NORTH MAHARASHTRA UNIVERSITY, JALGAON

SCHOOL OF CHEMICAL SCIENCES

(Academic Flexibility Since-2009)

SYLLABUS

for

MASTER OF SCIENCE in CHEMISTRY

With

Specialization in

INDUSRIAL CHEMISTRY

M.Sc. II (Semester III and IV)

(Choice Based Credit System, 60:40 Pattern)

w. e. f. June 2016

Syllabus for

M.Sc. Chemistry (with specialization in Industrial Chemistry)

[w.e.f. June 2016]

Course Structure for Second Year [Semester III and IV]

Semester – III

Course Code	: Title	Marks
IC 301	: Unit Operations and Processes in Chemical Industries	100
IC 302	: Synthetic Methods in Organic Synthesis	100
IC 303	: Industrial Polymers and Paint Technology	100
IC 304	: Pharmaceutical Chemistry	100
IC 004	: Laboratory Course in Industrial Chemistry – I	100

Semester – IV

Course Code	: Title	Marks
IC 401	: Applied Industrial Chemistry-I	100
IC 402	: Agrochemical Industries	100
IC 403	: Applied Industrial Chemistry-II	100
IC 005	: Laboratory Course in Industrial Chemistry – II	100
IC 006*	: Project	100

* The projects will be initiated in the beginning of Semester III and the examination will be conducted at the end of Semester IV.

* Educational Tour: Organizing Educational Tour aiming at giving practical exposure to second year students is expected (at their own cost).

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Second Year (Semester III)

IC-301: Unit Operations and Processes in Chemical Industries:

[60 hrs, 100 marks]

UNIT- I. **[12 hrs]**

a) Chemical Industry: [4 hrs]

Introduction, Chemical production, Raw materials and their sources.

b) Parameters of Chemical Industry: [4 hrs]

Plant location, Safety, Construction of plant, Management for productivity and creativity, Training for plant procedure and labor, Chemical process technology, Classification of chemical reactions, Batch and continuous operations, Industrial chemical reactions, Conversion, Selectivity and Yield.

c) Unit Operations: [02 hrs]

Introduction, Unit operations- Distillation, Crystallization, Filtration, Drying of solids, Extraction, Size reduction (crushers, grinders, and mills), Size separations (mechanical and hydraulic separation),

d) Unit processes: [02 hrs]

Introduction, Industrial unit processes- Definition and examples of Alkylation, Amination, Condensation, Cyclisation, Combustion, Cracking and pyrolysis, Hydrogenation and dehydrogenation, Diazotization and coupling, Dehydration, Esterification, Hydrolysis, Halogenation, Isomerization, Ion-exchange, Nitration, Sulphonation, Neutralization, Oxidization, Reduction.

UNIT- II **[12 hrs]**

a) Amination by Reduction: [06 hrs]

Introduction and definition, Methods of reduction, Metal and acid

Reductions, Metal and alkali reductions, Amination by amminolysis, aminating agents, physical and chemical factors affecting aminolysis, manufacture of aniline by reduction of nitrobenzene, p-phenylenediamine, aniline by continuous ammonolysis.

b) Alkylation: [06 hrs]

Introduction and types of Alkylation, Alkylating agents, factors controlling Alkylation, equipment for Alkylation, Alkylation methods for i) Alkyl-aryl sulphonates, ii) Ethylbenzene,

iii) Dimethylaniline.

UNIT- III **[12 hrs]**

a) Oxidation: [06 hrs]

Liquid and vapour phase oxidations, apparatus for Oxidation, technical oxidation of acetaldehyde, iso-propyl alcohol, naphthalene, and naphthalene sulphonic acid.

b) Esterification: [06 hrs]

Esterification of organic acids and derivatives, esters by addition, to unsaturated systems, interesterification of lard, technical preparation of ethyl acetate, cellulose acetate, nitroglycerol, polyethyl ether.

UNIT – IV **[12 hrs]**

a) Hydrogenation: [06 hrs]

Catalytic hydrogenation, Apparatus, Industrial processes, Hydrogenation of fatty oils, Synthesis of methanol.

b) Nitration: [06 hrs]

Introduction, Nitrating reagents, Aromatic nitration, Nitration of paraffinic hydrocarbons, nitrate esters, N-nitrocompounds, process equipment for technical nitration, Mixed acid nitration, Typical Industrial nitration processes.

UNIT - V

Sulfonation and Sulfation: **[12 hrs]**

Introduction, sulfonating and sulfating reagents and their principle applications. Chemical and physical features in sulfonation and sulfation, mechanisms, the desulfonation reaction, working up procedures, Industrial equipment and techniques, Transition from batch to continuous processing.

References:

1. Unit Processes in Organic Synthesis- P. H. Groggins
2. Outline of Chemical Industries- Dryden
3. Chemical Process Industries- B. Shreeve.
4. Comprehensive Industrial Chemistry- P. G .More

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IC-302: Synthetic Methods in Organic Synthesis

[60 hrs, 100 marks]

UNIT – I **[12 hrs]**

Organic Name Reactions:

Suzuki Coupling, Wittig-Horner Reaction, Sonogashira Coupling, Rosenmund Reduction, Pechmann Condensation, Olefin Metathesis, Knoevenagel Condensation, Heck Reaction, Diazotization, Wacker oxidation, Mukaiyama esterification, Hiyama coupling, Pauson-Khand reaction, Negeshi coupling, Monsanto acetic acid synthesis, Kumada coupling.

UNIT – II **[12 hrs]**

a) Natural Products:

Chemistry of natural products such as alkaloids, steroids, terpenes.

Total Synthesis of Carpanone (O .L. Chapman), Vitamin B12 (R. B. Woodward), Monensin (W. C. Still), Menthol (Takasago).

b) Isolation of Natural Products of Commercial Importance:

Methods of Isolation of Natural Products, Isolation of Nicotine form tobacco waste, Citral form lemon grass, extraction of Neem oil and eucalyptus oil.

UNIT – III **[12 hrs]**

a) Heterocyclic Chemistry: [06 hrs]

Synthesis and reactions of Pyridine (Hantzsch Synthesis), Quinoline (Bischler-Napieralski Synthesis), Pyrrole, Furan, Thiophene (Paal- Knorr Synthesis), Benzofuran, Indole (Fischer), Imidazole.

b) Designing Organic Synthesis: [06 hrs]

Common terms used in retro synthetic analysis, One group disconnections, Two group disconnections, Illogical two group disconnections.

UNIT – IV **[12 hrs]**

Industrial Hazards and management:

Chemical and Process Hazards: Toxicity, Flammability, Corrosively, Explosion, Ignition, Pressure, Temperature, Noise, Industrial safety, Hazardous Waste and Management.

UNIT – V **[12 hrs]**

b) Green Chemistry:

Introduction, Principles, Alternative reagents (PTC, crown ethers, cryptands), solvents (ionic liquids, eutectics, supercritical fluids), environmentally benign approaches: Sonochemistry, Polymer

supported reactions, Microwave mediated reactions, Solvent free and solid supported reactions, ball milling/grinding methods for synthesis.

References:

1 Advance Organic Chemistry - Jerry March.

2 Modern Methods of Organic Synthesis- W. Carruthers and I. Coldham.

3 Designing Organic Synthesis- Stuart Warren.

4 Modern Synthetic Reagents- H. O. House.

5 Organic Chemistry- S. H. Pine

6 Organic Chemistry- Morrison and Boyd.

7 Reaction Mechanism and Reagents in Organic Chemistry- G. R. Chatwal

8 Green Chemistry: Theory & Practice P. T. Anastas and J. C. Warner

9 Green Chemistry: Frontiers in Benign Chemical Synthesis P. T. Anastas and T. C. Williamson

10. Organic Synthesis: Special Techniques V. K. Ahluwalia and Renu Aggarwal

11. Green Chemistry. J. N. Gurtu, and A. Gurtu.

12. Green Chemistry. R. Sanghi, and M. M. Srivastava.

13. Classics in total synthesis. K. C. Nicoloue and E. J. Sorensen

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PC 303: Industrial Polymers and Paint Technology

(60 h. Marks-100)

Part A Industrial Polymers

Unit-I **(12 h)**

A. Basic Concepts of Polymers (06 h)

History, Trends, and General Polymer Background, Concept of functionality and reactivity, Degree of polymerization.

B. Techniques of Polymerization (06 h)

Bulk, Solution, Emulsion, Suspension and Interfacial polymerization.

Unit- II **(12 h)**

General Chemistry, Technology of Production, Properties and Applications of Chain growth polymers

a. Polyethylene (HDPE, MDPE, LDPE, LLDPE, UHMWPE, chlorinated PE),
b. Polypropylene (PP),
c. Polyisobutylene (PIB)),
d. Acrylics (PMMA & PAN)
e. Polyvinyles (PVC, PVDC & CPVC),
f. Polystyrene & copolymer (HIPS, SBR, SAN & ABS)
g. Poly(vinyl acetate)

Unit- III **(12 h)**

General Chemistry, Technology of Production, Properties and Applications of Step growth polymers:

a. Phenol formaldehyde (PF- Novolak and resol)
b. Urea formaldehyde (UF)
c. Melamine formaldehyde(MF)
e. Polyamides:- Nylon-6, Nylon-6, 6 & Kevlar.

Part B Paint Technology

Unit- IV **(12 h)**

A. Paints – Introduction and Definitions of paints, pigments, varnishes, lacquers, Anatomy of paints, functions & requirements of constituents of paints, classification of paints on the basis of order of application/ methods of curing / nature of solvent/ uses etc.

B. Paint Properties - color, tinting strength, reducing power, pigments classification of pigments, pigments properties-oil absorption, refractive index, particle size shape, bleeding, resistance to light and heat.

Unit-V **(12 h)**

A. Manufacture of Paints (05 h)

Ball mill, triple roll mill, bead mill, titrator, high speed and heavy-duty disperser.

B. Important Resins or Modifications of Resins for Paints and Coatings (07 h)

a. Epoxy Resins (BPA based resin, curing agents & flame retardant epoxy resins)
b. Alkyds – Introduction of alkyds, different components of it, Modification with rosin, maleic anhydride, acrylics, vinyls, imides etc.
c. Polyester resins - Unsaturated polyester resins
d. Modification of phenolics such as novolac-epoxy oil soluble and oil reactive Modification of aminor resins (UF & MF) with alcohols and phenols.

Recommended Books:

1. Polymer Chemistry - M. P. Stevens, 2nd Ed., Oxford University Press, 1990.

2. Poly. Synthesis - Stanley R. Sandler, Wolf Karo, Vol. 1, Academic Press, Inc., California, 1994.

3. Introduction to Polymer Chemistry - R.B. Seymour, Marcel Dekker, 3rd Ed., (1992)

4. Polymer Chemistry-properties and applications, Andrew Peacock, Allison Calhoun, Hanser Publishers, Munich, 2006.

5. Polymer Science and Technology of Plastics and Rubbers, Premamoy Ghosh, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1996.

6. Encyclopedia of Chemical Technology, Kirk and Othmer.

7. Plastics Materials, J. Brydson, Butterworths, &th Edn., London, 1999.

8. Polymer Chemistry, Ayodhya Singh, Campus Books, 2006.

9. Organic Polymer Chemistry, V. Jain, IVY Publishing House, New Delhi,

10. Outlines of Paint Technology, W. M Morgan 3rd edn CBS Publishers.

11. Paints, Coatings and solvents, Dieter Stoye, Werner Freitag, Wiley VCH Pub.

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IC-304: Pharmaceutical Chemistry

[60 hrs, 100 marks]

UNIT – I **[12 hrs]**

Introduction to pharmaceutical chemistry:

Brief history, Drugs, Classification of drugs, Characteristic of good drugs, Therapeutic index, Bactericidal and Bacteriostatic drugs. Biological and Medical terms used in pharmaceutical chemistry, pharmacon, Receptor, Affinity, Intrinsic activity, Bio-isosters, chemotherapy, pharmacodynamics, pharmacokinetics, Formulation of Drugs.

UNIT – II **[12 hrs]**

Theories of drugs action:

Relation of chemical structure and chemical reactivity (SAR and QSAR), Assay of drugs, Metabolism of drugs, Mode of action, Meaning of following terms with examples- Antipyretics, Analgesics, Anti-inflammatory drugs, Antidibetes, Leprosy, Antacids, Sedatives, Hypnotics, Cardiovascular drugs, Anthelmintics, Antibiotics, vitamins, hormones Chemical contraceptives.

UNIT – III **[12 hrs]**

Cancer therapy:

Nature of cancer, terminology, theories of cancers, Causes and treatment of cancer, surgery, photoratiation, radiation, immunotherapy, chemotherapy, combination therapy, adjurent therapy. Antineoplastic drugs: mercaptopurine, 6-thioguanine, 5-flurouracil, allopurinol, metholrexate. Alkylating agents. DNA inter calcating agents, effect of alkylating agents on DNA. Antimitotic agents. Other compounds.

UNIT – IV **[12 hrs]**

a) Anti-AIDS: [08 hrs]

Introduction, Mechanism of HIV multiplication, Pathogenicity of HIV diagnosis- ELISA Anti AIDS drugs, transmission and preventation of HIV.

b) Cardiovascular drugs: [04 hrs]

Introduction, synthesis of amyl nitrate, methyldopa, sorbitrate.

UNIT – V **[12 hrs]**

a) Anti-dibetic drugs: [02 hrs]

Introduction, synthesis of sequence of A and B chain of insulin, Glibenclamide, metformin.

b) Vaccine and Antisera: [02 hrs]

Types of Vaccine, Antisera – Antibody, Antibacterial, Antiviral sera

c) Vitamins: [03 hrs]

Types of Vitamins, Synthesis of Vitamin A, E and H.

d) Clinical Chemistry and Drug analysis: [05 hrs]

Composition of blood collection, and preparation of samples. Clinical analysis: serum electrolyte, blood glucose, blood urea nitrogen, uric acid, albumin, globulin, acidic and alkaline phosphates. Narcotics and dangerous drug, drug analysis by chromatography/spectrophotometry.

References:

1. Medicinal Chemistry G. R. Chatwal.
2. Principles of medicinal chemistry (4th edition) W.D. Foye, T.L. Lemke, and D. A. Williams.
3. Organic chemistry of drug action and design R. B. Siwerman
4. Synthetic Drug G. R. Chatwal.
5. Handbook of Industrial Chemicals (Vol.-I) K. M. Shah
6. Principles of Medicinal Chemistry Vol. I, S. S. Kadam and K.G.Bothara
7. A Text Book of Medicinal Chemistry P. Parimo
8. A Text Book of Pharmaceutical Formulations. B. M. Mittal
9. Fundamentals of analytical chemistry. D. A. Skoog, D. M. West, W. B. Saunders and F. J. Honer.

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Second Year (Semester IV)

IC-401: Applied Industrial Chemistry-I

[60 hrs, 100 marks]

UNIT – I **[12 hrs]**

a) Dyes Industries: [06 hrs]

Introduction, Classification of Dyes, Colour and Contribution – Valence Bond Theory, M. O. Theory, Witt's Theory, Synthesis of Fast Red A, Naphthol Blue Black 6B, Naphthol Green B, Rosaniline, Alizarin pyronene- G.

b) Fermentation Industries: [06 hrs]

Introduction, Outline of Fermentation, Basic requirement of Fermentation, Manufacture of chloramphenicol, acetic acid, butanol, ethyl acetate, oxalic acid and citric acid.

UNIT – II **[12 hrs]**

Oils and Oleochemicals Industries:

Introduction, Properties and classification of oils, extraction and purification of oils; Fatty acids- Introduction, nomenclature and applications of fatty acids; Soap- Introduction, classification, uses and manufacturing process of soap(s), Manufacture of detergents.

UNIT – III **[12 hrs]**

a) Cosmetics Industries: [06 hrs]

Introduction, manufacturing process of powder, cream and lotion, lipstick and nail polish, shampoo and hair dyes, tooth paste.

b) Perfumery Industries: [06 hrs]

Compounds used for different perfumes, Essential oils, Preparation of phenyl ethanol, Yara-Yara, β-ionone, musk ketone, musk ambrette, musk xylene, phenyl acetic acid and its' esters, benzyl acetate, synthetic musk, jasmine.

UNIT – IV **[12 hrs]**

a) Petrochemicals: [06 hrs]

Petroleum refining, outline of chemicals derived from ethylene, xylene and naphthalene.

b) Biofuels: [06 hrs]

Introduction, Types of biofuels (bioethanol, biodiesel), Raw materials for synthesis of biofuels, Properties of biofuels, biofuels and environment, biofuels and economic, standard specification of biofuels uses of biofuels, Modification of vegetables of oils as biodiesel.

UNIT – V **[12 hrs]**

High Energy Materials (HEMs):

Introduction, Explosives, Propellants and Energetic polymers, Classification of Explosives, Methods of Characterization of HEMs (Physical/ Structural/ Thermal/ Explosives properties), examples RDX, HMX, Azide compounds, Imidazole compounds, Nitramines, Nitric esters, Thermally stable and insensitive explosives.

References:

1. Chemical Process Industries – Shrieves
2. Chemical Technology – Dryden
3. Chemical Technology – Shah and Pandey
4. Synthetic Dyes – G. R. Chatwal
5. Organic Chemistry Vol. III – S. M. Mukharji, S. P. Singh, R P. Kapoor
6. Paint Technology – Morgan
7. Plants Oils as fuels: Present Science and Future Developments- N. Martini and J. S. Sebeli
8. Biofuels: Air Pollution and Health- K. R. Smith
9. Biofuels and Industrial Products from Jatropha- M. Mittel bach
10. Formulary of Cosmetic Preparations – M. Ash and I. Ash.
11. Formulary of Paints and Other Coatings – M. Ash and I. Ash.
12. Perfumery Technology- B. Billot and F. V. Wells
13. High Energy Materials, Propellants, Explosives and Pyrotechnics- Jai Prakash Agrawal.

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IC-402: Agrochemicals Industries

[60 hrs, 100 marks]

UNIT – I **[12 hrs]**

Agrochemicals: [06 hrs]

Introduction, Classification, Role of agrochemicals in agriculture. Pesticides- Classification, Nomenclature, formulation, toxicity, Principles of pest control, IPM.

Chemistry of Pesticides: [06 hrs]

Introduction to biological classes of pesticides, Structure, Chemical name, Physical properties, Chemical properties, Synthesis, Degradation and metabolism, Formulations, Mode of action, Uses, Toxicity.

UNIT – II **[12 hrs]**

Chemistry of Pesticides:

a) Insecticides: Cypermethrin, Phorate, Propoxur.

b) Acaricides: Dichlorvos, Phosphamidon,

c) Fungicides: Captan, Copper oxy chloride,

d) Rodenticides: Warfarin, Zinc Phosphide.

e) Nematicides: Aldicarb, Terbifos.

f) Fumigants: Ethylene dibromide, Methyl bromide.

g) Repellants (DEET) and attractants.

h) Molluscicides: Metaldehyde

i) Herbicides (2, 4-D, Dicamba, Propanil, Maleic hydrazide) and Plant growth regulators Chloramequat chloride, Daminozide, Ethephone, IAA).

Manufacturing processes of some pesticides:

Lindane (BHC), Dimethyl phthalate, Parathion, Phorate, Ethylene oxide, 2, 4-D, Copper sulphate.

UNIT – III **[12 hrs]**

Pesticide formulations:

Introduction, Inert ingredients, Necessity of formulations,

a) Dry formulations:

Diluents, Carriers, Important properties/factors affecting quality and stability of pesticides formulations- particle size, bulk density, flowability, sorptivity, compatibility, Synergists, adjuvants; Stability and shelf life of formulations. Dusts (D/DP), Granules (G), Wettable powders (WP/WDP), Manufacturing processes.

b) Liquid formulations: Solution/ oil Concentrates, Emulsifiable Concentrates (EC), Solvents, Adjuants, factors affecting quality and stability and shelf life of formulations.

c) Other formulations:

Fumigants, Smoke generators, Liquidators, Oils, creams and gels, Bait, Seed dressings, Aerosols, ULV.

UNIT – IV **[12 hrs]**

Advanced Pesticide formulations:

User friendly/ Safe and high performance formulations, i) Aqueous concentrates (AC), ii) Dustless Dusts (DL), Microgranules (MG), iii)Emulsion Concentrates (EW), Microemulsion (ME), Gels (GL), iv) Suspension Concentrates/ Flowables (SC/ SF), Water Ddispersible Granules (WDG) or Dry Flowables (DF), Water soluble package, v) Controlled Release Formulations (CRF), Encapsulated Granules (CG), vi) Suspo- Emulsions /Emulsions Flowables (SE), Capsule Suspension (CS), β-cylcodextrin (CD) inclusion complexes, Ultra low volumes (ULV), Next Generation Formulations (NGF).

UNIT – V **[12 hrs]**

Fertilizers:

Introduction, Classification, Principles and methods of fertilizers applications.

Synthetic fertilizers:

Introduction, Manufacture and uses of nitrogenous fertilizers- Urea, Phosphatic fertilizers- triple super phosphate, Potassic fertilizers- potassium chloride, Complex/compound fertilizers- nitro phosphate, Mixed fertilizers – method of preparation and formulation. Fluid fertilizers- Introduction, Manufacturing of nitrogenous and mixed fluids.

References:

1. Chemistry of Insecticides and Fungicides – U. S. Sree Ramulu
2. Pesticides Formulations – Van Wade. Velkenburg.
3. Agrobased Industries and Pesticides formulations – S. B. Shrivastava and V. K. Agrawal
4. Analytical Methods of Pesticides and Plant Growth Regulators and Food Additives Vol. I –IV – Gunter and Zweig
5. Pesticides Synthesis – Mavy, Kohn, Menn.
6. Outlines of Chemical Technology – C. E. Dryden
7. Manures and Fertilizers – K. S. Yawalkar, J. P. Agrawal, S. Bokde
8. Fluid Fertilizers – D. A. Palgrave
9. Commercial Fertilizers – G. H. Collings.

IC-403: Applied Industrial Chemistry-II

[60 hrs, 100 marks]

UNIT – I **[12 hrs]**

Paper and pulp industries: [06 hrs]

Introduction, types of pulping, types and quality of paper, lignin and lignas.

Leather Industry: [06 hrs]

Introduction, Constituents of animal skin, manufacture and preparation of hide, cleaning, soaking, limiting and degreasing, finishing and sharing, taning: leather, vegetable, chrome, tanning effluents: pollution and control.

UNIT – II **[12 hrs]**

Metallurgy:

Introduction, minerals in India, mineral processing, Ellingham diagram, manufacture and application of metal alloy and salts, technique for reusing low grade minerals, iron and steel (iron, steel alloy, tool steel and stainless steel), copper and its alloy, zinc, nickel and aluminum.

UNIT – III **[12 hrs]**

Glass and ceramics Industries:

Introduction, raw materials, soda glass, borosilicate glass, lead glass, colored glass, ceramic raw materials, clays, pottery, zeolites, fly ash, ceramic tiles.

UNIT – IV **[12 hrs]**

Electronic Industries:

Introduction, ferrite and magnetic materials, Curie temperature, phosphorous for various uses, luminous paint, high purity silicon, germanium, gallium, indium and arsenic.

UNIT – V **[12 hrs]**

Sugar industry based chemicals: [08 hrs]

Introduction of sugar industry, molasses, manufacture of oxalic acid, citric acid, ethanol, and furfural from sugar waste.

Industrial gases: [04 hrs]

Introduction, Hydrogen, nitrogen, oxygen, carbon dioxide, and liquefied gases.

References:

1. Extraction metallurgy. J. D. Gilchrist, Pergamon press.
2. Foundation of steel and iron metallurgy. W. H. Denis
3. Industrial chemistry. R. W. Thomos and P. Farago
4. Modern electroplating. F. A. Lowinbein.

6. Electroplating for engineerings: A Handbook. 3rd Edn. V. N. Reinbold.

7. Leather processing and Tanning technology: A handbook. NIIR Board of Consultants and Engineers.

8. Tanning Chemistry: The Science of Leather. Anthony D. Covington.

9. Comprehensive Industrial Chemistry- P. G .More.

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IC-004: Laboratory Course in Industrial Chemistry- I

[90 hrs, 100 marks]

1. Spectroscopic Analysis:

UV-visible, IR, NMR and MS structure determination on the basis of data.

2. Synthesis of Organic compounds

a) Inorganic preparations and analysis (any three)

Zinc sulphate, Calcium carbonate, Ferrous sulphate, Boric acid, Zinc stearate, Plaster of Paris.

b) Organic one step preparations (any three)

i) Preparation of benzoic acid by nitric acid oxidation

ii) Preparation of benzoic acid by $Kmno_4\backslash$

iii) Preparation of phenyl hydroxyl amine

iv) Preparation of P-nitroanilide by nitration

v) Preparation of anisole from phenol using DMS or methyl iodide

c) Organic two steps preparations (any three)

i. Acetanilide – p-Bromoacetanilide – p-Bromoaniline

ii. Phenyl hydrazine – Acetophenone phenyl hydrazine – 2-Phenyl indole

iii. Acetophenone – Acetophenone oxime – Acetanilide

iv. Cyclohexanone – Cyclohexanone oxime – Caprolactum

v. Aniline – Diazoaminobenzene – p-Aminoazobenzene

vi. Benzophenone – Benzpinacol – Benzopinacolone

d) Drug Preparation (any two)

Preparation of methyl salicylate, benzimidazole, sulphanilic acid, aspirin

3. Analysis of drugs (any five)

a) Sulpha drugs- Sulphadiazine, Sulphaoxazole, Sulphaacetamide

b) APC tablet,

c) Iodometric assay- Analigl, Acetarsol.

d) Gravimetric analysis- Piperazine adipate/hydrate/ Phosphate

e) Phenol estimation- Cyclobarbitone tablets

f) Determination of Water by KF method- Rifamycin Sodium,

g) Spectroscopic analysis of drugs- UV- Visible/ IR/ NMR.

4. Analysis of Water

i) Determination of DO, SS, Hardness, BOD, COD.

ii) Estimation of Chlorine and heavy metals by chemicals as well as instruments.

5. Estimation of functional groups (any two)

-COOH, -OH, -NH2, -CHO, R-CO-R', Ar-OH.

References:

1. A textbook of Practical Organic Chemistry – A. I. Vogel – ELBS with Longman, 5th Ed. (1989)
2. Laboratory Manual of Organic Chemistry- R. K. Bansal – Wiley Eastern 3rd Ed., (1994)
3. Advanced Practical Organic Chemistry – N. K. Vishnoi- Vikas 2nd, (1996)
4. Application of Absorption Spectroscopy of Organic Compounds- J. R. Dyer – Prentice Hall
5. Spectroscopic Methods in Organic Chemistry – D .H. Williams and I Flemming – Mcgraw Hill, (1989)
6. Organic Spectroscopy- P. S. Kalsi
7. Instrumental Methods of Analysis – Chattawal and Anand
8. Chemical Technology – Dryden
9. Chemical Technology – Shah and Pandey
10. Unit Processes in Organic Synthesis- P. H. Groggins
11. Synthetic Drugs- G .R. Chatwal
12. Pharmaceutical Drug Analysis- Ashutosh Kar.

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IC-005 Laboratory Course in Industrial Chemistry- II

[90 hrs, 100 marks]

I) **A) Spectroscopic Analysis:** UV-Vis, NMR, IR, Mass spectral interpretations.
B) Instrumental Analysis: DSC, TGA, DTA, SEM, TEM, XRD.

II) **Synthesis of chemical compounds**

a) Preparation of agrochemicals (any five)
1-/2- Naphthoxy acetic acid, 2- Chlorophenoxy acetic acid,
Maleic hydrazide, Phthallyl hydrazide, Dimethyl phthalate, Coumarin.

b) Prepartion of dyes (any three)
Sudan- I, Yellow chrome, Orange chrome, Prussian blue.

c) Organic two steps preparations (any three)
i. Benzoin – Benzil – Benzilic acid
ii. Acetanilide – p-Nitroacetanilide – p-Nitroaniline
iii. p-Nitrotoluene – p-Nitrobenzoic acid – p-Aminobenzoic acid
iv. o-Hydroxyacetophenone – o-Benzoyloxy acetophenone – o-Hydroxy benzoyl methane
v. p-Toluidine – 4-Acetomido-3-bromotoluene – 4-Bromotoluene
vi. p-Nitrotoluene – p-Nitrobenzylidine diacetate – p-Nitrobenzaldehyde

d) Preparation and characterization of polymers and paints (any three)
i) Preparation of Urea formaldehyde resin
ii) Preparation of Phenol formaldehyde resin – novolak and resol
iii) Preparation of alkyd resin
iv) Preparation of epoxy resin
v) Preparation of varnish
vi) Formulation of distemper, primer, undercoat and topcoat
vii) Characterization of surface coating viscosity, gloss, impact resistance, cross cut adhesion, Scratch resistance
vii) Preparation of nylon 66.

III) **Analysis of Agrochemicals (any three)**

Copper sulphate, Copper oxy chloride, Bleaching powder, Phosphamidon, Nuvan, Lindane.

IV) **Analysis of polymers and oils**

i) Determination of iodine/ acid/ Sap values.
ii) Estimation of FFA of oils.

V) **Analysis of Soap(s).**

VI) Use of reagents in Organic Synthesis (any three)

$LiAlH_4$, $NaBH_4$, SeO_2, B_2H_6, Grignard reagent, Lead tetra acetate, $KMnO_4$, DMS or alkyl halide, $NaIO_4$, PPA, $AlCl_3$, $DMF/POCl_3$.

References:

1. Methods of pesticides analysis- U. S. Sree Ramulu, Oxford- IBH

2. Pesticide Plant Regulators and Food Additives, Vol I to IV- Gunter Zweig- Academic press.
3. A textbook of Practical Organic Chemistry – A. I. Vogel – ELBS with Longman, 5th Ed. (1989)
4. Laboratory Manual of Organic Chemistry- R. K. Bansal – Wiley Eastern 3rd Ed., (1994)
5. Advanced Practical Organic Chemistry – N. K. Vishnoi- Vikas 2nd, (1996)
6. Application of Absorption Spectroscopy of Organic Compounds- J. R. Dyer – Prentice Hall
7. Spectroscopic Methods in Organic Chemistry – D .H. Williams ad I Flemming – Mcgraw Hill, 4th Ed., (1989)
8. Environmental Chemistry – A. K. De
9. Organic Chemistry- P. S. Kalsi
10. Instrumental Methods of Analysis – Chattawal and Anand
11. Chemical Technology – Dryden
12. Chemical Technology – shah and Pandey
13. Unit Processes in Organic Synthesis- P. H. Groggins
14. Synthetic Dyes- G. R. Chatwal
15. Paint Technology – Morgan.
16. Experiments in Polymer Science, D. G. Hundiwale, V. D. Athawale, U. R. Kapadi, V. V. Gite, New Age International Pvt. Ltd., New Delhi, 2009.

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IC- 006: Project

[100 marks]

The small research projects in groups of maximum two students are given under the supervision of faculty members. Individual student may also carry out project work under the guidance of his supervisor. The project work may include the industry sponsored small research project and or the research work proposed by supervisors.

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