

6.1 FERTILIZER TECHNOLOGY.

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RATIONALE

Fertilizer plants have large employment potential, therefore, this subject is being offered as an elective subject. Students will be imparted detailed knowledge of nitrogenous, Phosphatic and mixed fertilizers.

DETAILED CONTENTS

1. Introduction (08periods)
Demand and Supply in India. Overview of fertilizer industry in India. Important fertilizer plants in India. General introduction of NPK fertilizers
2. Nitrogenous Fertilizers: (20 periods)
 - Importance of ammonia, its manufacture from different processes and brief description of important fertilizers made from ammonia.
 - Detailed manufacturing processes of urea and major engineering problems
 - Detailed manufacturing processes of Ammonium Nitrate.
 - Major Engineering problems like corrosion, safety, crystallization, conditioned air requirements
3. Phosphatic Fertilizers: (16 periods)
 - Detailed manufacturing process of superphosphate and triple super phosphate with the help of flow sheet.
 - Ammonium phosphates: Detailed process description with the help of flow sheet
4. Potassic Fertilizers (08 periods)
Brief description of manufacturing of various Potassic fertilizers like KCl and K_2SO_4
5. Mixed Fertilizers: (10 periods)
 - Chemical Fertilizer; (A mixture of ammonium phosphate, ammonium sulfate and potash); Flow sheet and description of process.
6. Micronutrients: Different micronutrients, their effects. (12 periods)
7. Bio-fertilizers (06 periods)
Brief description of various types of bio-fertilizers

INSTRUCTIONAL STRATEGY

The fertilizer plants have large employment potential for chemical engineers so the students maybe imparted knowledge about the fertilizers in detail with their detailed flow sheets.

RECOMMENDED BOOKS

1. Agriculture in India, Vol. I by Kumar, Aggarwala and Others, Asia Publishing House, Mumbai
2. Handbook on Fertilizer Technology, published by Fertilizer Association of India
3. Fertilizer Quality Guide for Major and Micro Nutrients by HLS Tandon published by Fertilizer Association of India
4. Fertilizer Industry in India, Part I and II by Pritam Singh and VS Awasthi, 1992

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	15
2	20	20
3	16	15
4	08	10
5	10	15
6	12	15
7	06	10
Total	80	100

6.2 PETROLEUM AND PETROCHEMICALS

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RATIONALE

Petroleum industry being one of the fast growing industries has large employment potential. Students will be imparted detailed knowledge of petroleum and petrochemical products along with the processes involved in their production.

DETAILED CONTENTS

THE CONTENTS ARE NOT LEGIBLE

1. History and development of petroleum refining, composition constituents of petroleum. (08 periods)
2. Important petrochemical feed stocks and precursors . (10 periods)
3. Definition, properties and uses of flash point, fire point, cloud and pour point viscosity index, octane number, cetane number, diesel index, smoke point, aniline point, penetration number . (12periods)
4. Technology of cracking, reforming, alkylation, isomerization, hydrogenation, oxidation, nitration, polymerization. (12 periods)
5. Manufacturing processes of synthesis gas, acetaldehyde, vinyl acetate, ethyl chloride, styrene, acrylonitrile, propylene oxide, butadiene, and isoprene. (14 periods)
6. Cracking, different cracking processes like thermal cracking, visbreaking, catalytic cracking (fluidized bed and fixed bed). (08 periods)
7. Lube oil production processes. (08 periods)
8. Coking, different coking processes like delayed coking and fluidized bed coking. (08 periods)

LIST OF PRACTICALS

1. Flash point and fire point of oil by pensky-martan method.
2. Flash point and fire point of oil by clear and open cup method.
3. Viscosity of petroleum products by Redwood viscometer.
4. Viscosity of petroleum products by saybolt's viscometer.

5. Viscosity of petroleum products by Angular viscometer.
6. Smoke point of kerosene and other volatile liquids.
7. Aniline point of petroleum products.
8. Penetration numbers of greases, bitumen and asphalt.
9. Cloud and pour point of oils.
10. Colorific value by Bomb calorimeter.
11. Colour comparison by photoelectric colorimeter or by Lovibond Tintometer.

INSTRUCTIONAL STRATEGY

Theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with assignments. Extension lectures by experts from petroleum industry can enrich the students with better inputs regarding the various processes involved for improving the quality of petroleum products. Also a visit of the students to a refinery will further help them to understand the different processes and equipment involved in the petroleum industry.

RECOMMENDED BOOKS

1. Petroleum Refinery Engineering by WL Nelson
2. Petroleum Processing by RJ Hengsbeck

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	10
2	10	15
3	12	15
4	12	15
5	14	15
6	08	10
7	08	10
8	08	10
Total	80	100

6.3 PAINT TECHNOLOGY

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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 CONTENTS

- 1. Introduction** (06 hrs)
Definition of paint, primers, varnish, solvent, binder (resin) and additives and functions of each component. Pigment volume, concentration (PVC) and critical pigment concentration (CPC)
- 2. Synthetic resin-** Introduction, raw material, basic chemistry, properties and uses of such types of resins like alkyd resin, Epoxy resin, phenolics resins, polyester resin, silicone. (12 hrs)
- 3. Solvents** (06 hrs)
Classification of solvent and general properties of solvent
- 4. Pigments** (06 hrs)
Introduction, general physical Properties like colour, tinting strength, opacity, particle size, oil absorption. Classification of Pigment and name of pigments (organic and inorganic).
- 5. Manufacturing Process** (06hrs)
Paint manufacturing by ball mill and sand mill
- 6. Coatings** (06 hrs)
Properties and uses of such type of coating –primer coating, under coating, finishing coating.
- 7. Primers** (08 hrs)
Introduction, purpose of Primer, classification of Primer and uses.
- 8. Paints** (08 hrs)
Classification of paint(such as Latex, Emulsion, Glossy) and formulation and uses.
- 9. Application Methods** (09 hrs)
Introduction and different application methods such as brush coating, rolling coating, spray coating, Dip coating, powder coating, CED (cathodic electro disposition), advantages and disadvantages of these methods.

10. **Paint Defects** (06 hrs)

Introduction, causes and remedies methods of paint defects such as Settling, Brush drag, cracking, cratering, peeling, Pin holding, Wrinkling

11. **Testing Methods** (07 hrs)

Introduction and testing of different properties of paint and different coatings like viscosity, hardness, flexibility, covering power, gloss, impact resistance.

INSTRUCTIONAL STRATEGY

Extension lectures by a person from a paint industry will provide valuable inputs regarding latest techniques and new types of coatings/paints . Visits to paint industry like ICI paints, Asian Paints will provide the outlook of a paint plant, new equipment and techniques used in the plants and know how about the latest application technologies of paint. Visit to fully automated plants like ICI will also provide inputs about process control and instrumentation.

RECOMMENDED BOOKS

1. Surface Coating by Swaraj Paul
2. Outline of Paint Technology, Vol. 2 by WM Morgans

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	05
2	12	15
3	06	10
4	06	10
5	06	10
6	06	10
7	08	08
8	08	08
9	09	08
10	06	08
11	07	08
Total	80	100

6.4 PROCESS EQUIPMENT DESIGN

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RATIONALE

The topic included in the subject process equipment design are design of machine elements, storage, vessels, pressure vessels with the consideration of stress involved in materials and their protective coating. The students are expected to solve the elementary problems of different equipment used in process industry.

DETAILED CONTENTS

1. Basic Considerations in Process Equipment Design (08 periods)
Introduction, general design procedures, fabrication techniques, equipment Classification, power for rotational motion.
2. Design Considerations (08 periods)
Introduction, materials selections, corrosion prevention, stresses created due to static & dynamic loads, elastic instability, combined stresses and theories of failure, fatigue, brittle, fracture, creep, temperature effect, radiation effects, effects of fabrication methods, economic consideration.
3. Power Requirement of Pumps (10 periods)
Definition of pumps, types of pumps (centrifugal and reciprocating pumps), manometric head of centrifugal pump, efficiency of the centrifugal pumps (manometric efficiency, mechanical efficiency and overall efficiency), problems relating calculations of horse power (H.P.), N.P.S.H., for flow of incompressible fluid, characteristics curves for pumps, specification sheet for pumps.
4. Pressure Vessels (17 periods)
Selection of type of vessels, causes of failure of vessels, methods of fabrication, types of formed heads, stress in thin shells subjected to internal pressure, longitudinal and circumferential stress, joint efficiency and corrosion allowance, crown and knuckle radius, Problems relating calculation of shell thickness of cylindrical and spherical shells under internal and external pressure, thickness of torispherical heads subjected to internal pressure as per I.S. code.
5. Distillation Column (17 periods)
Preparation of equilibrium diagram, problems relating calculation of theoretical plates at a given reflux ratio and total reflux, minimum reflux ratio, feed plate location, by McCabe-thiele methods for separation of ideal binary mixtures, shell diameter calculations.

6. Heat Exchanger and Condensers (12 periods)
Problems relating calculation of L.M.T.D., individual and overall heat-transfer coefficients, number of tubes, number of passes, Heat-transfer coefficient for condensing vapors by Wilson's plot.
7. Evaporators (08 periods)
Problems relating calculation of heating area, steam requirement, steam economy for single and double effect evaporators. Methods of feeding evaporators and effect of Boiling Point Rise (B.P.R) and Hydrostatic Head.

INSTRUCTIONAL STRATEGY

The emphasis should be laid on numerical aspects for the design of distillation columns and process vessels. Field visits may help the students to know more about latest types of trays and packings used in distillation absorption columns. Emphasis should also be laid on material selection aspects for the equipment.

RECOMMENDED BOOKS

1. Process Equipment Design by Mane and Rushtom
2. Process Equipment Design by Bronwnell and Young
3. Process Equipment Design by MV Joshi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	10
2	08	10
3	10	20
4	17	20
5	17	20
6	12	10
7	08	10
Total	80	100

6.5 Pollution Control & Industrial Safety

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RATIONALE

This course is related with the cleaning of environment. This subject provides the knowledge of how to keep our environment free from any type of pollution, what are laws related to environment. In this subject, study of industrial safety and fire are also included.

DETAILED CONTENTS

- 1- **Introduction**: - What is environment? Environment keeps changing, component of the environment, factors affecting environment & types of environment. What is pollution? Classification of pollution & types of pollution, classification of pollutants.

(5 Periods)

- 2- **Air Pollution** :- Definition of air pollution, types of air pollutants, properties of air pollutants, various sources of air pollution like SPM, SO_x, NH₃, F, CL, CFC, CO₂, and their effects, Acid rain, Green house effects, Ozone layer.

(10 Periods)

Air pollution control equipment's:-

- (I) Settling chambers
- (II) Cyclones
- (III) Scrubber (dry & wet)
- (IV) Cyclones & multi-clones
- (V) Electrostatics properties
- (VI) Bag filters.

- Ambient air quality measurement & their standards.

- 3- **Water pollution**:- origin of waste water, different types of water pollutants, their sources & effects. Water pollution, standards for drinking water, domestic waste water & industrial waste water. Methods of measurement of various parameters like BOD, SS, P^H, COD, TDS etc. methods of treatment of industrial waste water like.(10 Periods)

- I) Chemical treatment
- II) Physio - chemical treatment
- III) Bio- chemical treatment
- IV) Any other advanced treatment

- 4- **Pollution and factory acts**: - water pollution control act 1974, air pollution act 1981, environment protection act 1986, hazardous chemical manufacturing, storage and impact rule 1989 and hazardous waste management and handling rule 1989, elementary knowledge of factory act 1948 and payment of wage act 1936.

(10 Periods)

5. Fire & prevention: - Fire triangle, classification of fires, flammable and Inflammable liquids, various types of fire extinguishers and their applications. Fire hazards and their prevention. **(6 Periods)**

6. Industrial safety:- Receiving, storing, transportation of flammable liquids, gases and toxic Materials and wastes, Safety in chemical reaction, pipelines in chemical factories, Precautions in the case of processes in operations involving explosives and inflammable Dusts, gases, vapours etc. codes of practice and specification for safety equipment/ Alarms/signals (reference should be made from I.S. Codes). **(10 Periods)**

7. Elements of safety- safety aspects related to site, plant layout, process development And design stages, identification of hazards and its estimation risk, risk analysis and Assessment methods, fault free method, event free method, scope of risk assessment, Controlling toxic chemicals and flammable materials **(7 Periods)**

8. Toxic substances and degree of toxicity- its estimation, their entry routes into human System, their doses and responses, control techniques for toxic substances exposure, Use of respirators, ventilation systems. **(6 Periods)**

LIST OF PRACTICALS

1. Estimation of TS, TDS
2. Estimation of BOD
3. Estimation of COD by titration methods
4. Estimation of PH value, carbonate, bicarbonate and hydroxide alkalinity of waste water sample
5. To determine the turbidity of waste water sample
6. To determine the hardness of water
7. Demonstration of various types of fire extinguishers

INSTRUCTIONAL STRATEGY

In this subject, it is essential to instruct to students about the environment and pollution due to industry and how it may be minimized It must be essential to students to visit industry for pollution related problems.

RECOMMENDED BOOKS

1. Safety and Accident Prevention in Chemical Operation by Fawcett and Wood, Inter Science Publication
2. Chemical Engineering, Vol. 1, II, III and IV by Coulson and Richardson, Pergamon Press Publication
3. Air Pollution by Perkins, McGraw Hill Publication
4. Fundamentals of Air Pollution by Williamson, Addison Wesley Publication
5. Liquid Wastes of Industries by Nemerow, Addison Wesley Publication
6. Waste Water Engineering by Metcalf and Eddy, McGraw Hill Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	05	10
2	10	15
3	10	15
4	10	15
5	06	10
6	10	15
7	07	10
8	06	10
Total	64	100

6.6 MAJOR PROJECT WORK

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RATIONALE

Every diploma holder has to do a project work before going to the world of work so that he may have sufficient knowledge to face the various problems involved in solving the project. Chemical engineering technician must be well aware of these too. So the projection the design of pressure vessel, storage tanks, heat exchanger, distillation column and evaporator are included in the subject.

Project work aims at developing skills in the students whereby they apply the knowledge and skills gained through the course in totality to solve a particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of 5-6 students. The project assignments may consist of:

- Design of pressure vessel
- Design of heat exchanger
- Design of distillation column
- Design of evaporator
- Development of prototypes
- Study of the process of manufacturing of paints, detergents etc.
- Fabrication of components/equipments
- Fault diagnosis and rectification experiences
- Bringing improvements in the existing system/equipment
- Calibration and testing of equipment or any other innovative project which can develop creative skills in the students

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance criteria	Max. marks	Rating Scale				
			Excellent	Very good	Good	Fair	Poor
1.	Selection of project assignment	10	10	8	6	4	2
2.	Planning and execution of considerations	10	10	8	6	4	2
3.	Quality of performance	20	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20	20	16	12	8	4
5.	Sense of responsibility	10	10	8	6	4	2
6.	Self expression/communication skills	5	5	4	3	2	1
7.	Interpersonal skills/human relations	5	5	4	3	2	1
8.	Report writing skills	10	10	8	6	4	2
9.	Viva voce	10	10	8	6	4	2
Total marks		100	100	80	60	40	20

The overall grading of the practical training shall be made as per following table

	Range of maximum marks	Overall grade
i)	More than 80	Excellent
ii)	79 <> 65	Very good
iii)	64 <> 50	Good
iv)	49 <> 40	Fair
v)	Less than 40	Poor

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared “not eligible to receive diploma”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

Important Notes

- 1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.**
- 2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.**

- 3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.**
- 4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.**

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.

6.7 EMPLOYABLE SKILLS

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Periods per week - - 4

RATIONALE

Diploma holders are required to not only possess subject related knowledge but also soft skills to get good jobs and to rise steadily at their workplace. This subject is included to develop employability skills amongst the students.

DETAILED CONTENTS

1. Industrial Scenario Engineering Education and expectations of competences from an engineer by employer (04 period)
2. Personality types, characteristic and features for a successful engineer (04 period)
3. Professional Engineer desirable values and ethics and their development. Relation between engineering profession, society and environment (04 period)
4. Managing project (16 period)
 - Leadership
 - Motivation
 - Time management
 - Resource management
 - Computer Software
 - Interpersonal relationship
 - Engineer economics and fundamentals
5. Effective Communication (08 period)
 - Listening
 - Speaking
 - Writing
 - Presentation Technique/Seminar
 - Group discussion
6. Preparing for Employment (08 period)
 - Searching for job/job hunting
 - Resume Writing
 - Interview technique in personal interview telephonic interview, panel interview, group interview, video conference
7. Managing Self (06 period)
 - Managers body, mind, emotion and spirit

- Stress Management
 - Conflict resolution
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8. Continuing professional development (04 period)
 - Organising learning and knowledge
 - Use of computer for organising knowledge resource

 9. Creativity, Innovation and Intellectual property right (06 period)
 - Concept and need in present time for an engineer

 10. Basic rules, laws and norms to be adhered by engineers during their working (04 period)