

5. Antifungal Drugs: Fatty acids and their derivatives (Propionic acid, zinc propionate, sodium caprylate, zinc caprylate, undecylenic acid, Zinc undecylenate, Triacetin), Salicylanilids, Salicylic acid, Tolnaftate, pchloromethoxylenol, Acrisocrin, Fluconazole, Itraconazole, Haloprogin, clotrimazole, Econazole, Miconazole Ketoconazole, Flucytosine, Griseofulvine, Polyene antibiotics (Nystatin, Amphoetericin-B), chlorophenesin, Dithranol.

Commercial Synthetic routes to: Miconazole, Clotrimazole, Econazole, Fluconazole, Griseofulvin, ketoconazole, Naftidine, Tolnaftate, Flucytosin,

Books Recommended:

1. Wilson and Gisvolds Textbook of Organic medicinal and Pharmaceuticals Chemistry, 8th Edition, edited by R.F. Doerge, J.B. Lippincott Company, Philadelphia, 1982.
2. Pharmaceutical Chemicals in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley & Sons, New York, 1989.
3. W.O. Foye, T.L. Lamke, D.A. Williams, Principles of Medicinal Chemistry, 5th Edition, Lippincott Williams and Wilkins, 2002.

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. III Semester
Industrial Chemistry
Catalysis & Corrosion (ICM – 3003)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit – I Corrosion:

Phenomenon of corrosion, Direct chemical corrosion and its mechanism, Electrochemical corrosion and its mechanism, various type of Corrosion, Factors influencing corrosion, corrosion control.

Unit – II

Economic Impact of corrosion, corrosion rate Expressions and Allowances, Corrosion Reactions and Free – Energy change, Characteristics of corrosions Environments, Biologically Influenced Corrosion, corrosion control by Cathodic and Anodic Protection.

Unit – III

Principles of catalysis: Catalysis sites yield, selectivity, Introduction to Industrial catalysis.

Unit – IV

Relationship between reactivity and the structure and composition of surfaces in the atomic scales (i) Static Technique: LEED, AES and (ii) Transport Techniques.

Books:

Corrosion: Understanding the Basics Joseph R. Davis – 2000
[Books.google.co.in/books? Isbn +1615030389](https://books.google.co.in/books?isbn+1615030389)

M.Sc. II YEAR
Third Semester (2004-2005)
Industrial Chemistry Practical-I (ICM3071)

Credit = 4
M.M. = 100 (30+70)
6 Periods/week

1. Extraction of essential oil
2. Mass Transfer coefficient
3. Steam Distillation
4. Solid-liquid extraction
5. Liquid-liquid extraction
6. Bomb calorimeter determination of calorific value
7. RTD in CSTR
8. Solid-fluid reaction

M.Sc. Second year
Third Semester (2004-2005)
Industrial Chemistry Practical-II A & B (ICM3072)

Credit = 4
M.M. = 100 (30+70)
6 Periods/week

A. FOOD SCIENCE & TECHNOLOGY

1. Determination of moisture content by hot air oven and infra-red moisturemeter:
2. Estimation of titrable acidity in the given food sample.
3. Determination of fat content of given soy flavour sample using soxhelt apparatus.
4. Estimation of protein content by Kjeldhal apparatus.
5. Determination of Vitamin C in the citrus fruit/juice/squash.
6. Determination of total and reducing sugar by Lane and Eynon method.
7. Determination of pectin content of guava fruit.
8. To identify the bacteria by Gram staining method.
9. Estimation of total plate, plate counts of a given food sample.
10. To identify the mold containing the food samples.

B: HIGH TEMPERATURE CHEMISTRY

- (1) Determination of plastic and Dry properties of Ceramic Raw materials.
- (2) Estimation of moisture in powder/Raste/Cake etc.
- (3) Determination of pH of suspension/solution.
- (4) Determination of specific gravity of material.
- (5) Determination of dry/green shrinkage of products/fabricated items.
- (6) Determination of compressive, Tensile strength and MOR of green pieces in proper shape.
- (7) Stirring/dispersion of solid in liquid and preparation of casting slip etc.
- (8) Demagnetization.
- (9) Determination of Solid contents in the slip.
- (10) Ecological properties of casting slip.

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. IV Semester
Industrial Chemistry
CHEMICAL REACTION DYNAMICS AND PLANT DESIGN (ICM – 4001)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit 1: Non Ideal behavior of Chemical Reactions.

Basic concepts of non ideal flow, Introduction of Residence Time Distribution (RTD) of fluid in vessels, RTD for ideal and non ideal reactors, RTD measurement, Conversion from RTD in non ideal reactors, Non Ideal Flow Models- Dispersion Model, Tank in Series Model.

Unit 2: Heterogeneous Reactions.

Introduction to Heterogeneous reaction, Non-catalytic heterogeneous reaction, Kinetics of fluid particle non catalytic reaction - Unreacted core model and shrinking core model, Catalyst and catalytic reactions, Mechanism of catalytic reactions, External and Internal diffusion effects in catalytic reactions, Rate controlling step.

Unit 3: Process Synthesis and Development

Hierarchy of process design, Principle and approaches to process synthesis, Large scale low cost processing systems, Reaction path synthesis, Choice of reactors and separators, Process selection, Study of alternate process scale-up methods, Flow Sheet preparation, Sketching, Equipment numbering, Stream designation.

Unit 4: Plant Design and Economics

Introduction, Process Design development, General design considerations, Plant site selection, Plant layout, Plant operations and control, Cost and asset accounting, Cash flow for industrial operations, factors effecting investment and production cost, capital investments, estimation of capital investments, cost indices, cost factors in capital investment, Environmental considerations in plant designing.

BOOKS:

1. Octave Levenspiel, “**Chemical Reaction Engineering**”, John Wiley & Sons (Asia) Pvt Ltd.
2. H. Scott Fogler, “**Elements of Chemical Reaction Engineering**”, Prentice Hall of India Pvt Ltd
3. J.M. Smith, “**Chemical Engineering Kinetics**”, McGraw-Hill
4. Max S. Peters, Klaus D. Timmerhaus and Ronal E. West, **Plant Design and Economics for Chemical Engineers**, McGraw-Hill, New York

DEPARTMENT OF CHEMISTRY
A.M.U., ALIGARH

M. Sc. III Semester
Industrial Chemistry
Pharmaceuticals – II (ICM – 4002)
(w.e.f. 2015 – 2016)

Credits: 4
4 Periods/weeks
M.M.: 100 (30+70)

Unit I

Structure, stereochemistry, Mode of action, Structure activity relationships, specific clinical applications of following classes of pharmaceuticals with synthetic/commercial route to the indicated examples.

1. Antibacterials: Pencillines, Cephalosporine, Tetracyclines, aminoglycosides, Chloramphenicol, Macrolides, Lincomycine, polypeptides antibiotics, polyene antibiotics. Sulfonamides and sulfones fluoroquinolones, Trimethoprim and other unclassified antibiotics. Antimycobacterials: Sulfanilamides, p-Aminosalicylic acid derivatives, Thioamides, Thiourea, derivatives, Thiosemicarbazones, Isoniazid, Kanamycin Sulfate, Capreomycine, Rifaampin, Pyraazinamide, Anthionamide, Clofazimine, Cyclosporin, Dapsone, Sulfazem.

Commercial synthetic/Semi-Synthetic routes to: 6-aminopenicillanic acid, ampicilline, amoxycillin, production of penicillin, 7-aminocephalosporanic acid, cephalexin, ceftizoxime, cefaclor, cephalothin,

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Unit II

2. Cinchona alkaloids, 4-Aminoquinolines, 8-Aminoquinolines, Aminoacridines, Biguanides, Pyrimidines and Sulfones, Mefloquin, Sulfonamides.

Commercial Synthetic routes to: Chloroquine, pamaquine, primaquine, proguanil, Amodiaquine, mefloquine, Pyremethamine, Sontoquine.

3. **Antiamoebic and Antiprotozoal Drugs:** Emetine hydrochloride, 8-Hydroxyquinoline, Iodochlorohydroxyquinol, metronidazole, Diloxanide furoate, Bilamical hydrochloride, Hydroxystilbamidine isothionate, Pentamidine isothionate, Nifurtimox, Suramin sodium, Carbarsone, Glycobiarsol, melarsoprol, Sodium stibogluconate, Dimercapool, Diethylcabamazine citrate, Centarsona, Acetarsona, Antimony Potassium tartarate, Bismuth sodium thioglycollate sulphonomamide, stibiophen. Bismuth sodium thioglycollamate, Furazolidone.

Commercial Synthetic routes to: Metronidazole, ronidazole, flunidazole, iodoquinol, nifurimox, benzindazole, tryparsamide.

Unit III

4. Anthelmintics: Introduction, Tetrachloroethylene, Piperazines, Gentain violet, Pyrvinium pamoate, Thiabendazole, Mabendazole, baphenium hydroxynaphthoate, dichlophene, Niclosamide, Levamisole hydrochloride, Tetramisole Niridazole, Biothional Antimonypotassium tartarate, Stibiophen, Sodium Stibiocaptate.

Unit IV

5. Antifungal Drugs: Fatty acids and their derivatives (Propionic acid, zinc propionate, sodium caprylate, zinc caprylate, undecylenic acid, Zinc undecylenate, Triacetin), Salicylanilids, Salicylic acid, Tolnaftate, pchloromethoxylenol, Acrisocrin, Fluconazole, Itraconazole, Haloprogin, clotrimazole, Econazole, Miconazole Ketoconazole, Flucytosine, Griseofulvine, Polyene antibiotics (Nystatin, Amphoetericin-B), chlorophenesin, Dithranol.

Commercial Synthetic routes to: Miconazole, Clotrimazole, Econazole, Fluconazole, Griseofulvin, ketoconazole, Naftidine, Tolnaftate, Flucytosin,

Books Recommended:

1. Wilson and Gisvold's Textbook of Organic medicinal and Pharmaceuticals Chemistry, 8th Edition, edited by R.F. Doerge, J.B. Lippincott Company, Philadelphia, 1982.
2. Pharmaceutical Chemicals in Perspective, B.G. Reuben and H.A. Wittcoff, John Wiley & Sons, New York, 1989.
3. W.O. Foye, T.L. Lamke, D.A. Williams, Principles of Medicinal Chemistry, 5th Edition, Lippincott Williams and Wilkins, 2002.

M.Sc. SECOND YEAR
Fourth Semester (2004-2005)

Industrial Chemistry
Polymer and Plastic Technology (ICM 4003)
(w.e.f. 2015 – 2016)

Credit = 4

M.M.: 100 (30+70)

4 Periods/week

Unit-I. Polymer and Polymerization: Addition polymerization, condensation polymerization, copolymerization, Ring opening polymerization, stereoselective polymerization, electrochemicals polymerization, solid state polymer and kinetic length.

Unit-II. Characterization of polymers: End group analysis, colligative property measurement, solution viscosity and molecular size, IR of polymers, NMR and ESR of polymers, Thermal analysis, Microscopy, Physical testing.

Unit-III. Polymer reaction: Hydrolysis, Autolysis, Aminolysis, Hydrogenation, addition and substitution reaction, reactions of various specific groups, cyclization reaction, cross-linking reaction, leading to graft and block copolymers, Miscellaneous reactions (Polymerization by step reaction).

Unit-IV. Rheology of polymers : Viscous flow, kinetic theory of rubber elasticity, Viscoelasticity, The mechanical properties of polymer.

Morphology of polymers : Configuration of polymer chain-crystal structure, Morphology of crystalline polymers, Strain induced morphology.

Polymer processing by molding and other processing methods, plasticizers and other additives, fibres manufacture technology.