PANJAB UNIVERSITY
CHANDIGARH

FACULTY OF SCIENCE

SYLLABI

FOR
INDUSTRIAL CHEMISTRY
ELECTIVE/ADD-ON COURSE
EXAMINATIONS, 2010-2011
**PANJAB UNIVERSITY, CHANDIGARH**

Outlines of tests, syllabi and course of reading for B.Sc. (General) Part I, Part II & Part III examinations in the Elective subject of “Industrial 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.

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

**B.Sc. (General) Part I:**

<table>
<thead>
<tr>
<th>Paper</th>
<th>Syllabus details</th>
<th>Max. Marks.</th>
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<tbody>
<tr>
<td>Paper A</td>
<td>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>Paper B</td>
<td>Core 124, 125 and 126 i.e. Material and energy balance; unit operations in chemical industry; utilities &amp; fluid flow and Heat transport.</td>
<td>75</td>
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<td><strong>Practicals:</strong></td>
<td>Total combined practicals mentioned under B.Sc. I Semester I &amp; II.</td>
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**B.Sc. (General) Part II:**

| Paper A  | Core 231, 232 & 233 i.e. Material balance and unit processes in Org. Chem. Manufacture I & II. | 75          |
| 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 Semester I & II. | 50          |

The Entrepreneurship Development course. Non-credit

**B.Sc. (General) Part III**

| Paper A | Core 351, 352 & 353 i.e. Chemical Process economics, Industrial organization & Industrial Chemical Analysis. | 75          |
**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, Semester I. 25  
(b) Practicals mentioned under respective elective subjects. 25

**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 is April/May.
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<tr>
<th>Sr. No.</th>
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JOB 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 agrobased industries such as insecticides. They will also be suitable in Technical Marketing of produce. 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.
NOTE ON SYLLABUS FOR INDUSTRIAL CHEMISTRY AT B.SC. LEVEL

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:

Semester I-No. additional equipments required
Semester II–Refractometer, Tensiometer/stalgmometer, Polarimeter, Viscometer (Ostwald).
Demonstration Experiments: Different types of valves, fittings, Laboratory models of filters, dryers, impeller

Second year:

Semester I-Colorimeter, pH meter, Potentiometer, conductometer, Dielectric Constant apparatus, Thermal conductivity measurement apparatus, Thermisters, thermocouples, transducers.
Semester II-Ignition point apparatus, flash point apparatus Rotameter, Nesseler tubes.

Third year:

Semester I-No additional equipments required.
Semester II- 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
Semester I

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.

Paper I

Industrial Aspects of Organic Chemistry

Unit-I
IC 101 Nomenclature Generic names, Trade names 2L
IC 102 Raw materials for organic compounds: Petroleum: Natural gas.

Unit-II
Fractionation of crude oil, cracking reforming hydroforming isomerisation. 13L

Unit-III
IC 103 Coal: Types, structure, properties, distillation of Coal, chemicals derived therefrom. 8L

Unit-IV
IC 104 Renewable natural resources: Cellulose, Starch-Properties, modification important ind. Chemicals derived from them, Alcohol and alcohol based chemicals oxalic acid, furfural. 7L

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.
## Suggested Books

Paper II
Industrial Aspects of Inorganic 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 105 Basic metallurgical operations - Pulverisations Calcination, Roasting, Refining

Unit-II
IC 106 Physicochemical principles of extraction of - Iron, Copper, Lead

Unit-III
Silver, Sodium, Aluminum, Magnesium, Zinc, Chromium.

IC 107 Inorganic materials of industrial importance - Their availability, forms, structure and modification.

Unit-IV
Alumina, silica, silicates, clays, mica, carbon, zeolites.

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.

Suggested Books

Paper III
Industrial Aspects of Physical 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 108 Surface chemistry and Interfacial phenomena, Adsorption isotherm, Sols, Gels, Emulsions. 16L

Unit-II
Microemulsions, Micelles, Aerosols, Effect of surfactants, Hydrotropes

Unit-III
IC 109 Catalysis: Introduction, Types-Homogeneous and Heterogeneous, Basic principles, mechanisms, Factors affecting the Performance. 14L

Unit-IV
Introduction to phase transfer catalysis, Enzyme catalysed reactions. Rate model, Industrially important reactions.

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.

Suggested Books

**PRACTICALS**

1. **Simple laboratory techniques**- Crystallization, fractional crystallization fractional crystallization Distillation, fractional distillation boiling point diagram.
2. **Extraction processes**– Phase diagram, partition coefficient
3. Preparation of standard solutions-Primary and secondary standards, Determination of H₂SO₄ and H₃PO₄ in a mixture.
4. Calibration of thermometers
5. Acquaintance with safely measures in a laboratory Hazards of chemicals

**Suggested Books**

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 110 Dimensions and units: Basic Chemical Calculations-Atomic weight, molecular weight, equivalent weight, more, Composition of- (i) liquid mixtures, and (ii) gaseous mixtures

Unit-II

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

Unit-III

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.

Unit-IV

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

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.
Suggested Books


Paper II
Unit Operations in Chemical Industry

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 114 Distillation - Introduction, Bath and continuous distillation, 5 L
Separation of azeotropes, Plates columns and packed columns

Absorption - Introduction: Equipments- packed columns, spray 4 L
Columns, bubble columns, packed bubble columns, mechanically agitated contractors.

Unit-II
IC 115 Evaporation - Introduction, Equipments- short tube (standard) 4 L
Evaporator forced circulation evaporators, falling film evaporators, climbing film (upward flow) evaporators, wiped (agitated) film evaporator

Filtration - Introduction, filter media and filter aids, 4 L
equipments- plate and frame filter press, notch 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, fluid bed dryer, drum dryer, spray dryer.

**Unit-III**

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

**Unit-IV**

**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.

**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.

**Suggested Books**

Paper III
Utilities and Fluids Flow and Heat Transport in Industry

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Unit-I

IC 118
Utilities in chemical Industry 15L

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

Boilers- types of boilers and their functioning.

Unit-II

Water- specifications for industrial use, various water treatments,
Steam- Generation and use

Air- specifications for industrial use
Processing of air.

Unit-III

IC 119
Fluid Flow: Fans, blowers, compressors, vacuum pumps, ejector 4L
Pumps; Reciprocating pumps, Gear pumps, Centrifugal pumps. 4L

Unit-IV

Heat Transfer: Heat exchangers- shell and Tube type; finned tube heat exchangers, plate heat exchangers, refrigeration cycles. 7L

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.
Suggested Books

Practicals
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
B.Sc. SECOND YEAR
Semester I

Material science

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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 201 Mechanical properties of materials and change 2 L
With respect to temperature.

IC 202 Materials of constructions used in Industry

Matals and alloys: Important and alloy; iron, copper, aluminium 6 L
Lead, nickel, titanium and their alloys- Mechanical and chemical properties and their applications.

Unit-II

Cement- Types of cement, composition, manufacturing process, setting of cement 4 L
Ceramics- Introduction, types manufacturing processes, applications, Refractories 4 L

Unit-III

Polymeric materials: Industrial polymer and composite materials- 6 L
Their constitution, Chemical and physical properties, Industrial applications. 6 L

Unit-IV

Glass- Types, composition, Manufacture, Physical and Chemical properties, Applications.
Corrosion- Various types of corrosion relevant to chemical industry-Mechanism, Preventive methods.

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.
Suggested Books

Paper II
Unit processes in organic chemicals manufacture-I

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Unit-I
IC 203  Nitration: Introduction-Nitrating agents, Kinetic and mechanism of nitration processes such as nitration of:
   i. Paraffing hydrocarbons
   ii. Benzene to nitrobenzene and m-dinitrobenzene
   iii. Chlorobenzene to o-and p-nitrochlorobenzenes
   iv. Acetanilide to p-nitrooacetanilide
   v. Toluene

Unit-II
IC 204  Halogenation: Introduction-Kinetics of halogenation reactions, Reagents for halogenation Halogenation of aromatics-side chain and nuclear halogenations.

Unit-III
Commercial manufactures-chlorobenzenes, chloral monochloracetic and chloromethanes, dichlorofluoromethane.

Unit-IV
IC 205  Sulphonation: Introduction-sulphonating agents, Chemical and physical factors in sulphonation.
Kinetics and mechanism of sulphonation reaction, Commercial sulfonation of benzene, naphthalene, alkyl benzene, Batch vs continuous sulphonation.
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.

**Suggested Books**


**Paper III**

**Unit processes in Organic Chemicals Manufacture-II**

**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 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-II**

**IC 207 Hydrogenation:** Introduction-Kinetics and thermodynamics of hydrogenation reactions, Catalysts for hydrogenation reactions, Hydrogenation of vegetable oil, Manufacture of methanol from carbon monoxide and hydrogen, hydrogenation of acids and esters to alcohols, catalytic reforming.

**Unit-III**

**IC 208 Alkylation:** Introduction, Types of alkylation, Alkylation 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).

Unit-IV

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 thermody-anics and mechanism of hydrolysis

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Suggested Books


Practicals

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.
OBJECTIVE OF THE COURSE

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Unit-I
IC  210  Air, Oxygen, nitrogen cycle, water 8 L
        Biosphere flora and fauna energy soil.

Unit-II
IC  211  Pollutants and their statutory limits. 7 L
        Pollution evaluation methods.

Unit-III
IC  212  Air pollution-Various pollutants. 15 L
        Water pollution-Organic/inorganic pollutants.
        Noise pollution

Unit-IV
        Sewage analysis
        Pesticide pollution
        Radiation pollution, Green house effect, Future.

Instructions for paper setters and candidates:
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Suggested Books
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 213 Principles and equipments for aerobic, anaerobic Treatment, adsorption, filtration, sedimentation. 10 L

Unit-II Bag filters, electrostatic precipitator mist eliminating 8 L
Unit-III wet scrubbers Absorbers 4 L
Unit-IV Solid waste management Industrial safety 4 L

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

Suggested Books

Paper III
Process Instrumentation

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**
Concept of measurement and accuracy  
Principle, construction and working of following measuring instruments.  
*Temperature*- glass thermometers bimetallic  

**Unit-II**  
Thermometer pressure spring thermometer, vapour filled thermometer resistance thermometers.  
*Pressure*- Manometers, barometers bourdon  

**Unit-II**  
Pressure gauge bellow type diaphragm type pressure gauges macleod gauges Pirani gauges etc.  
*Liquid level*: Direct- indirect liquid level  

**Unit-IV**  
Measurement float type liquid level gauge ultrasonic level gauges bubbler system  
Density measurement  
Viscosity measurement  

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.

Suggested Books

Practicals
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 hyroxide, carbon tetrachloride Benzoic acid, (5-6 compounds)
6. Limit tests for heavy metals Pb. As, Hg, Fe and ash content.
B.Sc. THIRD YEAR
Semester I

Paper I
Chemical Process Economics

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 301 Factors involved in project cost estimation, 6 L
Methods employed for the estimation of capital investment.

Unit-II
Interest and investment costs, Time value of Money-equivalence. 3 L
Depreciation methods of determining 4 L
Depreciation Taxes.

Unit-III
Some aspects of marketing pricing policy. 4 L
Profitability criteria Economics of selecting Alternatives. 3 L

Unit-IV
Variation of cost with capacity break-even 5 L
Point. Optimum batch sizes, production scheduling etc.

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.
Suggested Books

Paper II
Industrial Organisation

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 302 Concept of scientific management in Industry 4 L
Functions of management decision making 9 L

Unit-II
Planning organizing directing and control.
Location of industry 3 L

Unit-III
Materials management 5 L
Inventory control 4 L

Unit-IV
Management of human resources-section 5 L
Incentives welfare and safety.

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.
Suggested Books

Paper III
Industrial Chemical Analysis

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
Industrial Analysis
Sampling procedures sampling of bulks materials 3 L
Techniques of sampling solids liquids and gases 2 L
Collecting and processing of data

Unit-II
Chromatography paper chromatography TLC, GLC, HPLC 4 L
Particle size determination 2 L
Rheological properties of liquids plastics and their analysis 3 L

Unit-III
Modern instrumental methods of analysis 3 L
UV-visible spectroscopy 3 L
IR-spectroscopy and non-dispersive IR 3 L

Unit-IV
NMR-spectroscopy 3 L
Atomic Absorption Flame photometry
Neutron diffraction 1 L
X-ray fluorescence 1 L
Ion-selective electrodes 1L
Ion-chromatography 1 L
Instructions for paper setters and candidates:

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**Suggested Books**


**Practicals**

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  
   20 expts.
## 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.

### PHARMACEUTICALS

#### Paper I

<table>
<thead>
<tr>
<th>Unit-I</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Historical background and development of pharmaceutical Industry in India in brief.</td>
<td>2 L</td>
</tr>
</tbody>
</table>

| 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                          |

<table>
<thead>
<tr>
<th>Unit-II</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aseptic conditions need for sterilisation, various methods</td>
<td>3 L</td>
</tr>
<tr>
<td>Methods of sterilisation.</td>
<td></td>
</tr>
</tbody>
</table>

| Various types of pharmaceutical excipients-their Chemistry, process of manufacture and quality specifications- | 4 L                          |

<table>
<thead>
<tr>
<th>Unit-III</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Glidants, lubricants, diluents preservatives antioxidants, emulsifying agents coating agents binders colouring agents flavouring agents gelatin and other additives sorbitol mannitol viscosity builders etc.</td>
<td>7 L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit-IV</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical dressings sutures ligatures-with respect to the process equipments used for manufacture method of sterilization and quality control.</td>
<td>5 L</td>
</tr>
</tbody>
</table>

| Pharmaceutical packaging-Introduction package | 5 L                          |
| Selection packaging materials ancillary materials packaging machinery quality control of packaging materials. |                             |
Instructions for paper setters and candidates:

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III. All questions carry equal marks.

**Suggested Books**
4. The British Pharmacopoeia 2010

**PHARMACEUTICALS**

**Paper II**

**Unit-I**
FDA, Important schedules and some legal aspects of drugs 3 L

Phytochemicals-Introduction to plant classification and Crude drugs cultivation collection preparation for the market and storage of medicinal plants. 3 L

**Unit-II**
Evaluation of crude drugs-Moisture content Extractive Value volatile oil content foreign organic matter. 6 L

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.

**Unit-III**
Chemical constitution of plants-including carbohydrates 9 L
Amino acids, proteins fats waxes, volatile oils, terpenoids, sterioids, saponins, flavonoids, tannins, glycosides, alkaloids.

**Unit-IV**
Various isolation procedures for active ingredients 3 L
With example for alkaloid e.g., vincaalkaloids, reserpine one for steroids sapogenin osgenin, diagroh.

Pharmaceutical quality control (other than the Analytical methods covered under core subject) Sterility testing pyrogenic testing glass testing bulk density of powder etc.
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**Suggested Books**
5. Indian Pharmacopoeia Commission, Indian Pharmacopoeia 2007, 3 Vols. with One Supplement (Addendum 2008).

**PHARMACEUTICALS**

**Paper III**

**Unit-I**
Classification of various types of drugs with examples. 15 L
Raw materials, process of manufacture effluent handling etc., of the following bulk drugs
1. Sulpha drugs-Sulphaguanidine, sulphamethoxazole
2. Antimicrobial-chloramphenicol furazolidine mercurochrome isoniazid Na-PAS.

**Unit-II**
4. Steroidal hormones-Progesterone, Testosterone, methyl testosterone.
6. Barbiturates-Pentobarbital
7. Blickers-Propranolol, atenolol
8. Cardiovascular agent-Methyl depa

**Unit-III**
Products based on fermentation processes 7 L

**Unit-IV**
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. 8 L
Instructions for paper setters and candidates:

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

**Practicals**

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. 5 expt.
Evaluation of crude drugs-Microscopic examination 7 expt.
Determination and identification of starch granules, calcium oxalate, Palisate raction, stomatal index determination. Identification of few drugs. TLC method for identification. 4 expt.
Microbiological testing-Determination of MTC of some antibacterial drugs by zone/cup plate method.
B.Sc. THIRD YEAR Semester II Elective subjects
HEAVY AND FINE CHEMICALS

OBJECTIVE OF THE COURSE

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HEAVY AND FINE CHEMICALS

Paper I

Heavy Inorganic Chemicals

Unit-I
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.

3L

Synthetic nitrogen products-Ammonia, nitric acid 4 L
ammonium nitrate and ammonium sulphate.

Unit-II
Chlor-alkali industrial products- Caustic soda Chlorine. 3 L
Phosphorus chemicals-Phosphorus, phosphoric acid 3 L
ammonium phosphate, superphosphate, triple superphosphate.
Industrial carbon-carbon blacks, manufactuer of graphice and carbon. 2 L

Unit-III
Lime, gypsum, 2 L
Silicon, chlorine carbide, silicon carbide 2 L
Flourine, Bromine, Iodine, hydrobromic acid, Interhalogen compounds. 3 L

Unit-IV
Sodium chloride, sodium sulphate, sodium 4 L
sulphite, sodium thiosulphate, borax boric acid.
Industrial catalysts-Raney nickel other forms of nickel palladium 3 L
and supported palladium copper chromate, vanadium and platinum based catalyst.
Aluminium alkoxides, titanium tetrachloride, and titanates, titanium dioxide. 2 L
Instructions for paper setters and candidates:

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III. All questions carry equal marks.

**Suggested Books**


**HEAVY AND FINE CHEMICALS**

**Paper II**

**Heavy Organic Chemicals**

**Unit-I**
Manufacture of the following with reference to (i) Raw materials (ii) Flow chart (iii) Effluent management (iv) Kinetics (v) Uses

- Fischer-Tropsch Synthesis-Examples

- **5L**

- **2 L**

**Unit-II**
Applications and uses of zeolites as catalyst. Their use in isomerization and dehydration/dehydroxyllation.

- Chemicals derived from acetylenes-Acetylene, propargyl alcohol, 1,4-butene diol, acrylates, vinyl esters, vinyl chloride.

- **4 L**

- Pyridine, picolines, phenol, acetone, resorcinol, phthalic, anhydride.

- **3 L**

**Unit-III**
Glycerol, sorbitol, melamine, formaldehyde, formic acid,

- **3 L**

- Triphenyl phosphine, alkyl phosphates chlorination of methane-to methyl chloride, dichloromethane chloroform carbon tetrachloride.

- **2 L**

- Ethanolamine, mono-di-tri ethanolamines, Dialkyl aminoethanols (dimethyl, diethyl).
**Unit-IV**
Alkyamines-Methylamine, ethylamine, di-tri butyl amines, propyl amines.

3 L

Ketene, ethyl and methyl acetoacetates.

1 L

Acetaldehyde, paraldehyde

1 L

Speciality industrial solvents-DMF, DMSO, sulpholane, alkylpyrrolidone, THF, dibutyl ether, diethyl ether, diglyme dimethoxy ethane dioxane.

1 L

**Instructions for paper setters and candidates:**

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III. All questions carry equal marks.

**Suggested Books**


**HEAVY AND FINE CHEMICALS**

**Paper III**

**Fine and speciality Chemicals**

**Unit-I**

**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.

**Chromatographic materials and HPLC solvents:** Coating material, precoating of plates, Spectroscopy grade chemicals methanol, ethanol, potassium bromide, carbon tetrachloride, methyl, chloroform.

2 L

3 L

**Unit-II**

**Biochemical reagents:** Ninhydrin, tetrazolium blue, 1,2-Naphthaquine-4-sulphonate.

1 L

**Manufacture of following fine chemicals** with reference to (i) Raw material of common industrial compound involving two step reactions-for example 4-Bromoaniline, 3-itoaninesulphierial (ii) Production process (iii) Special material of construction (iv) Hazard and safety (v) Effluent management

2 L
(vi) Quality control (vii) Specifications.
Sodium borohydride, lithium aluminium hydride sodium 2 L
Amide, sodium ethoxide, sodium methoxide
Paracetamol, 2 L

Unit-III
Indigo vat dyes, reactive dyes 2 L
Essential oils-general, organic flavour, camphor, citral, citronellor, menthol 3 L
Surfactants and emulsifying agents-PEG, Tweens, Spans. 2 L

Unit-IV
Colouring agents-Manufacture of some natural colours and synthetic colours 2 L
flavouring agents-Fragrances and Food additives. 3 L
Natural tartaric acid (i) tartaric acid Resolution of Tartaric acid 2 L
Citric acid 1 L
Chemicals required for electronic industry 1 L

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Suggested Books

PRACTICALS
Preparation of Raney-Nickel from Ni-Al alloys and testing its properties. 1 L
Any one reaction using the above catalyst. 1 L
Reparation of synthetic zeolites. 2 L
Reparation 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, flavour chemicals Paracetamol, sulphanilamide.
Purification of lemon grass oil to obtain citral.
Resolution of farteric acid and-phenyl ethyl amine. 6 L
Isolation of some natural products, like tartaric acid citric acid, etc. 4 L
**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.

**PETROCHEMICALS**

**Paper I**

**Unit-I**
Introduction to crude oil, exploratory methods, oil reservoirs, transportation of crude oil, Constitution of crude oil, Natural gas-constituents 6 L

**Unit-II**
Distillation of crude oil, Separation of natural gas and different fractions based on relative volatilities, Compositions of different distillates 3 L

Meaning of terms such as-Pour point depressants, drag reducers, viscosity reducers ignition point, flash point, octane number, doctor solution. 4 L

**Unit-III**
Types of hydrocarbon fuels and their characteristics 2 L

Detailed discussion of the following operations with respect to process, mechanism, catalysts used and applications, Cracking-Catalytic cracking 15 L

**Unit-IV**
Hydrocracking, Isomerization, Reforming, Isomerization, Alkylation.

**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.
Suggested Books

PETROCHEMICALS
Paper II

Unit-I
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-II
Manufacture of the following compounds. Methane ethylene, acetylene, propylene, C-4, Hydrocarbons, higher olefins.

Unit-III
Preparation of reagent grade chemicals-Sodium

Carbonate black, hydrogen cynide, chlorinated Methanes, carbon disulphidez.

Unit-IV
Preparation of the following from ethylene-Ethyl chloride, ethanol, ethylene oxide, ethylene glycol, acetaldehyde, acetic acid, styrene, vinyl acetate, ethanolamines, vinyl chloride, acrylonitrile.

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.

Suggested Books
PETROCHEMICALS
Paper III

Unit-I
Manufacture of the following from propylene 3 L
Isopropanol, cumene, glycerine, acrylonitrile.

Manufacture of the following from acetylene 3 L
Vinyl chloride chloroprene, acrylonitrile, acetaldehyde.

Unit-II
Manufacture of the following from C-4 hydrocarbons 3 L
Butadiene, isobutene, isobutene, butanediols, oligomers

Manufacture of aromatic compounds-Benzene, toluene, xylenes, naphthanlene, linear alkyl benzenes and their sulphonates, detergents. 4 L

Unit-III
Various catalysts used in petrochemical industry, Preparation structure applications and selectivity. 6 L

Unit-IV
Importance of petroleum and petroleum industry in the context of Indian economy. 4 L
Indian petrochemical industry-Indian reserves, quality and petroluem distribution, Future. 4 L

Instructions for paper setters and candidates:

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III. All questions carry equal marks.

Suggested Books
Practicals

- 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 Semester II Elective subjects

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.

WASTE RECYCLING

Paper I

Unit-I
Need for waste recycle: Limitations of raw material resources, waste elimination 4 L

Conversion of waste into useful products
Identification and quantification of industrial domestic and agro waste. 4 L

Unit-II
Feasibility of recycle, Separation of wastes solid Liquid gaseous.

Solid wastes: Removal of solid contaminants from water by coagulation, sedimentation flocculation solid waste disposal, 10 L

Unit-III
incineration, fuel palletization, soil conditioning.

Water management: Waste water treatment. Biological, physical and chemical treatment. 12 L

Unit-IV
Treatment of water and its reuse in industries, agriculture, oil refineries, thermal power station and domestic uses. Reuse of cooling water.

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.
WASTE RECYCLING

**Paper II**

**Physical and chemical processes used for the recovery of important compounds from waste**

**Unit-I**
Activated carbon adsorption, ion exchange process, evaporation, extraction,

**Unit-II**
Distillation, centrifugation, filtration, coagulation, membrane processes - osmosis, reverse osmosis, electrodialysis

**Unit-III**
Pervaporation, freezing processes.

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

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

**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.

**Suggested Books**
WASTE RECYCLING

Paper III

Characterization of wastes, their management and recovery of important compounds from the wastes from the following industries:

**Unit-I**  Dyestuff, Fertilizers, Textile

**Unit-II**  Oil, fats and soap iron and steel plants

**Unit-III**  Tanneries, slaughter houses, rubber, sugar, heavy chemicals, fermentation

**Unit-IV**  Thermal power stations, electroplating, paper, paint.

Economics of recycling of waste  2 L

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.

Suggested Books


Practicals

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.
B.Sc. THIRD YEAR Semester II Elective subjects

AGROCHEMICALS

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.

AGROCHEMICALS

Paper I

Unit-I
Pests and pest control, Types of pests, Types of Chemicals used of control pests. 4 L

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

Unit-II
Insecticides:
Inorganic insecticides- Arsenic insecticides, Paris green, fluoro insecticides. 3 L
Insecticides of plant origin–Nicotine, nornicotine, 4 L
Pyrethroids, rotenoids, anabasin, allethrin.

Unit-III
Chlorinated hydrocarbons-DDT, DDD, nestran dilan, Perthane, dikite, 10 L
chlorobenzilate, suphenex. Ovotran, aramide, DFDT. SAR in the class and mode of action.

Unit-IV
BHC, chlordane, heptachlor, aldrin, doeldrin, endrin 9 L
feodrin endosulfan, SAR in the class and mode of action.

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.
Suggested Books
   Frear D.E. H., Chemistry of Insecticides and Fungicide, Pubs: Van-Nostrand, New York

AGROCHEMICALS
Paper II

Unit-I
Organophosphorus insecticides:
Introduction, Phosphoric acid derivatives-Dimecron, 4 L
Dichlorovos, naled phosphinon, etc. SAR in the class.

Dithiophosphonic acid-derivatives-Melathion 6L

Unit-II
Dimethoate, thiocron, formothion, mecarbam etc.
Thiophosphoric acid-Parathion, methyl parathion, 6 L

Unit-III
Thiophos, demetron, chlorthion, paraoxon, etc.
Phyrophosphoric acid derivatives-TEPP, sulfotepp, schradan 4 L

Unit-IV
other organophosphorus, insecticides-Isopestox, trichlorofon, IPN. 4 L
Carbamate insecticides- Carbaryl, isolan, mesurol, 6 L
zectran, demetram, pyrolan, baygon, mode of action.

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.

Suggested Books
2. Frear D.E. H., Chemistry of Insecticides and Fungicide, Pubs: Van-Nostrand, New York

AGROCHEMICALS
Paper III

Unit-I
Fungicides-General introduction 1 L
Inorganic fungicides- Sulphur, Lime sulphur, copper 4 L
sulphate, Bordeaux mixture, Bordeaux paste, Bordeaux paint, Burgundy mixture, copper oxychloride, cuprous oxide, mercurous chloride.
**Orgenomericuric compounds** - ethyl mercuric chloride, Ceresin-M, panogen, agalol, uspulan, puratized, germisan, Mode of action, agresan GN.

**Unit-II**

**Dithiocarbamates** - Ziram, ferbam, thiram, nabam, Zineb, manebl, captan, hinesanm vapam, etc., mode of action.

**Miscellaneous fungicides** - Dithanon, dichlons, captan, polpet, difolatan, mesulfan, brestan, dodine, glyodin, methyrimol, terrazele.

**Unit-III**

**Herbicides** - Introduction 2,4,D, 2, 4-DB, 2, 4-DES, MCPB, 2, 4, 5-T. Monuron, Fenuron, TCA, paraquat.

**Fumigants** - HCN, CS, ethylene, balides, durofume, methyl halides.

**Rodenticides** - Zice phosphides, warfarin,

**Nematicides** - DD mixture, aldiearb, fensulfothion.

**Unit-IV**

**Plant growth regulators** - Introduction, gibberilic acids, indole acetic and butyric acids Naphthalene acetic acid, cycocil. Mode of action.

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

**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.

**Suggested Books**


**Practicals**

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 Semester II Elective subjects
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.

DYES
Paper I

Unit-I
Chemistry of Intermediates

Introduction of the History of Dyes. Natural to synthetic dyes, landmarks in the historical development.

Unit-II
Benzene intermediates-Chloronitoobenzenes, Nitroanilines, Bromonitroanilines, Nitroanisoles, Toluene and xylene intermediates, xylidines, Diaminobenzenes, etc.

Unit-III

Unit-IV
Anthraquinone intermediates and miscellaneous intermediates 1-Amino and 2-amino anthraquinones, Bromane acid, Quinazirin, methyl and methylamino anthraquinones, Disperse dye intermediates, Disperse-reactive intermediates, Acid-dye intermediates.
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.

**Suggested Book**

**DYES**
**Paper II**

**Chemistry of Dyes**
**Unit-I**
Introduction classification of dyes on the basis of structure and the mode of application to the fibre. Colour and chemical constitution of dyes.

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.

**Unit-II**
Azodyes-Acid, acid mordant, direct, milling, and stilbene azo dyes

**Unit-III**
Basic dyes
Anthraquinone (vat) dyes
Indigoid dyes

**Unit-IV**
Reactive dyes
Disperse dyes
Optical whiteness-Cyanuric chloride based optical whiteners.

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.
Suggested Book

**DYES**
**Paper III**

**Analysis and application of Dyes and Dye Intermediates**

**Unit-I**
9L
**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.

**Unit-II**
9L
**Dyeing** - General introduction to dyeing methods. Dyeing methods for the following dyes - Direct, acid, reactive, disperse, vat, cationic, sulphur, indigo, azoics.

**Unit-III**
6L
**Quality control and factory layout** for dyestuff industry

**Unit-IV**
6L
**Effluent treatment and pollution control** in dye stuff industry.

**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.

Suggested Book

**Practicals**

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.
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.

POLYMERS

Paper I

Unit-I
Brief history of macromolecular science. General characteristics of polymers in comparison with common organic compounds. Nomenclature. Distinction between plastics, elastomers and fibres.

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

Unit-III

Unit-IV
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
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.

Suggested Books

POLYMERS
Paper II

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

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

Unit-III
Vinyl polymers- Polyvinyl acetate and its modifications like PVA, PVB and polycetals.
Vinyl polymers- Nylin-6, Nylon-66 and other Nylons.

Unit-IV
Polyethers and polysters- Terephthalates.
Cellusosics such as esters, ethers, acetates, butyrate, nitrate, CMC, Regenerated cellulosics.

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.
Suggested Books

POLYMERS
Paper III

Unit-I
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.

Unit-II
Introductory concepts of kinetics of polymerization and Carother’s relation.
Glassy state, glass transition temperature, TGA, Factors affecting GTT, Crystallinity in polymers.

Unit-III
Viscosity, solubility, optical properties, electrical properties, thermal properties, mechanical properties of polymers.

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

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.

Suggested Books
Practicals

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.

3. Preparation and analysis of the above (viscosity, m.p., mol wt. determination).

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

5. Analysis of raw materials- Phenolic, formaldehyde, urea, melamine, epichlorohydrin.