FACULTY OF SCIENCE

SYLLABI

FOR

INDUSTRIAL CHEMISTRY
ELECTIVE /ADD-ON COURSE
EXAMINATIONS 2013

--:O:--
**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.

**Subject Title: “Industrial Chemistry (Elective Course)”**

<table>
<thead>
<tr>
<th>B.Sc. (General) Part I:</th>
<th>Max. Marks.</th>
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<tbody>
<tr>
<td><strong>Paper A:</strong> Core 111, 112, &amp; 113 i.e. Industrial Aspects of Organic, Inorganic and Physical Chemistry.</td>
<td>75</td>
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<tr>
<td><strong>Paper B:</strong> Core 124, 125 and 126 i.e. Material and Energy balance; Unit operations in Chemical Industry; utilities &amp; fluid flow, and Heat transport.</td>
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<td><strong>Practicals:</strong> Total combined practicals mentioned under B.Sc. I (Pr A &amp; B)</td>
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<th>B.Sc. (General) Part II:</th>
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<tr>
<td><strong>Paper A:</strong> Core 231, 232 &amp; 233 i.e. Material balance and Unit processes in Org. Chem. Manufacture I &amp; II.</td>
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<tr>
<td><strong>Paper B:</strong> Core 244, 245 &amp; 246 i.e. Pollution, Effluent Treatment and Waste management and Process Instrumentation.</td>
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<td><strong>Practicals:</strong> Total combined practicals mentioned under B.Sc. II (Pr A &amp; B)</td>
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<tr>
<td>The Entrepreneurship Development course. Non-credit</td>
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<th>B.Sc. (General) Part III</th>
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<tr>
<td><strong>Paper A:</strong> Core 351, 352 &amp; 353 i.e. Chemical Process Economics, Industrial Organization &amp; Industrial Chemical Analysis.</td>
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<tr>
<td><strong>Paper B:</strong> Core 364, 365 &amp; 366/I or II or III or IV or V or VI or VII i.e. out of Pharmaceuticals, Heavy &amp; Fine chemicals, Petrochemicals, Waste recycling, Agrochemicals, Dyes &amp; Polymers-any one elective is to be selected.</td>
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<tr>
<td><strong>Practicals:</strong> (a) Practicals mentioned under B.Sc. III (Pr A)</td>
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<tr>
<td>(b) Practicals mentioned under respective elective subjects. (Pr B)</td>
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**NOTE:** The Entrepreneurship Development Course will be taught in the Second year 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.
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<tr>
<th>Sr. No.</th>
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JOBS POTENTIAL OF VOCATIONAL PROGRAMME IN INDUSTRIAL CHEMISTRY

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.

**First year:**

**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

**Second year:**

**Paper A** - Colorimeter, pH meter, Potentiometer, conductometer, Dielectric Constant apparatus, Thermal conductivity measurement apparatus, Thermisters, thermocouples, transducers.  
**Paper B** - Ignition point apparatus, flash point apparatus, Rotameter, Nesseler tubes.

**Third year:**

**Paper A** - No additional equipments required.  
**Paper B** - Special papers.  
(a) Pharmaceuticals: Micrometer, vernier oven for drying, Microscopes, Icabat or Autoclave, glasswares for microbiological testing.  
(b) Heavy and Fine Chemicals: No additions equipments required.  
(c) Petrochemicals: Tensiometer, Viscometers, Rotameter, Manometer, Flash point apparatus, Ignition Point apparatus, Pour point apparatus, Penetrometer, Calorimeter, Bomb, Calorimeter, Oxygen cylinder.  
(d) Waste recycling: Bomb Calorimeter, Cod-Incubator.  
(e) Agrochemicals: No additional; equipment required.  
(f) Dyes: Lab dyeing bath, Light sources, colorimeter, Fluorimeter.  
(g) Polymers: Viscometers, Dielectric constant apparatus, Tensile Strength apparatus.

**Notes:** 1. Some of the above equipments are available in the Physical Chemistry Laboratory. Hence, very few additional equipments will be needed to start the course. The equipments are not very costly.  
2. As the course is a vocational course the students should make factory visits and submit the report.  
3. In view of the strength of the students expected to take this course on the job training may not be possible.
B.Sc. FIRST YEAR
Paper A

Industrial Aspects of Chemistry

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 101 Nomenclature Generic names, Trade names 2L
IC 102 Raw materials for organic compounds: Petroleum; Natural gas. Fractionation of crude oil, cracking, reforming, hydroforming, isomerisation. 8L
IC 103 Coal: Types, structure, properties, distillation of Coal, chemicals derived there from. 5L

UNIT II

IC 104 Renewable natural resources: Cellulose, Starch-Properties, modification important ind. Chemicals derived from them, Alcohol and alcohol based chemicals oxalic acid, furfural. 9L
IC 105 Basic metallurgical operations- Pulverisations Calcination, Roasting, Refining 6L

UNIT III

IC 106 Physicochemical principles of extraction of –Iron, Copper, Lead Silver, Sodium, Aluminum, Magnesium, Zinc, Chromium. 7L
IC 107 Inorganic materials of industrial importance-Their availability, forms, structure and modification. Alumina, silica, silicates, clays, mica, carbon, zeolites. 8L

UNIT IV

IC 108 Surface chemistry and Interfacial phenomena, Adsorption isotherm, Sols, Gels, Emulsions. Microemulsions, Micelles, Aerosols, Effect of surfactants, Hydrotropes 8L
IC 109 Catalysis: Introduction, Types-Homogeneous and Heterogeneous, Basic principles, mechanisms, Factors affecting the Performance. Introduction to phase transfer catalysis, Enzyme catalysed reactions-Rate model, Industrially important reactions. 7L
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.

PRACTICALS (A)
1. Simple laboratory techniques- Crystallization, fractional crystallization fractional crystallization Distillation, fractional distillation boiling point diagram. 10 exp.
2. Extraction processes – Phase diagram, partition coefficient 5 exp.
3. Preparation of standard solutions-Primary and secondary standards, Determination of H₂SO₄ and H₃PO₄ in a mixture. 8 exp.
5. Acquantance with safely measures in a laboratory Hazards of chemicals 5 exp.

SUGGESTED BOOKS
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**UNIT I**

**IC 110 Dimensions and units:** Basic Chemical Calculations-Atomic weight, molecular weight, equivalent weight, mole, Composition of- (i) liquid mixtures, and (ii) gaseous mixtures 3L

**IC 111 Material balance without chemical Reactions**
Flow diagram for material balance, simple material balance with or without recycle or by-pass for chemical engineering operations such as distillation, absorption, crystallisation, evaporation, extraction, etc. 7L

**IC 112 Material balance involving chemical, Reaction**
Concept of limiting reactant conversion, yield, Liquid Phase reaction, gas phase reactions, with/without recycle or by-pass. 5L

**UNIT II**

**IC 113 Energy Balance**
Heat capacity of pure gases and gaseous mixtures at constant pressures. Sensible heat changes in liquids, enthalpy changes. 7L

**IC 114 Distillation**
- Introduction, Batch and continuous distillation,
- Separation of azeotropes, Plate columns and packed columns 5L

**Absorption**
- Introduction: Equipments- packed columns, spray
- Columns, bubble columns, packed bubble columns, mechanically agitated contractors. 3L

**UNIT III**

**IC 115 Evaporation**
- Introduction, Equipments- short tube (standard)
- Evaporator, forced circulation evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporator 8L

**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, bound moisture drying curve; equipments- tray dryer, rotary dryer, flash dryer, fluidized bed dryer, drum dryer, spray dryer.

**IC 116 Crystallization** - Introduction: solubility, supersaturation nucleation, crystal growth; Equipment- tank crystallizer, agitated crystallizer, evaporator crystallizer, draft tube crystallizer.

**IC 117 Extraction** - Introduction: selection of solvent; Equipments- Spray column, packed column, rotating disc column, mixer-settler.

**Mixing** - Introduction; mixing of liquid-liquid, solid-solid, liquid-solid systems.

**UNIT IV**

**IC 118 Fuel** - types of fuels- advantages and disadvantages of combustion of fuels, calorific value, specifications for fuel oil.

**IC 119 Fluid Flow** - Fans, blowers, compressors, vacuum pumps, ejector Pumps; Reciprocating pumps, Gear pumps, Centrifugal pumps.

**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.

Practicals (B)

1. Depression and elevation in b.p./m.p. of solids and liquids.
2. Chromatography-column, paper, thin layer.
3. Ore analysis-dolomite, limestone, calcite analysis of alloys such as cupro-nickel
5. Study experiments/demonstration experiments.

SUGGESTED BOOKS

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UNIT-I

IC 201 Mechanical properties of materials and change with respect to temperature. 1L

IC 202 Materials of constructions used in Industry
   Metals and alloys: Important metals and alloy; iron, copper, aluminium 2L
   Lead, nickel, titanium and their alloys- Mechanical and chemical properties and their applications.
   Cement-Types of cement, composition, manufacturing process, setting of cement 3L
   Ceramics-Introduction, types, manufacturing processes, applications, Refractories. 2L
   Polymeric materials: Industrial polymer and composite materials- Their constitution, Chemical and physical properties, Industrial applications. 3L
   Glass-Types, composition, Manufacture, Physical and Chemical properties, Applications. 2L
   Corrosion- Various types of corrosion relevant to chemical industry-Mechanism, Preventive methods. 2L

UNIT II

IC 203 Nitration: Introduction-Nitrating agents, Kinetic and mechanism of nitration processes such as nitration of: Paraffine hydrocarbons Benzene to nitrobenzene and m-dinitrobenzene Chlorobenzene to o-and p-nitrochlorobenzenes Acetanilide to p-nitrooagtanilide Toluene Continuous vs batch nitration. 7L

IC 204 Halogenation: Introduction-Kinetics of halogenation reactions, Reagents for halogenation Halogenation of aromatics-side chain and nuclear halogenations, Commercial manufactures-chlorobenzenes, chloral monochloracetic and chloromethances, dichlorofluoromethane. 8L
UNIT III


IC 206 Oxidation: Introduction—Types of oxidation reactions, oxidizing agents, Kinetics and mechanism of oxidation of organic compounds Liquid phase oxidation, Vapor phase oxidation Commercial manufacture of benzoic acid maleic anhydride, phthalic anhydride, acrolein, acetaldehyde, acetic acid.

UNIT IV


IC 208 Alkylation: Introduction, Types of alkylation, Alkylating agents. Thermodynamics and mechanism of alkylation reactions, Manufacture of alkylbenzenes (for detergent manufacture), ethylbenzene, phenyl ethyl alcohol, N-alkyl anilines (mono and di-methyl and ethyl anilines).


IC 209 Amination: (A) By reduction: Introduction Methods of reduction—metal and acid catalytic sulfide electrolytic metal and alkali sulfites metal hydrides, sodium metal concentrated caustic oxidation, reduction, commercial manufacture of aniline, m-nitroaniline, p-amino phenol. (B) By aminolysis: Introduction, aminating agents, factors affecting.

Hydrolysis: Introduction, hydrolyzing agents, Kinetics thermodynamics and mechanism of hydrolysis

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.

**Practicals (A)**

**Unit process:** One to two examples of each of the following unit processes
- Nitration, sulphonation, Friedel-crafts reactions, esterification, Hydrolysis, Oxidation, Halogenation, chlorosulphonation, Reduction, polymerization, reactions of diazonium salts.

**Instrumental methods of analysis:** Use of colourimeter, pH meter, potentiometer, conductometer, refractometer, polarimeter.

**Material testing:** Testing of alloys Identification of plastics/rubber Estimation of yield point young’s modulus, flaredness, Optical thermal mechanical and electrical properties.

Process Instrumentation-transducers of different types.

**PAPER B**

**POLLUTION**

**UNIT-I**

| IC 210 | Air, Oxygen, nitrogen cycle, water Biosphere flora and fauna energy soil. | 5L |
| IC 211 | Pollutants and their statutory limits. Pollution evaluation methods. | 3L |
| IC 212 | Air pollution-Various pollutants. Water pollution-Organic/inorganic pollutants. Noise pollution Sewage analysis Pesticide pollution Radiation pollution, Green house effect, Future. | 7L |

**UNIT II**

| IC 213 | Principles and equipments for aerobic, anaerobic treatment, adsorption, filtration, sedimentation. Bag filters, electrostatic precipitator mist eliminators wet scrubbers Absorbers | 5L 6L 4L |

**UNIT III**

| IC 214 | Solid waste management Industrial safety Concept of measurement and accuracy Principle, construction and working of following measuring instruments. | 7L 4L 4L |
UNIT IV

IC 215  **Temperature**- glass thermometers bimetallic
Thermometer pressure spring thermometer, vapour filled
thermometer resistance
thermometers.  5L

**Pressure**- Manometers, barometers bourdon
Pressure gauge bellow type, diaphragm type pressure gauges
macleod gauges , Pirani gauges etc.  4L

**Liquid level:** Direct- indirect liquid level

Measurement float type liquid level gauge, ultrasonic level
gauges, bubbler system  2L
Density measurement  2L
Viscosity measurement  2L

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.

**Practicals (B)**

1. Use of Transducers for measuring flow control.
2. Determination of flash point and ignition points of liquids.
3. Water analysis-solid content, Hardness, COD and other tests as per industrial specifications.
5. Monographs of representative raw materials such as sulphuric acid, toluene, sodium, carbonate, sodium hyx Roxide, carbon tetrachloride Benzoic acid, (5-6 compounds)
6. Limit tests for heavy metals Pb. As, Hg, Fe and ash content.
THIRD YEAR

PAPER A

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UNIT-I

IC 301  Factors involved in project cost estimation, 4L
Methods employed for the estimation of capital investment.

Capital formation, Elements of cost accounting 4L
Interest and investment costs, Time value of
Money-equivalence.

Depreciation methods of determining 3L
Depreciation Taxes.

Some aspects of marketing pricing policy. 2L
Profitability criteria Economics of selecting
Alternatives.

Variation of cost with capacity break-even 2L
Point. Optimum batch sizes, production scheduling etc.

SUGGESTED BOOKS

Economics of Chemical Industry, Hempel. E.H

UNIT-II

IC 302  Concept of scientific management in Industry 2L
Functions of management decision making 3L
Planning organizing directing and control.

Location of industry 2L

Materials management 2L

Inventory control 3L

Management of human resources-selection 3L
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

IC 303  Industrial Analysis-
Sampling procedures sampling of bulks materials 2L
Techniques of sampling solids liquids and gases Collecting and processing of data 2L
Chromatography paper chromatography TLC, GLC, HPLC 6L
Particle size determination 2L
Rheological properties of liquids plastics and their analysis 3L

SUGGESTED BOOKS

UNIT-IV
Modern instrumental methods of analysis
UV-visible spectroscopy 3L
IR-spectroscopy and non-dispersive IR 4L
NMR-spectroscopy 2L
Atomic Absorption Flame photometry 2L
Neutron diffraction 1L
X-ray fluorescence 1L
Ion-selective electrodes 1L
Ion-chromatography 1L

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 (A)

1. Industrial Analysis-Analysis of common raw materials as per the industrial specifications, such as phenol, aniline, formaldehyde, hydrogen peroxide, acetone, epoxide, elefins, oils, etc.
   12 expts.

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

Introduction to various types formulations and roots of Administration.

Aseptic conditions need for sterilisation, various methods Methods of sterilisation.

Various types of pharmaceutical excipients-their Chemistry, process of manufacture and quality specifications-

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

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.

Pharmaceutical packaging-Introduction package

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.

Evaluation of crude drugs-Moisture content Extractive 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, reserpine one for steroids
sapogenin osgenin, 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
1. Sulpha drugs-Sulphaguandine, sulphamethoxazole
2. Antimicrobial-chloramphenicol furazolidone mercurochrome
isoniazid Na-PAS.
3. Antalgesciranti-inflammatory-salicyclic acid and its derivatives,
Iuprofen, mefenamic acid. 5L

SUGGESTED BOOKS
2. Lemke T.L., Williams D.A., Foye’s Principles of Medicinal Chemistry, Pubs: Lippincott
Williams & Wilkins, 2007.
Wiley Interscience, 2008.
5. 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 testosterne.
Vitamins-Vit. A, Vit. B6, Vit. C
Barbiturates-Pentobarbital
Bickers-Propranolol, atenolol
Cardiovascular agent-Methyl depa
Antihistamines-Chlorophener amine maleate.  

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.  

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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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.

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

Demonstration of various pharmaceutical products.
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
Determination and identification of starch granules, calcium oxalate.
Palisate ration, stomatal index determination. Identification of few drugs. TLC method for identification
Microbiological testing-Determination of MTC of some antibacterial drugs by zone/cup plate method.
THIRD YEAR ELECTIVE SUBJECTS
PAPER B

HEAVY AND FINE CHEMICALS

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 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 and 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 phosphate, 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 thiosulphate, 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 dehydration/dehydroxylation. 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, paraldehyde
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 acidperchloric 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-itoanilinesulperterial (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 flavouring 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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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)

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 isopropoxide 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, flaovour chemicals Paracetamol, sulphanilamide.
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
B.Sc. THIRD YEAR ELECTIVE SUBJECTS
PAPER B
PETROCHEMICALS

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 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 6L
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 5L
Detailed discussion of the following operations with respect to process, mechanism, catalysts used and applications, Cracking-Catalytic cracking 4L

UNIT-II
IC 342
Hydrocracking, Isomerization, Reforming, Isomerization, Alkylation. Sulphur, hydrogen, petroleum coke and nitrogen Compounds from petroleum. 7L
General discussion of the following reactions with respect to mechanism and applications-Oxidation ammonidation, hydro-formylation, hydration. 8L

UNIT-III
IC 343
Manufacture of the following compounds. Methane ethylene, acetylene, propylene, C-4, Hydrocarbons, higher olefins. 6L
Preparation of reagent grade chemicals-Sodium Carbonate black, hydrogen cyanide, chlorinated Methanes, carbon disulphidez. 5L
Preparation of the following from ethylene-Ethyl chloride, ethanol, ethylene oxide, ethylene glycol, acetaldehyde, acetic acid, styrene, vinyl acetate, ethanolamines, vinyl chloride, acrylonitrile. 4L

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, naphthlanlene, 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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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.
OBJECTIVE OF THE COURSE

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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, CO$_2$, SO$_2$, NO$_X$, 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  
Tanneries, slaughter houses, rubber, sugar, heavy chemicals, fermentation  
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 SO$_2$, NH$_3$, NO$_X$
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.
OBJECTIVE OF THE COURSE

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UNIT-I

<table>
<thead>
<tr>
<th>Code</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC 361</td>
<td>Pests and pest control, Types of pests, Types of Chemicals used to control pests.</td>
</tr>
<tr>
<td></td>
<td><strong>Types of pesticides:</strong> Stomach poison, contact poisons systemic poisons, fumigants.</td>
</tr>
<tr>
<td></td>
<td><strong>Insecticides:</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Inorganic insecticides:</strong> Arsenic insecticides, Paris green, fluoro insecticides.</td>
</tr>
<tr>
<td></td>
<td><strong>Insecticides of plant origin:</strong> Nicotine, nornicotine, Pyrethroids, rotenoids, anabasin, allethrin.</td>
</tr>
<tr>
<td></td>
<td><strong>Chlorinated hydrocarbons:</strong> DDT, DDD, nestran dilan, Perthane, dikite, chlorobenzilate, suphenex. Ovotran, aramite, DFDT. SAR in the class and mode of action.</td>
</tr>
</tbody>
</table>

UNIT-II

<table>
<thead>
<tr>
<th>Code</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>IC 362</td>
<td>BHC, chlordane, heptachlor, aldrin, doeldrin, endrin feodrin endosulfan, SAR in the class and mode of action.</td>
</tr>
<tr>
<td></td>
<td><strong>Organophosphorus insecticides:</strong> Introduction, Phosphoric acid derivatives-Dimecron, Dichlorovos, naled phosphinon, etc. SAR in the class. Dichlorophosphonic acid-derivatives-Melathion</td>
</tr>
<tr>
<td></td>
<td>Dimethoate, thiocron, formothion, mecarbam etc. Thiophosphoric acid-Parathion, methyl parathion,</td>
</tr>
</tbody>
</table>
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

**Organomercuric 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, manebl, captan, hinesann vapam, etc., mode of action.

**Miscellaneous fungicides**- Dithanon, dichlons, captan, polpet, difolatan, mesulfan, brestan, dodine, glyodin, methyrimol, terrazole. 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, cycocil. Mode of action. 4L

**Formulation of pesticides**- Dry formulation Dusts, granules, wettable powders, seed disinfectants liquid formulations Emulsions, suspensions, etc. 3L

SUGGESTED BOOKS


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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.

B.Sc. THIRD YEAR ELECTIVE SUBJECTS
PAPER B
DYES

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 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, Bromazine 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
UNIT-III

IC 373

Basic dyes
Anthraquinone (vat) dyes
Indigoid dyes
Reactive dyes
Disperse dyes
Optical whiteness-Cyanuric chloride based optical whiteners.

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

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.

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

SUGGESTED BOOK


Instructions for paper setters and candidates:

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III. All questions carry equal marks.

Practicals (B)

1. Analysis of intermediates-Nitrite titrations, diazo-coupling, tannous 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.
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 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, m branched and crosslinked polymers. 5L

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

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

Polymers 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

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. 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- Epoxy 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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