PANJAB UNIVERSITY
CHANDIGARH

FACULTY OF SCIENCE

SYLLABI

FOR
INDUSTRIAL CHEMISTRY
(Elective)
1\textsuperscript{st} & 2\textsuperscript{nd} Year (Semester System)
3\textsuperscript{rd} Year (Annual System)
EXAMINATIONS 2015-2016
PANJAB UNIVERSITY, CHANDIGARH

Outlines of tests, syllabi and course of reading for B.Sc. (Semester system) examinations in the Elective of “Industrial Chemistry” 2015-2016

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Industrial Chemistry and their applications. The syllabus pertaining to B.Sc. (Semester system) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

Subject Title: “Industrial Chemistry (Elective)”.

B.Sc. (General) Semester-I:

| | 75 |

B.Sc. (General) Semester-II

| Paper B: Core 124, 125 and 126 i.e. Material and Energy balance; Unit operations in Chemical Industry; utilities & fluid flow and Heat transport. | Max. Marks. |
| | 75 |

Practicals: Total combined practical mentioned under B.Sc.Ist year (Semester I and II) 50

NOTE: The Entrepreneurship Development Course will be taught in the 3rd and 4th semester programme of B.A./B.Sc. This course being a non-credit course, the examination will be conducted by the Colleges themselves as they do for the House Examination. The result is to be conveyed in a sealed cover to be Deputy Registrar (Secrecy) P.U., Chandigarh well before the commencement of the final Examination.
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<tr>
<th>Sr. No.</th>
<th>Title of the Paper</th>
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<th>Total teaching Periods</th>
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<tr>
<td>Core</td>
<td>Semester I</td>
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<td>111</td>
<td>Industrial – Aspects of Organic Chemistry</td>
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<td>Industrial Aspects of Inorganic Chemistry</td>
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<td>Core</td>
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<td>124</td>
<td>Material and Energy Balance</td>
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<td>125</td>
<td>Unit Operations in Chemicals Industry</td>
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<td>126</td>
<td>Utilities and Fluid Flow and Heat Transport</td>
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The graduates with Industrial Chemistry are better suited for the job requirements in an industrial environment. As the course covers almost all the aspects of a chemicals industry, these students will be suitable for any Department in Chemical industry, like production Q.C., product development effluent treatment etc. They will be better motivated and chances of going up in the organization will be much higher. The suggested course is for the most part, general in nature and they could be absorbed in any Chemical Industry. The students will be able to start or be employed in village industries based in agricultural raw materials or agro based industries such as insecticides. They will also be suitable in Technical Marketing of product. They can be employed by the Government in Factory Inspectorate, Pollution Control agencies and other development agencies. There is scope for them to be employed in Banks. Financial Institutions etc., where their experience may be utilized in Project Appraisals for purposes of financing projects. Thus, a graduate in Industrial Chemistry will be a better motivated and more useful person in the Chemical Industries and allied Government and non-Governmental bodies. It is anticipated that there will be very good demand for these graduates.
The practicals in Industrial Chemistry B.Sc. course can be conducted in the present Chemistry undergraduate laboratories. At present, generally 40/60 students work in the laboratory and they are divided into two/three batches of 20 students each. The same strength may be maintained for the Ind. Chem. course. The normal agents, chemicals and lab-wares provided to the Chemistry students are sufficient for Ind. Chem. students. Additional minor equipments required are given below semester wise. No costly sophisticated equipments are required for the entire course.

**Paper A** - No. additional equipments required.

**Paper B** - Refractometer, Tensiometer/stalgmometer, Polarimeter, Viscometer (Ostwald).

**Demonstration Experiments:** Different types of valves, fittings, Laboratory models of filters, dryers, impeller
B.Sc.  Semester-I  
Paper A

Industrial Aspects of Chemistry

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Unit I
Fractionation of crude oil, cracking, reforming, hydroforming, isomerisation.
Coal: Types, structure, properties, distillation of Coal, Advantages and disadvantages of coal.

Unit II
Cellulose; Viscose manufacturing and Cellulose acetate manufacturing, Manufacture of starch, dextrin and dextrose from corn, Alcohol and alcohol based chemicals oxalic acid, furfural
Basic metallurgical operations- Pulverisations, Calcinations, Roasting, Refining

Unit III
Physicochemical principles of extraction of –Iron, Lead
Silver, Sodium, Aluminum.

Inorganic materials of industrial importance-Their availability, forms, structure and modification.
Alumina, silicates and types zeolites.

Unit IV
Surface chemistry and Interfacial phenomena, Adsorption isotherm, Sols, Gels, Emulsions.
Microemulsions, Micelles, Aerosols, Effect of surfactants

Catalysis: Introduction, Types-Homogeneous and Heterogeneous, Catalytic poisoning, Autocatalysis, Negative catalysis.
Introduction to phase transfer catalysis.
Suggested Books


Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.
III. All questions carry equal marks.
Matrerial and Energy Balance

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Industrial Chemistry and their applications. The syllabus pertaining to B.Sc. (Semester system) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT I

Dimensions and units: Basic Chemical Calculations-Atomic weight, molecular weight, equivalent weight, mole, mole fractions Material balance
The concept of material Balance, Open and closed systems, Steady state and Unsteady state systems, Multiple component systems, Accounting for Chemical Reactions in material balances, Material balance for batch and semi batch process Concept of limiting reactant conversion, yield. (Qualitative treatment only).

UNIT II

Energy Balance Heat capacity of pure gases and gaseous mixtures at constant pressures. Sensible heat changes in liquids, enthalpy changes. (Qualitative treatment only).

Distillation- Introduction, Batch and continuous distillation, Separation of azeotropes, Plate columns and packed columns

Absorption- Introduction: Equipments- packed columns, spray Columns, bubble columns, packed bubble columns, mechanically agitated contractors.

UNIT III

Evaporation- Introduction, Equipments- short tube (standard) Evaporator, forced circulation evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporator

Filtration- Introduction, filter media and filter aids, equipments- plate and frame filter press, nutch filter, rotary drum filter, sparkler filter, candle filter, bag filter, centrifuge.

Drying- Introduction, free moisture, equipments- tray dryer, rotary dryer, flash dryer, fluidized. bed dryer, drum dryer, spray dryer.

Extraction- Introduction: selection of solvent
UNIT IV

Fuel- types of fuels- advantages and disadvantages of combustion of fuels, calorific value, specifications for fuel oil.

Boilers- types of boilers and their functioning.

Water- specifications for industrial use, various water treatments, desalination

Air- specifications for industrial use, Processing of air.

Heat Transfer: Heat exchangers- shell and Tube type; finned tube heat exchangers, plate heat exchangers.

Suggested Books


Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.

IV. Complex numerical problems not to be asked.
Practical (A and B Combined)

Simple techniques used in Chemistry lab
1. Calibration of thermometers
2. Fractional Crystallization (Copper Sulphate-Mohr Salt Solution)
3. Distillation: Simple, Vacuum, Fractional, Distillation (1 Expt. Each)
4. Filtration: Simple Filtration, Vacuum Filtration
5. Preparation of Standard solutions of NaOH, KMnO4, H2SO4, HCl, Oxalic Acid, Na2CO3 with introduction to primary and secondary standards.
6. Determination of sulphuric acid and phosphoric acid in a mixture.
7. Determination of Elevation and depression in b.p/m.p of liquids. Determination of Vant Hoff Factor, Degree of Dissociation in strong electrolyte.

Applications of Refractometer, Polarimeter, Stalagamometer, Viscometer.
8. Determine the Refractive Index and polarizability of a given liquid using a refractometer.
9. Determine the concentration of sugar in a solution refractometrically
10. Determine specific rotation of a given compound.
11. Determine the percentages of two active substances in a solution with polarimeter.
12. Identify whether the given compound is dextro-rotatory or laevo rotatory.
13. Compare cleansing power of detergents (any two) with stalagamometer.
14. To measure the interfacial tension.
15. Determine molar mass of polymers by viscosity method
16. Study the variation of viscosity of ethanol-water with change in composition

Phase Diagram, Chromatography and Ore analysis
17. Construct a Phase Diagram: Water, Chloroform and Acetic Acid ternary system
18. Application of Thin layer chromatography

Instructions for paper setters and candidates:

General Instructions to the Examiners:
Note: Practical examination will be of four hours duration & shall consist of the following questions:
Q. No. I Expt 1-7 (Perform 1 expt out of two offered) 12 marks
Q. No. II Expt 8-14 (Perform 1 expt out of two offered) 12 marks
Q. No. III Expt 15-18 (Perform 1 expt out of two offered) 12 marks
Q. No. IV Viva-Voce 8 marks
Q. No. V Note Book 6 marks
TRAINING/WORKSHOP/INDUSTRIAL VISITS

8 Credits

i. Visit to a local industry during the year and students to submit a report on the same. The report should contain information about: Raw materials used in industry, Steps involved in manufacturing, Finished product and quality control measures involved.

ii. A demonstration be given to students regarding use of excel for managing data and making graphs.

iii. Demonstration on use of software likes ISIS Draw, Chem Draw or related software available free on the internet.

iv. Each student to deliver a seminar/power point presentation relevant to theory/practical syllabus.

Suggested Books

Outlines of tests, syllabi and course of reading for B.Sc. (Semester system) examinations in the Elective of “Industrial Chemistry” 2015-2016

OBJECTIVE OF THE COURSE

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Subject Title: “Industrial Chemistry (Elective)”

B.Sc. (General) Semester-III:

Paper A: Core 231, 232 & 233 i.e. Material balance and Unit processes in Org. Chem. Manufacture I & II. 75

B.Sc. (General) Semester-IV

Paper B: Core 244, 245 & 246 i.e. Pollution, Effluent Treatment and Waste management and Process Instrumentation. 75

Practicals: Total combined practicals mentioned under B.Sc. II year (Semester III and IV)

The Entrepreneurship Development course. Non-credit 50

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**B.Sc. SEMESTER-III**
**PAPER A**

**Material science**

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**Unit-I**

Mechanical properties of materials and change with respect to temperature; Elasticity, Electrical and Thermal conductivity.

**Materials of constructions used in Industry**

**Metals and alloys:** Purpose of making alloys, Alloy Steels: Heat resistant, Corrosion resistant, magnetic stainless steels, High speed steels, Brass, Bronze, super alloys,

**Cement:** Types of cement, composition, manufacturing process, setting of cement.

**Ceramics:** Introduction, types, properties, manufacturing processes, applications.

**Polymeric materials:** Constituents of plastic, initiators, inhibitors, Moulding of plastics into articles, Spinning of fibres, mercerization.

**UNIT II**

8L

**Nitration:** Introduction-Nitrating agents, Kinetic and mechanism of nitration processes such as nitration of: Paraffinic hydrocarbons, Benzene to nitrobenzene and m-dinitrobenzene Acetanilide to p-nitroaoacetanilide, Continuous vs batch nitration.

**Halogenation:** Introduction-Kinetics of halogenation reactions, Reagents for halogenations, Halogenation of aromatics-side chain and nuclear halogenations.

Commercial manufactures- chlorobenzenes, chloromethanes, Mono Chloroacetic acid

**UNIT III**

7L

**Oxidation:** Introduction- Oxidizing agents, Kinetics and mechanism of oxidation of organic compounds Liquid phase oxidation, Vapour phase oxidation Commercial manufacture of benzoic acid, maleic anhydride, phthalic anhydride,

**Esterification:** Commercial manufacture of-ethyl acetate, cellulose acetate.

**Hydrolysis:** Introduction, hydrolyzing agents, mechanism of hydrolysis
UNIT IV


Alkylation: Introduction-Types of alkylation, Alkylation agents Manufacture of-alkylbenzenes (for detergent manufacture); ethylbenzene, phenyl ethyl alcohol, N-alkyl anilines (mono ethyl anilines).

Amination: Methods of reduction-iron and acid reductions, other metal and acid reductions: zinc, tin, electrolytic reductions, metal and alkali reductions, commercial manufacture of aniline, p-amino phenol.

Suggested Books


Instructions for paper setters and candidates:

I. Examiner will set total of NINE questions comprising TWO questions from each unit and ONE compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt FIVE questions in all, ONE question from each unit and the Compulsory question.

III. All questions carry equal marks.
OBJECTIVE OF THE COURSE

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UNIT-I
Air, Oxygen, nitrogen cycle, water Biosphere flora and fauna energy soil.
Pollutants and their statutory limits.
Pollution evaluation methods.
Air pollution-Various pollutants.
Water pollution-Organic/inorganic pollutants.
Sewage analysis, Sludge Treatment
Pesticide pollution

UNIT II
Principles and equipments for aerobic, anaerobic Treatment, adsorption, filtration, sedimentation.
Bag filters, electrostatic precipitator mist eliminators wet scrubbers Absorbers

UNIT III
Solid waste disposal and management,
concept of measurement and accuracy
Instrumental Techniques of Environmental Chemical Analysis:
HPLC, GC, Atomic Absorption spectrophotometer, Ion Chromatography

UNIT IV
Temperature- glass thermometers bimetallic
Thermometer pressure spring thermometer, vapour filled
Thermometer, resistance thermometers.
Pressure- Manometers, barometers bourdon
Pressure gauge bellow type, diaphragm type pressure gauges
macleod gauges, Pirani gauges etc.
Liquid level: Direct- indirect liquid level
Density measurement and viscosity measurement
**Suggested Books**


**Instructions for paper setters and candidates:**

I. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.
I. **Unit process:**
   - Nitration: Nitration of benzene/acetonilide
   - Sulphonation: To prepare sulphanilic acid from aniline
   - Friedel-crafts reactions: To prepare acetophenone/toluene from benzene
   - Esterification: Conversion of acetic acid into ethyl acetate
   - Hydrolysis: To prepare p-nitroaniline from p-nitroacetonilide
   - Polymerization: Preparation of Nylon 6,6 etc. (any One)

II. **Instrumental methods of analysis**

   **Use of colorimeter:**
   1. Verify beer’s law for KMnO₄ and K₂Cr₂O₇ solution and measure concentration of given solution of unknown concentration
   2. Determine iron in a sample of water colorimetrically

   **pH meter,**
   1. Find the normality and strength of a given NaOH solution by titrating against Standard HCl using a pH Meter
   2. Titrate Phosphoric acid and NaOH using pHmetry

   **Potentiometer,**
   1. Titrate HCl and NaOH Potentiometrically
   2. Determine dissociation constant of acetic acid using potentiometer

   **Conductometer,**
   1. To verify Debye-huckel onsager equation.
   2. Study the variation of conductance with dilution in case of strong and weak electrolytes.
   3. Verify Kohlrauch Law. e.g. Find Molar Conductance of Acetic acid at infinite dilution

   **Polarimeter,**
   **Flash Point Apparatus**
   1. Determine the flash point and fire point of oils

**Material testing:**
1. Testing of alloys: Any one out of brass/bronze/nickel coin/silver coin//solder
2. Identification of plastics/rubber Estimation of yield point young’s modulus,
3. Optical thermal mechanical and electrical properties.
4. Use of Transducers for measuring flow control.
5. Water analysis-solid content, Hardness, COD and other tests as per industrial specifications.
7. Monographs of representative raw materials such as sulphuric acid, sodium carbonate, sodium hyroxide,
8. Limit tests for heavy metals Pb. As, Hg, Fe and ash content.

**Instructions for paper setters and candidates:**

**General Instructions to the Examiners:**

*Note: Practical examination will be of four hours duration & shall consist of the following questions:*

- Q. No. I Unit Process (Perform 1 expt out of two offered) 12 marks
- Q. No. II Instrumental methods of analysis((Perform 1 expt out of two offered) 12 marks
- Q. No. III Material testing ((Perform 1 expt out of two offered) 12 marks
- Q. No. IV Viva-Voce 8 marks
- Q. No. V Note Book 6 marks
TRAINING/WORKSHOP/INDUSTRIAL VISITS (8 Credits)

i. Visit to a local industry during the year and students to submit a report on the same. The report should contain information about: Raw materials used in industry, Steps involved in manufacturing, Finished product and quality control measures involved. (Different from the one submitted in 1st Year)

ii. A demonstration be given to students regarding use of excel for managing data and making graphs.

iii. Submission of worksheets based on Internet Software like ISIS Draw, Chem Draw and Use of 3D Software like MDL Chime, Cosmo Player etc.

iv. Students will also submit a project report on water-effluent analysis/soil analysis/food adulteration etc. (Different from the one submitted in first year)

v. Student to submit a report on one small scale unit: Safety matches, Naphtalene balls, Wax candles, Shoe Polish, Gum Paste, Pen Ink, Chalk, Plaster of paris

vi. Each Student to present a seminar relevant to the syllabus.
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Subject Title: “Industrial Chemistry (Elective)”. 

B.Sc. (General) Part III

Paper A: Core 351, 352 & 353 i.e. Chemical Process Economics, 75
Industrial Organization & Industrial Chemical Analysis.

Paper B: Core 364, 365 & 366/I or II or III or IV or V or VI or VII i.e. 75
out of Pharmaceuticals, Heavy & Fine chemicals, Petrochemicals,
Waste recycling, Agrochemicals, Dyes & Polymers-any one elective is to be selected.

Practicals: (a) Practicals mentioned under B.Sc. III (Pr A & B) 50

NOTE: The Entrepreneurship Development Course will be taught in the 3rd and 4th semester programme of B.A./B.Sc. This course being a non-credit course, the examination will be conducted by the Colleges themselves as they do for the House Examination. The result is to be conveyed in a sealed cover to be Deputy Registrar (Secrecy) P.U., Chandigarh well before the commencement of the annual Examination in April/May.
OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Industrial Chemistry and their applications. The syllabus pertaining to B.Sc. (3 Year Course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

Factors involved in project cost estimation, Methods employed for the estimation of capital investment. Capital formation, Elements of cost accounting Interest and investment costs, Time value of Money-equivalence.
Some aspects of marketing pricing policy. Profitability criteria Economics of selecting Alternatives.
Variation of cost with capacity break-even Point. Optimum batch sizes, production scheduling etc.

Suggested Books
Economics of Chemical Industry, Hempel. E.H

UNIT-II

Concept of scientific management in Industry
Functions of management decision making Planning organizing directing and control.
Location of industry, Materials management Inventory control Management of human resources-selection Incentives, welfare and safety.

Suggested Books
2. Industrisl Organization and Management, Bethel L.L.
3. Industrial Engineering and Management Science, Banga T.R.,Agarwal N.K
4. Business Organisation and Management,Bhushan Y.K.

UNIT-III

Industrial Analysis-
Sampling procedures sampling of bulks materials
Techniques of sampling solids liquids and gases
Advanced Chromatography techniques GLC, HPLC
Particle size determination
Rheological properties of liquids plastics and their analysis
**Suggested Books**


**UNIT-IV**

**Modern instrumental methods of analysis**

Structure elucidation Problems based on combined UV, IR and NMR spectroscopy only be done (Students are expected to have done theory and principals of UV, IR and NMR in BSc III Organic Chemistry)


**Suggested Books**


**Instructions for paper setters and candidates:**

I. Examiner will set total of **NINE** questions comprising **TWO** questions from each unit and **ONE** compulsory question of short answer type covering whole syllabi.

II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.
OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Industrial Chemistry and their applications. The syllabus pertaining to B.Sc. (3 Year Course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

Pharmacopoeias-Development of India Pharmacopoeia and Introduction to B.P., U.S.P., E.P., N.F. and other important Pharmacopoeias.

Introduction to various types formulations and roots of Administration.

Aseptic conditions need for sterilisation, various methods of sterilisation.

A brief introduction to Glidants, lubricants, diluents, preservatives, antioxidants, emulsifying agents, coating agents binders, colouring agents, flavouring agents gelatin and other additives sorbitol, mannitol viscosity builders etc.

Suggested Books


UNIT-II

Surgical dressings sutures ligatures-with respect to the Process equipments used for manufacture method of sterilization And quality control.

Pharmaceutical packaging-Introduction package Selection, packaging materials, ancillary materials. Quality control of packaging materials. FDA, Important schedules and some legal aspects of drugs

Phytochemicals-Introduction to plant classification and Crude drugs cultivation collection preparation for the market and storage of medicinal plants.

Evaluation of crude drugs-Moisture content Extractive Value volatile oil content foreign organic matter.

Introduction to chromatographic method of identification of crude drugs.
Suggested Books

UNIT-III

Chemical constitution of plants: waxes, volatile oils, terpenoids, steriods, saponins, flavonoids, tannins, glycosides, alkaloids.

Various isolation procedures for active ingredients With example for alkaloid e.g., Vinca alkaloids, steroids; Sapogenin

Pharmaceutical quality control (other than the Analytical methods covered under core subject) Sterility testing Pyrogenic testing glass testing bulk density of powder etc.

Classification of various types of drugs with examples. Raw materials, process of manufacture effluent handling etc., of the following bulk drugs

1. Sulpha drugs-Sulphaguandine, sulphamethoxazele
2. Antimicrobial-chloramphenicol, furazolidine

Suggested Books
5. Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One Supplement (Addendum 2008).
Classification of various types of drugs with examples. Raw materials, process of manufacture, effluent handling etc. of the following bulk drugs:
Steroidal hormones-Progesterone, Testosterone
Vitamins-Vitamin A, Vitamin C
Barbiturates-Pentobarbital
Blickers- Propranolol, atenolol
Cardiovascular agent-Methyl dopa
Antihistamines-Chlorpheniramine maleate.

General principle of fermentation processes and product processing.
Manufacture of antibiotics: Penicillin-G and semi synthetic penicillin,
Biotransformation processes-for prednisolone, 11-hydroxylation in steroids.
Enzyme catalyzed transformation manufacture of ephedrine.

**Suggested Books**
5. Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One Supplement (Addendum 2008).

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II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.
Practicals (A)

1. Industrial Analysis—Analysis of common raw materials as per the industrial specifications, such as phenol, aniline, hydrogen peroxide, acetone, oils, etc. 6 expt

2. Synthesis of common industrial compounds involving two step reactions for example 4-Bromoaniline, 3-nitroaniline, sulphanilamide, 4-Aminobenzoic acid, 4-Nitrobenzoic acid, Dihalobenzenes, Nitrohalobenzenes 9 expt

Practicals (B)

1. Demonstration of various pharmaceutical packaging Materials, Quality control tests of some materials Aluminium strips, cartons, glass bottles. 2 expt.

2. Limit tests for chlorine, heavy metals, arsenic, Etc. of two representative bulk drug. 2 expt.

3. Demonstration of various pharmaceutical products. Active ingredient analysis of few types of formulations Representing different methods of analysis Acidimetry, Alkalimetry, nonaqueous complexometry, potentiometry etc. 3 expt.

4. Determination of sulphate ash, loss on drying and other tests of bulk drugs, complete I.P. monograph of three drugs representing variety of testing methods. 2 expt.


6. Microbiological testing-Determination of MTC of some antibacterial drugs by zone/cup plate method. 2 expt.

Instructions for paper setters and candidates:

General Instructions to the Examiners: Total Marks 50

Note: Practical examination will be of four hours duration & students shall perform three experiments:

Q1. Two experiments be set from Practical (A) part. Student to perform any one experiment. 12

Q2. Two experiments be set from Practicals (B) based on S.No. 1, 2, 3 Student to perform any one experiment. 12

Q3. Two experiments be set from Practicals (B) based on S.No. 4, 5, 6 Student to perform any one experiment. 12

Q4. Viva 08

Q5. Note Book 06
TRAINING/WORKSHOP/INDUSTRIAL VISITS (8 Credits)

1. Visit to a local industry during the year and students to submit a report on the same. The report should contain information about: Raw materials used in industry, Steps involved in manufacturing, Finished product and quality control measures involved.

   (Different from the one submitted in 1st Year)

2. Students will also submit a project report on water-effluent analysis/soil analysis/ food adulteration etc.(Different from the one submitted in first year)

3. Each Student to present a seminar relevant to the syllabus.
THIRD YEAR ELECTIVE SUBJECTS
PAPER B
PHARMACEUTICALS

OBJECTIVE OF THE COURSE
To teach the fundamental concepts of Industrial Chemistry and their applications. The syllabus pertaining to B.Sc. (3 Year Course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

IC 321  Historical background and development of pharmaceutical Industry in India in brief.
Pharmacopoeias- Development of India Pharmacopoeia and Introduction to B.P., U.S.P., E.P., N.F. and other important pharmacopoeias. 2 L
Introduction to various types formulations and roots of Administration. 2 L
Aseptic conditions need for sterilisation, various methods Methods of sterilisation. 3 L
Various types of pharmaceutical excipients-their Chemistry, process of manufacture and quality specifications- 4 L
Glidants, lubricants, diluents preservatives antioxidants, emulsifying agents coating agents binders colouring agents flavouring agents gelatin and other additives sorbitol mannitol viscosity builders etc. 4 L

SUGGESTED BOOKS
Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One Supplement (Addendum 2008).
The British Pharmacopoeia 2010

UNIT-II

IC 322  Surgical dressings sutures ligatures-with respect to the process equipments used for manufacture method of sterilization and quality control. 3 L
Pharmaceutical packaging-Introduction package 4 L
Selection packaging materials ancillary materials packaging machinery quality control of packaging materials.
FDA, Important schedules and some legal aspects of drugs Phytochemicals-Introduction to plant classification and Crude drugs cultivation collection preparation for the market and storage of medicinal plants. 3 L
Evaluation of crude drugs-Moisture content Extractive 2 L
Value volatile oil content foreign organic matter.
Quantitative microscopic exercises including of starch leaf content
(Palisade ratio stomatal number and index vein islet number and
vein termination number) crude fibre content. Introduction to chromatographic
method of identification of crude drugs. 3L

SUGGESTED BOOKS
Lemke T.L., Williams D.A., Foye’s Principles of Medicinal Chemistry, Pubs: Lippincott
Williams & Wilkins, 2007.
Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One
Supplement (Addendum 2008).
The British Pharmacopoeia 2010

UNIT-III

IC 323  Chemical constitution of plants-including carbohydrates
Amino acids, proteins fats waxes, volatile oils, terpenoids, steriods,
saponins, flavonoids, tannins, glycosides, alkaloids. 3L

Various isolation procedures for active ingredients
With example for alkaloid e.g., vincaalkaloids, reserpin one for steroids
sapogenin osogin, diagroh. 4L

Pharmaceutical quality control (other than the
Analytical methods covered under core subject) Sterility testing
Pyrogenic testing glass testing bulk density of powder etc. 3L

Classification of various types of drugs with examples.
Raw materials, process of manufacture effluent handling etc., of the
following bulk drugs
4. Sulpha drugs-Sulphaguandine, sulphamethoxazele
5. Antimicrobial-chloramphenicol furazolidine mercurochrome
isoniazid Na-PAS.
6. Antalgesicranti-inflammatory-salicyclic acid and its derivatives,
luprofen, mefenamic acid. 5L

SUGGESTED BOOKS
Williams & Wilkins, 2007.
Wiely Interscience, 2008.
11. Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One
Supplement (Addendum 2008).
UNIT-IV

IC 324 Classification of various types of drugs with examples.
Raw materials, process of manufacture effluent handling etc.,
of the Following bulk drugs
Steroidal hormones-Progesterone, Testosterone, methyl testosterone.
Vitamins-Vit. A, Vit. B6, Vit. C
Barbiturates-Pentobarbital
Blickers-Propranolol, atenolol
Cardiovascular agent-Methyl depa
Antihistamines-Chlorophener amine maleate. 6L

Products based on fermentation processes
Brief idea of microorganisms, their structure, growth and usefulness.
Enzyme systems useful for transformation microbial products. General
principle of fermentation processes and product processing. 5L

Manufacture of antibiotics-Penicillin-G and semisynthetic penicillins,
Rifamycin, tetracyclins, Vit, B12. Biotransformation processes-for
prednisolone, 11-hydroxylation in steroids.
Enzyme catalyzed transformation manufacture of ephedrine. 4L

SUGGESTED BOOKS

Williams & Wilkins, 2007.
Wiley Interscience, 2008.
11. Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One
Supplement (Addendum 2008).

Instructions for paper setters and candidates:
I. Examiner will set total of NINE questions comprising TWO questions from each unit
and ONE compulsory question of short answer type covering whole syllabi.
II. The students are required to attempt FIVE questions in all, ONE question from each
unit and the Compulsory question.
III. All questions carry equal marks.

Practicals (B)

1. Demonstration of various pharmaceutical packaging
   Materials, Quality control tests of some materials
   Aluminium strips, cartons, glass bottles. 4 expt.

2. Limit tests for chlorine, heavy metals, arsenic,
   Etc. of two representative bulk drug. 3 expt.

Demonstration of various pharmaceutical products. 7 expt.
Active ingredient analysis of few types of formulations representing different methods of analysis: Acidimetry, Alkalimetry, nonaqueous complexometry, potentiometry, etc.

Determination of sulphate ash, loss on drying and other tests of bulk drugs, complete I.P. monograph of three drugs representing variety of testing methods.

Evaluation of crude drugs-Microscopic examination


Microbiological testing-Determination of MTC of some antibacterial drugs by zone/cup plate method.
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UNIT I

IC 331 Manufacture of the following with reference to (i) consumption Pattern (ii) Raw materials (iii) Production process (iv) Major engineering aspects (v) Special material of constructions (vi) Quality control (vii) Hazards ana safety (viii) Effluent management. 6L

Synthetic nitrogen products-Ammonia, nitric acid ammonium nitrate and ammonium sulphate. 3L

Chlor-alkali industrial products- Caustic soda Chlorine. Phosphorus chemicals-Phosphorus, phosphoric acid ammonium phoaphate, superphosphate, triple superphosphate. Industrial carbon-carbon blacks, manufactuer of graphice and carbon. 3L

Lime, gypsum,
Silicon, calcium carbide, silicon carbide
Flourine, Bromine, Iodine, hydrobromic acid, Interhalogen compounds. 3L

UNIT II

IC 332 Sodium chloride, sodium sulphate, sodium sulphite, sodium thinosulphate, borax boric acid.
Industrial catalysts-Raney nickel other forms of nickel palladium and supported palladium copper chromate, vanadium and platinum based catalyst. 6L

Aluminium alkoxides, titanium tetrachloride, and titanates, titanium dioxide. Manufacture of the following with reference to (i) Raw materials (ii) Flow chart (iii) Effluent management (iv) Kinetics (v) Uses 3L

Fischer-Tropsch Synthesis-Examples

Applications and uses of zeolites as catalyst. Their use in isomerization and dehydrogenation/dehydroxyllation. 3L

Chemicals derived from acetylenes-Acetylene, propyl alcohol 1,4-butene diol, acrylates, vinyl esters, vinyl chloride. Pyridine, picolines, phenol, acetone, resorcinol, phthalic, anhydride. 3L
UNIT-III

IC 333

Glycerol, sorbitol, melamine, formaldehyde, formic acid,
Triphenyl phosphine, alkyl phosphates chlorination of
methane-to methyl chloride, dichloromethane chloroform carbon tetrachloride.
Ethanolamine, mono-di-tri ethanolamines, Dialkyl
aminoethanols (dimethyl, diethyl).
Alkylamines-Methylamine, ethylamine, di-tri
alkylamines (methyl, ethyl) butyl amines, propyl amines. 5L
Ketene, ethyl and methyl acetoacetates.
Acetaldehyde, paraaldehyde
Speciality industrial solvents-DMF, DMSO, sulpholane
alkylpyrrolidone, THF, dibutyl ether, diethyl ether, diglyme
dimethoxy ethane dioxane. 4L

Reagents- Laboratory chemicals from heavy chemical
Industry in required purity-Acids, alkalis, carbonates, drying agents. Analytical
reagents-Sodium carbonate, sodium bicarbonate, potassium dichromate, oxalic
acid perchloric acid, Common solutions-Fehling solution, karlfisher reagent. 3L

Chromatographic materials and HPLC solvents- Coating
material, precoating of plates, Spectroscopy grade chemicals methanol, ethanol,
potassium bromide, carbon tetrachloride nujol, chloroform. 3L

UNIT-IV

IC 334

Biochemical reagents-Ninhydrin, tetrazolium blue, 1,2-
Naphthaquione-4-sulphonate. 2L

Manufacture of following fine chemicals with reference to
(i) Raw material of common industrial compound involving two step
reactions-for example 4-Bromoaniline, 3-itoanilinesulpherteral
(ii) Production process
(iii) Special material of construction (iv) Hazard and safety
(v) Effluent management
(vi) Quality control (vii) Specifications.
Sodium borohydrate, lithium aluminium hydride sodium
Amide, sodium ethozide, sodium methoxide
Paracetamol, 5L
Indigo vat dyes, reactive dyes
Essential oils-general, organic flavour, camphor, citral, citronellor, menthol
Surfactants and emulsifying agents-PEG, Tweens, Spans. 3L

Colouring agents-Manufacture of some natural colours and synthetic colours
flavouing agents-Fragrances and Food additives.
Natural tartaric acid (i) tartaric acid Resolution of Tartaric acid
Citric acid 5L
Chemicals required for electronic industry
SUGGESTED BOOKS


Instructions for paper setters and candidates:
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III. All questions carry equal marks.

PRACTICALS (B)
Preparation of Raney-Nickel from Ni-Al alloys and testing its properties. 1 L
Any one reaction using the above catalyst. 1 L
Preparation of synthetic zeolites. 2 L
Preparation using zeolites. 2 L
Preparation of aluminium isopropanoxide and reactions using the same. 4 L
Synthesis of trimethyl phosphate and related reagents 4 L
applications of this for o-alkylation and N-alkylation.
Preparation of reagent grade chemicals-Sodium carbonate 6 L
sulphuric acid etc., solvents etc.Synthesis of few fine chemicals -for example, Amyl acetate, floavour chemicals Paracetamol, sulphanalamide.
Purification of lemon grass oil to obtain citral.
Resolution of farteric acid and-phehyl ethyl amine. 6 L
Isolation of some natural products, like tartaric acid citric acid, etc. 4 L
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UNIT-I

IC 341  Introduction to crude oil, exploratory methods, oil reservoirs, transportation of crude oil, Constitution of crude oil, Natural gas-constituents
Distillation of crude oil, Separation of natural gas and different fractions based on relative volatilities, Compositions of different distillates
Meaning of terms such as-Pour point depressants, drag reducers, viscosity reducers ignition point, flash point, octane number, doctor solution.
Types of hydrocarbon fuels and their characteristics
Detailed discussion of the following operations with respect to process, mechanism, catalysts used and applications, Cracking-Catalytic cracking

UNIT-II

IC 342  Hydrocracking, Isomerization, Reforming, Isomerization, Alkylation.
Sulphur, hydrogen, petroleum coke and nitrogen Compounds from petroleum.
General discussion of the following reactions with respect to mechanism and applications-Oxidation ammonidation, hydro-formylation, hydration.

UNIT-III

IC 343  Manufacture of the following compounds. Methane ethylene, acetylene, propylene, C-4, Hydrocarbons, higher olefins.
Preparation of reagent grade chemicals-Sodium Carbonate black, hydrogen cynide, chlorinated Methanes, carbon disulphidez.
Preparation of the following from ethylene-Ethyl chloride, ethanol, ethylene oxide, ethylene glycol, acetaldehyde, acetic acid, styrene, vinyl acetate, ethanolamines, vinyl chloride, acrylonitrile.
UNIT-IV

IC 344

Manufacture of the following from propylene
- Isopropanol, cumene, glycerine, acrylonitrile. 2L
- Manufacture of the following from acetylene
  - Vinyl chloride chloroprene, acrylonitrile, acetaldehyde. 2L
- Manufacture of the following from C-4 hydrocarbons
  - Butadiene, isobutene, isobutene, butanediols, oligomers 2L
- Manufacture of aromatic compounds
  - Benzene, toluene, xylenes, naphthalene, linear alkyl benzenes and their sulphonates, detergents. 3L

- Various catalysts used in petrochemical industry,
- Preparation structure applications and selectivity. 2L
- Importance of petroleum and petroleum industry in the context of Indian economy.

- Indian petrochemical industry-Indian reserves, quality and petroleum distribution, Future. 4L

SUGGESTED BOOKS


Instructions for paper setters and candidates:

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III. All questions carry equal marks.

Practicals (B)

- Viscosity-Viscosity of hydrocarbons and hydrocarbon mixture, Effect of Viscosity reducers.
- Surface tension-Surface tension of different liquids, effect of surfactants.
- Flow measurement in pipes of different materials effect of drag reducers.
- Measurement of flash point, ignition point, pour point of pour point departments.
- Determination of calorific value
- Preparation of a few catalysts used in petrochemicals industry like doped silica gel aluminas treatment of silica gel and alumina with acids.
- Characterization of coke.
- Characterization of bitumen.
- Characterization of petrol kerosene, diesel, furnace oil, with respect to flash point viscosity, surface tension compositions distillation fractions.
- Hydration of olefins- styrene.
- Dehydration of alcohols-tert-butanol.
- Sulphonation of aromatics and preparation of the sodium salt of the sulphonic acid as a detergent.
B.Sc. THIRD YEAR ELECTIVE SUBJECTS  
PAPER B  
WASTE RECYCLING

OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Industrial Chemistry and their applications. The syllabus pertaining to B.Sc. (3 Year Course) in the subject of Chemistry has been upgraded as per provision of the UGC module and demand of the academic environment. The course contents have been revised from time to time as per suggestions of the teachers of the Chemistry working in the Panjab University, Chandigarh. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills.

UNIT-I

IC 351 Need for waste recycle: Limitations of raw material resources, waste elimination
Conversion of waste into useful products
Identification and quantification of industrial domestic and agro waste.

Feasibility of recycle, Separation of wastes-solid, Liquid, gaseous. 3L

Solid wastes: Removal of solid contaminants from water
by coagulation, sedimentation, flocculation, solid waste disposal,
incineration, fuel palletization, soil conditioning. 5L

Water management: Waste water treatment. Biological,
physical and chemical treatment. 7L

UNIT-II

IC 352 Treatment of water and its reuse in industries, agriculture, oil refineries,
thermal power station and domestic uses. Reuse of cooling water. 7L

Physical and chemical processes used for the recovery of
Important compounds from waste
Activated carbon adsorption, ion exchange process, evaporation, extraction,
distillation, centrifugation, filtration, coagulation, membrane processes-
osmosis reverse, osmosis, electrodialysis, advanced oxidation processes 8L

UNIT III

IC 353 Pervaporation, freezing processes.

Biological processes for the treatment of waste water:
Trickle filters, activated sludge process, microbial degradations. 4L

Gaseous wastes:
Adsorption, catalytic/non-catalytic conversion recovery of important
gases, CO₂, SO₂, NOₓ, etc., electrostatic precipitation, bag filters,
wet/dry grid arrestors. 6L

Characterization of wastes, their management and
recovery of important compounds from the wastes from the following
industries: Dyestuff, Fertilizers, Textile 5L
UNIT-IV

IC 354 Water treatment of following industries:
Oil, fats and soap iron and steel plants 5L
Tanneries, slaughter houses, rubber, sugar, heavy chemicals, fermentation 5L
Thermal power stations, electroplating, paper, paint.
Economics of recycling of waste 5L

SUGGESTED BOOKS


Instructions for paper setters and candidates:

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Practicals (B)

Estimations of SO₂, NH₃, NOₓ
Estimation of hardness, acidity, alkalinity and pH of water.
Estimation of BOC, COD content of effluent water from different industries.
Analysis of the solid contents from the liquid effluent from different industries, separation of the constituents, chromatographic separation-TLC, paper chromatography.
**Ion exchangers:** Ion exchange capacity of resins, softening of hard water, separation of important metals, Fe. Ni, Cr from the effluents and their estimations.
**Activated carbon:** Efficiency of carbon, adsorption isotherms, separation of some important chemicals by adsorption on carbon.
Fuel pallets from garbage and solid wastes. Calorific value.
The students are expected to collect solid and liquid wastes from nearby industries and analyse with respect to constituents recovery of important constituents and disposal methods.
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UNIT-I

IC 361 Pests and pest control, Types of pests, Types of Chemicals used to control pests. 3L

Types of pesticides: Stomach poison, contact poisons systemic poisons, fumigants.

Insecticides:

Inorganic insecticides- Arsenic insecticides, Paris green, fluoro insecticides. 4L

Insecticides of plant origin–Nicotine, nornicotine, Pyrethroids, rotenoids, anabasin, allethrin. 3L

Chlorinated hydrocarbons-DDT, DDD, nestran dilan, Perthane, dikite, chlorobenzilate, suphenex. Ovotran, aramite, DFDT. SAR in the class and mode of action. 2L

UNIT-II

IC 362 BHC, chlordane, heptachlor, aldrin, doeldrin, endrin feodrin endosulfan, SAR in the class and mode of action. 4L

Organophosphorus insecticides: Introduction, Phosphoric acid derivatives-Dimecron, Dichlorovos, naled phosphinon, etc. SAR in the class.

Dithiophosphonic acid-derivatives-Melathion 6L

Dimethoate, thiocron, formothion, mecarbam etc.

Thiophosphoric acid-Parathion, methyl parathion, 5L

UNIT-III

IC 363 Thiophos, demetron, chlorthion, paraoxon, etc.

Phyrophosphoric acid derivatives-TEPP, sulfotepp, schradan 3L

other organophosphorus, insecticides-Isopestox, trichlorofon, IPN. 2L

Carbamate insecticides- Carbaryl, isolan, mesurol, zectran, demetram, pyrolan, baygon, mode of action. 3L

Fungicides-General introduction

Inorganic fungicides- Sulphur, Lime sulphur, copper sulphate, Bordeaux mixture, Bordeaux paste, Bordeaux paint, Burgundy mixture, copper oxychloride, cuprous oxide, mercurous chloride. 4L
**Orgenomericuric compounds**- ethyl mercuric chloride, Ceresin-M, panogen, agalol, uspulan, puratized, germisan, Mode of action, agresan GN 3L

**UNIT-IV**

**IC 364**

**Dithiocarbamates**- Ziram, ferbam, thiram, nabam, Zineb, maneb, captan, hinesanm vapam, etc., mode of action. **Miscellaneous fungicides**- Dithanon, dichlons, captan, polpet, difolatan, mesulfan, brestan, dodine, glyodin, methyrimol, terrazele. 3L

**Herbicides**- Introduction 2,4,D, 2, 4-DB, 2, 4-DES, MCPB, 2, 4, 5-T. Monujron, Fenuron, TCA, paraquat. 2L **Fumigants**- HCN, CS, ethylene, balides, durofume, methyl halides. 3L

**Rodenticides**- Zice phosphides, warfarin, **Nematicides**- DD mixture, aldiearb, fensulfothion. **Plant growth regulators**- Introduction, gibberilic acids, indole acetic and butyric acids Naphthalene acetic acid, cyccocil. Mode of action. 4L **Formulation of pesticides**- Dry formulation Dusts, granules, wettable powders, seed disinfectants liquid formulations Emulsions, suspensions, etc. 3L

**SUGGESTED BOOKS**


**Instructions for paper setters and candidates:**

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II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.

III. All questions carry equal marks.

**Practicals (B)**

Isolation of nicotine from tobacco leaves/waste.
Preparation of copper sulphate, Estimation of copper in sulphate formulation, Formulations of copper sulphate.
Estimation of arsenic in arsenic insectioides.
Isolation and estimation of active ingredients of commercially available insecticide formulations.
Preparation of selected pesticide formulation in the form of dusts, emulsions, sprays.
Estimation of pesticide residues in food articles.
Study of the degradation of pesticides in soil in the presence of sunlight and moisture.
Determination of pesticide contents in the soil.
Effect of plant growth regulators on the development of plants and fruits.
Industrial visits to agrochemicals industry and submission of reports.
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UNIT-I

IC 371 Chemistry of Intermediates
Introduction of the History of Dyes. Natural to synthetic dyes, landmarks in the historical development. 5L

Benzene intermediates-Chloronitrobenzenes, Nitroanilines, Bromonitroanilines, Nitroanisoles, Toluene and xylene intermediates, xylidines, Diaminobenzenes, etc. 5L

Naphthalene intermediates- H- and J-acid, R-acid, acid, N-W-acid, Chicago acid, Schaffer R and G acid, Naphthols, Naphthol sulphonic acids, Naphthylamine sulphonic acids. 5L

UNIT-II

IC 372 Anthraquinone intermediates and miscellaneous intermediates
1-Amino and 2-amino anthraquinones, Bromanine acid, Quinazirin, methyl and methylamino anthraquinones, Disperse dye intermediates, Disperse-reactive intermediates, Acid-dye intermediates. 5L

Introduction classification of dyes on the basis of structure and the mode of application to the fibre. Colour and chemical constitution of dyes. 2L

Chemistry of the following dyes with respect to general structural features, chemistry, mode of application to fibre, colour shades, synthesis of typical 4-5 dyes., uses. 5L

Azodyes-Acid, acid mordant, direct, milling, and stilbene azo dyes 3L

SUGGESTED BOOK

UNIT-III

IC 373 Basic dyes
Anthraquinone (vat) dyes
Indigoid dyes
Reactive dyes
Disperse dyes 6L

Optical whiteness-Cyanuric chloride based optical whiteners. 3L

Analysis of intermediates-Different methods used in the analysis. Nitrite value determination, coupling value, titanous chloride reduction, chromatography, halogen content determination, set point,
iodimetry, metal estimations-Cu, Ni, Cr, etc. 6L

SUGGESTED BOOK

UNIT-IV

IC 374  Dyeing- General introduction to dyeing methods. Dyeing methods for the following dyes: Direct, acid, reactive, disperse, vat, cationic, sulphur, indigo, azoics. 7L

Quality control and factory layout for dyestuff industry 3L
Effluent treatment and pollution control in dye stuff industry. 5L

SUGGESTED BOOK

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Practicals (B)

1. Analysis of intermediates- Nitrite titrations, diazocoupling, titanous chloride titration, estimations of Cu, Ni, Cr, etc. TLC of intermediates, paper chromatography of dyes.

2. Dyeing – Dyeing of the following dyes on cotton-direct, Azoics, Acid-on wool and silk, TPM-on silk, Vat, Reactive, Sulphur.

   Evaluation of the fastness properties of dyes with respect to light, washing and sublimation.

3. Preparation of Methyl orange, Methyl red, orange II, Fluorescein, Anthraquinone.
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UNIT-I

IC 381
Brief history of macromolecular science. General characteristics of polymers in comparison with common organic compounds.
Nomenclature. Distinction between plastics, elastomers and fibres. 4L

Natural polymers- Cellulose, silk, gums, rosin and shellac
Types of polymers- Thermoplastics and thermosettings.
Functionality concept
Concept of crosslinking- Linear, branched and crosslinked polymers. 5L

Types of polymerization- Addition, condensation, ionic, coordination.
Addition-polymerisation-Mechanism, initiation, propagation and termination processes, initiator, inhibitors.
Mechanism of ionic polymerisation. 6L

UNIT-II

IC 382
Methods of polymerization- Bulk, suspension emulsion, solution.
Necessity of copolymers and copolymerisation, Blocks and graft copolymers
Detailed study of the following thermosetting polymers with respect to synthesis, chemistry, properties and applications.
(i) Phenol-formaldehyde resins
(ii) Amino-resins-Urea-formaldehyde and melamine formaldehyde resins
(iii) Polyurethanes 5L

Detail study of the following thermoplastic polymers with respect to synthesis, chemistry, properties and applications.
Polyolefine- Polyethylenes-HDP, LDP, LLDP, Polypropylene,
Ethylene-propylene copolymers. 6L

Polyvinyl chloride- Grades of PVC, Teflone
Polystyrene- Homopolymers, copolymers such as SER, ABS, SAN. 4L

SUGGESTED BOOKS
UNIT-III

IC 383  **Vinyl polymers**- Polyvinyl acetate and its modifications like PVA, PVB and polyacetals.  2L
        **Vinyl polymers**- Nylin-6, Nylon-66 and other Nylons.  2L

        **Polyethers and polyesters**- Terephthalates.
        **Cellulosics** such as esters, ethers, acetates, butyrate, nitrate, CMC, Regenerated celluloses.  4L

        **Molecular weight and molecular weight distribution**- Number, weight and viscosity average molecular weights of polymers, Methods of determining molecular weight, Practical significance of molecular weight distribution. Size of polymers.  7L

SUGGESTED BOOKS

UNIT-IV

IC 384  Introductory concepts of kinetics of polymerization and Carother’s relation.
        Glassy state, glass transition temperature, TGA, Factors affecting GTT, Crystallinity in polymers.  4L
        Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers.  2L

        Degradation of polymers by thermal, oxidative, mechanical and chemical methods.  2L
        Polymer processing-Compression moulding, casting, extrusion. Fibre spinning, injection moulding, thermoforming vulcanization of elastomers, Polymer industry in India.  7L

SUGGESTED BOOKS

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II. The students are required to attempt **FIVE** questions in all, **ONE** question from each unit and the Compulsory question.
III. All questions carry equal marks.
Practicals (B)

1. Determination of –(i) Acid value- Rosin ester gum, plasticizers, polyester resin, alkyd resin (ii) Iodine number-Linseed oil, castor oil (iii) Saponification value-Coconut oil, polyester (iv) Melting point and softening point- Expoxy resin, ester gum, nylon-6 (v) Viscosity- Nitrocellulose-polystryene, PV acetate (vi) Hydroxyl value.

2. Preparation of representative polymers-
   - **Bulk polymerization**- Polystyrene, polyvinyl acetate, polyacrylamide, polyacrylic acid.
   - **Solution polymerization**- Phenol-formaldehyde, urea formaldehyde, alkyd resin.
   - Preparation and analysis of the above (viscosity, m.p., mol, wt, determination).

3. Identification of simple polymers by simple physical and chemical tests.


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