5.1 CHEMICAL PROCESS INDUSTRIES

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RATIONALE

A chemical engineer, during his/her professional career, is primarily working in plants engaged in the manufacture of various chemical products. It is therefore necessary to provide adequate information to the chemical engineering student about the new materials, the chemistry involved and the outline of manufacturing process of some important chemical products.

DETAILED CONTENTS

1. Cement (8 hrs)

   Definition of cement & portland cement, major cement industries in India, composition of portland cement, process description, raw material, flow sheet & major engineering problems associated with the dry processes for manufacturing of portland cement.

2. Chlor-Alkali Industry (8 hrs)

   Definition of electrochemistry , manufacture of soda ash by solvay process, manufacture of chlorine & caustic soda by diaphragm cell, advantages & disadvantages of diaphragm & comparison with mercury cell.

3. Glass Industry (7 hrs)

   Definition of glass, general composition of glass, raw material, methods of manufacture of glass, manufacture of special glasses- fused silica and high silica glass.

4. Inorganic Acids & Allied Industry (10 hrs)

   Detailed flow sheet, raw material requirement, industrial applications, and major engineering problems associated for the following processes:

   Sulfuric acid, hydrochloric acid & citric acid.

5. Fuel gases (7 hrs)

   Manufacture of producer gas, water gas by continuous process, coke oven gas, natural gas & LPG.

6. Oils (8 hrs)

Vegetable oils and vanaspati: extraction methods, hydrogenation of vegetable oils

Essentals oils : general methods of production

7. Paints & Varnishes (8 hrs)

Brief description of requirements for surface coatings, simple flow sheet of paint coatings, simple flow sheets of paint manufacturing process, types & composition of different types of varnishes & their applications of primary ingredients of surface coating.

8. Soap & detergent industry (8 hrs)

Continuous hydrolysis & saponification process, flow sheet for continuous process, for fatty acids, soap & glycerine; types of surface active agents, different constituents of detergent, manufacturing process of detergent (sulfonation and sulfation and compounding of detergent) .

LIST OF PRACTICALS

1. To find out Acid value for different oils (any two).
2. To find out Iodine value for different oils (any two).
3. To find out saponification value for different oils (any two).
4. To find out flash point of given oil (any two)
5. To find out fire point of given oil (any two).
6. To find out smoke point of given oil (any two).
7. To find out viscosity by redwood viscometer.
8. Estimation of available chlorine in given sample of bleaching powder.
9. Estimation of percentage moisture of coal.
10. Estimation of percentage Ash of coal.

RECOMMENDED BOOKS

1. Outlines of Chemical Technology by Dryden, East-West Press Publishing.
2. Chemical Process Industries by shreve, Mc Graw Hill Publication.
3. Text book of Chemical Technology Vol.-I & Vol.-II, by G.N. Pandey, Vikas Publication.

5.2 MASS TRANSFER - II

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RATIONALE

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipments like distillation columns, absorption columns, crystallizers and driers which are used in industries for purification of products

DETAILED CONTENTS

1. Distillation (14 hrs)

   Relative volatility, vapour liquid equilibrium, various distillation methods, flash distillation, continuous, fractionating column with details and identification of different parts, flash distillation, steam distillation, introduction to azeotropic, extractive distillation, different types of distillation columns, concept of flooding, weeping, entrainment and loading in distillation columns

   (Qualitative treatment only, final expressions and the physical meaning of terms therein – derivations excluded)

2. Adsorption (10 hrs)

   Concept of adsorption operation and its types, effect of temperature and industrial applications

3. Crystallization (12 hrs)

   Study of various factors affecting crystallization, nucleation, crystal growth, size and shape, variation of different materials during crystallization, types of crystallizers – continuous crystallizer, DTB crystallizer

4. Drying (12 hrs)

   Definition, industrial application, moisture content, wet and dry basis, equilibrium moisture, bound, unbound, free moisture

   Batch drying; direct driers, tray driers, two track driers, rate of drying curve

   Continuous drying, turbo type drier, rotary driers

LIST OF PRACTICALS

1. To study the bubble cap distillation column and determine its efficiency
2. To determine the rate of distillation by steam distillation
3. To determine the number of transfer units (NTU) and height equivalent to theoretical plate (HETP) of packed distillation column
4. Experiment on packed absorption column, its construction detail and operations
5. Experiment on batch distillation
6. Experiment on crystallizer
7. To determine the drying characteristics of a given substance (drying rate measurement)
8. To perform an experiment on a rotary dryer and find rate of drying
9. To perform an experiment on a tray drier and find rate of drying

RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by badger and Banchero; McGraw Hill Publication
3. Unit Operations of Chemical Engineering by Mc Cabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigtord and Wilke; McGraw Hill Publication
5. Chemical Engineers Hand book by Perry and Chilton; McGraw Hill Publication

5.3 PROCESS EQUIPMENT DRAWING.

L	T	P
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RATIONALE

After undergoing this course the students will be able to understand various diagrammatic representation and drawing of various chemical process equipments, symbols and line diagrams of process instruments used in chemical industries and brief design of process equipments.

DETAILED CONTENTS

1. Systematic representation of different equipments, pumps, compressors, dryers, re boilers, heat exchangers. (20 hrs)

2. Symbols & line diagrams. (12 hrs)

3. Plant layout. (12 hrs)

4. Flow sheets, flow sheets for Ammonia, Urea, Chlor-Alkoli, Sulphuric acid etc. (12 hrs)

5. Different types of joint (a) rivet (b) Flange joint raised face flanges, tongue & groove flanges. (12 hrs)

6. Assembly Drawing: (12 hrs)
   - Non-Return Valve.
   - Blow-Off Valve.
   - Feeb Check Valve.

7. Equipment Drawing (16 hrs)
   - Double pipe & shell & tube heat exchanger.
   - Auto-clave.
   - Distillation column.
   - Crystallizer
   - Evaporator
   - Pumps (Centrifugal, Rotary, Reciprocating)
     (Three sheets should be on computers).

RECOMMENDED BOOKS

1. Outlines of Chemical Technology by Dryden, East-West Press Publication.
2. Plant Design & Economics for Chemical Engg. by M.S. Peter & Timmerhaus K.D, Mc Graw Hill Publication.
3. Chemical Process Industries by Shreve, MC Graw Hill Publication.
4. Principles of unit operation by Foust, John Wiley Publication.

5.4 INDUSTRIAL MANAGEMENT

L	T	P
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RATIONALE

The knowledge of this subject is required of all diploma holders who wish to choose industry/field as this career. This course is designed to develop understanding of various functions of management, role of workers and engineers and providing knowledge about safety and labour, industrial laws and management in different areas.

DETAILED CONTENTS

1. Principles of Management (2 hrs)

   - Management, different functions of management: Planning, organizing, coordination and control.
   - Structure of an industrial organization.
   - Functions of different departments. Relationship between individual departments.

2. Human and Industrial Relations (4 hrs)

   - Human relations and performance in organization.
   - Understand self and others for effective behaviour.
   - Behaviour modification techniques.
   - Industrial relations and disputes.
   - Relations with subordinates, peers and superiors.
   - Characteristics of group behaviour and trade unionism.
   - Mob psychology
   - Grievance, handling of grievances.
   - Agitations, strikes, lockouts, picketting and gherao
   - Labour welfare.
   - Workers' participation in management.

3. Professional Ethics (4 hrs)

   - Concept of ethics.
   - Concept of professionalism.
   - Need for professional ethics.
   - Code of professional ethics.
   - Typical problems of professional engineers.
   - Professional bodies and their role.

4. Motivation (4 hrs)

- Factors determining motivation
- Characteristics of motivation.
- Methods for improving motivation.
- Incentives, pay, promotion, rewards.
- Job satisfaction and job enrichment.

5. Leadership (4 hrs)

- Need for leadership.
- Functions of a leader.
- Factors for accomplishing effective leadership.
- Manager as a leader.

6. Human Resource Development (4 hrs)

- Introduction.
- Staff development and career development.
- Training strategies and methods

7. Wage Payment (4 hrs)

- Introduction
- Classification of wage payment scheme.

8. Labour, Industrial and Tax Laws (6 hrs)

- Importance and necessity of industrial legislation.
- Types of labour laws and disputes.
- Brief description of the following Acts: The Factory Act 1948; Payment of Wages Act 1936; Workmen Compensation Act 1923; Industrial Dispute Act 1947; Employee' State Insurance Act, 1948; Provident Fund Act.
- Various types of Taxes-Production Tax, Local Tax, Sales Tax, Excise Duty, Income Tax.
- Labour Welfare schemes.

9. Accidents and Safety (4 hrs)

- Classification of accidents; according to nature of injuries i.e. fatal, temporary; according to event and according to place.
- Causes of accidents-psychological, physiological and other industrial hazards.
- Effects of accidents.
- Accidents-prone workers.
- Action to be taken in case of accident with machines, electric shock, road accident, fires and erection and construction accidents.

- Safety consciousness & publicity.
- Safety procedures.
- Safety measures-Do's and don'ts & good housekeeping (5S).
- Safety measures during executions of Electrical Engineering works.

10. Environmental Management (4 hrs)

Basics of environmental pollution, various management techniques for control of environmental pollution, various control acts for air, water, solid waste and noise.

11. Materials Management (4 hrs)

Material in industry, inventory control model, ABC Analysis, Safety stock, Re-order, level, Economic ordering quantity, Stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, Hoist, Cranes, conveyors, trucks, fork trucks.

12. Financial Management (3 hrs)

Important, ledger, Journal, Profit and Loss Account, Balance Sheet, Interpretation of Statements, Ration Analysis, Project financing, Project appraisal, return on investments.

13. Marketing and Sales (3 hrs)

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligraphy, perfect competition, Cost Elements of Cost, Contribution, Break even analysis, Budgets, Pricing Policies.

RECOMMENDED BOOKS

1. Industrial Engineering and Management by TR Banga.
2. Industrial Engineering and Management by OP Khanna, Dhanpat Rai Publications, Delhi.
3. Industrial Management by VK Sharma, OP Harkut.
4. Sharma BR, Environmental and Pollution Awareness: Satya Prakashan, New Delhi.
5. Thakur Kailash, Environment Protection Law & Policy in India: Deep & Deep publication, New Delhi.
6. Handbook of Small Scale Industry by P.M. Bhandari.
7. Marketing Management by Philip Kotler, Prentice Hall of India, New Delhi
8. Principles of Management by Philip Kotler, TEE Publication.
9. Industrial Organisation and Management by Tara Chand, Nem Chand and Brothers, Roorkee

5.5 (a) PAINT TECHNOLOGY

L	T	P
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RATIONALE

This specialized subject will enable the students to study the paint technology in detail along with its applications and defects. This subject is of importance in view of the increasing job potential in paint industry.

DETAILED CONENTS

1. Introduction to Coatings: Purpose, types of coatings (binder, filler, precoat, final coat etc.) (6 hrs)

2. Different components of coatings: resin/binder, solvent, pigments, Antistatic/ Antishimming agents, others (fungicides, other protective agents) (12 hrs)

   - Function of each component.
   - Different types of paints based on solvent (Oil based, Latex paints)

3. Various terms used in paints (critical pigment case. (CPC), coverage ratio, thickness etc.) (6 hrs)

4. Study of each component in detail; (24 hrs)

   - Resins: Alkyd, Acrylic, Polyurethane Epoxy, Urea Formaldehyde, Melamine Formaldehyde.
   - Solvents: Active solvents, latent solvents & Dilutents.
   - Pigments: Classification.
   - Other agents.

5. Application Methods: Spray, Brush, Roller and dip. (8 hrs)

6. Paint Defects.

RECOMMENDED BOOKS

1. Surface coatings by Swaraj Paul.

5.5 (b) SUGAR TECHNOLOGY

L	T	P
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RATIONALE

This specialized subject will enable the students to study the sugar manufacturing process in detail which will enable him/her to find employment in this industry.

DETAILED CONTENTS

1. Introduction

   - Demand and supply in India
   - Overview of sugar industry in India
   - Development of various sugar rates

2. Sugar Raw Materials

   Introduction of variety of canes, cane preparation, extraction of cane juice from canes.

3. Purification Process

   Clarification of juice, settling process, filteration, preparation of thick juice, bleaching process, crystallisation of thick juice, separation of crystal from mother liquor, drying of sugar crystals, conveying of sugar, bagging of sugar.

4. Chemical Control

   Chemical control for sugarcane juice, syrup and molasses.

5. a) Preparation of Ethyl Alcohol
   Preparation of molasses, fermentation of molasses, distillation of molasses
   b) Baggase as a raw material for paper production

6. Power Generation

   Steam generation by baggasse, generation of power from steam.

RECOMMENDED BOOKS

1. Sugarcane Handbook by Miade and Chen
2. Sugar Technology by Peter Honig
3. Cane Sugar Engineering by E Hugot
4. Sugarcane Byproduct Utilization by Paterau

5.5 (c) FOOD TECHNOLOGY

L	T	P
4	-	-

RATIONALE

The Scope of food technology is increasing with the increasing demand of food technologists in the industry. This specialized subject will make the students aware about food chemistry, microbiology, food processing, handling, storage, transportation, food evaluation, quality control and packaging technology.

DETAILED CONTENTS

1. Food Chemistry and Nutrition (10hrs)

   Importance of food, Introduction to different food groups, chemical scope and importance of water, carbohydrates, proteins, fats, minerals, vitamins and enzymes.

2. Food Microbiology (10 hrs)

   Classification of micro-organisms, Bacteria, Fungi, Microbiology of milk, poultry & egg products, fruits and vegetable products & cereals.

3. Principles of Food Processing and Preservation (12 hrs)

   Importance of food processing and preservation. Preservation by sugar & salt, low temperature, high temperature and moisture removal.

3. Handling, Transportation and Storage of Foods (12 hrs)

   Importance of handling, transportation & storage of food & food products, post harvest changes in food. Handling, transportation& storage of fruits & vegetables, grains, animal foods, milk & eggs.

4. Food Evaluation and Quality control (10 hrs)

   Need of quality. Principles of evaluating food. Principles and functions of quality control. Sampling, food laws & regulations in India. General Hygiene in food Industry.

5. Food Packaging Technology (10 hrs)

   Importance of packaging of foods. Packaging materials, types of packaging, packaging requirements and their selection, package labeling.

RECOMMENDED BOOKS

1. Essentials of Food and Nutrition by Swaminathan, Vol. I and II, McGraw Hill Publishing
2. Food Microbiology by WC Frazier, Tata McGraw Hill Publication
3. Preservation of Fruit and Vegegables by Girdhari Lal, Sidhapa and Tandon
4. Handling, Transportation and Storage of Fruits and Vegetables by A Lloyd, Ryall Penizer, AVI Publication
5. Post Harvest Technology of Fruits and Vegetables – Handling, Processing, Fermentaiton and Waste Management by LR Verma and VK Joshi, Indus Publishing Co., New Delhi
6. Quality Control for the Food Industry (Vol. I and II) by Kramer and Twigg, AVI Publication
7. Handbook of Packaging by Paine and Paine, Prentice Hall of India Publication

5.6 COMPUTER APPLICATIONS IN CHEMICAL INDUSTRY

L	T	P
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RATIONALE

In today's environment almost all the processes in chemical industry are computerized. In order to prepare diploma holders to work in this environment, this subject has been kept as a core subject. This subject will ensure the students to have proficiency in handling different types of softwares used in chemical industries.

DETAILED CONTENTS

1. Introduction (16 hrs)

   Introduction to computers and its various parts; CPU, peripheral devices (Input devices : mouse, keyboard, joystick, touchpad, track ball, light pen etc., Output devices: printers, monitors, speakers etc.)

2. Hardware and Software (Application software and System software) (10 hrs)

3. Introduction to various computer generations (I to V Generations) and their development : Languages : Machine language, Assembly language, High level languages (6 hrs)

4. Types of Computers: Personal Computers, Minicomputers, Microcomputer, Mainframe and Supercomputers, Based on the data handled: Digital, Analog and Mixed Computers (4 hrs)

5. Concept of timesharing, multiprogramming, multi-testing and real time processing (4 hrs)

6. Application Software like: MS-Word, MS-Excel and MS-Powerpoint (16 hrs)

7. Introduction to C++ language, various data types, input-output commands, control statements and looping (16 hrs)

8. Simple programmes related to Chemical Industry in C++
   Ex.: i) Calculation of area of Heat Exchanger
   ii) Calculation area of cylinder
   iii) Conversion of Units (°F to °C)
   iv) Calculation of flow rate from volumetric flow rate and area (16 hrs)

9. Introduction to Internet : Email, Search-Engines (8 hrs)

RECOMMENDED BOOKS

1. Learning C++ by Robert Lafore
2. C++ by Ravichandran
3. Introduction to Computers by A. Leon and Leon
4. Algorithm and Data Structure Program by Wirth, PHI
5. The Art of Computer Programing by Kruth, Addison Wesley Publication
6. A First House in Computers by Sanjay Saxena, 2000, Vikas Publication
7. Object Oreinted Programming with C++ by E. Balaguruswamy, 2nd Edition, Tata McGraw Hill Publication