



BANGLADESH TECHNICAL EDUCATION BOARD
Agargaon, Dhaka-1207

4-YEAR DIPLOMA-IN-ENGINEERING PROGRAM
SYLLABUS (PROBIDHAN-2016)

CHEMICAL TECHNOLOGY

TECHNOLOGY CODE: **663**

7th SEMESTER

DIPLOMA IN ENGINEERING
PROBIDHAN-2016

CHEMICAL TECHNOLOGY (663)

7th SEMESTER

Sl. No	Subject Code	Name of the subject	T	P	C	Marks				Total
						Theory		Practical		
						Cont. assess	Final exam	Cont. assess	Final exam	
1	66371	Chemical Engineering Operation -5	3	3	4	60	90	25	25	200
2	66372	Chemical Process Industries -4	2	3	3	40	60	25	25	150
3	66373	Natural Gas & Fertilizer	2	3	3	40	60	25	25	150
4	66374	Corrosion Technology	2	3	3	40	60	25	25	150
5	66375	Plastic and Polymer Technology	2	3	3	40	60	25	25	150
6	66376	Chemical Engineering Project	0	6	2	0	0	50	50	100
7	66853	Innovation & Entrepreneurship	2	0	2	40	60	0	0	100
Total			13	21	20	260	390	170	170	1000

AIMS

- To be able to understand the basic concepts of mass transfer, distillation, absorption of gases, leaching and liquid-liquid extraction.
- To be able to perform experiments on distillation, absorption of gases, leaching and liquid-liquid extraction.

SHORT DESCRIPTION

Diffusion and mass transfer, Mechanism of diffusion; Theories of mass transfer; Basic concepts of distillation; Methods of distillation; Simple distillation, Equilibrium distillation and Fractional distillation; Different types of columns; Azeotropic distillation; Extractive distillation; Steam distillation; Basic concepts of absorption of gases; Mechanism of absorption; Packed towers; Plate towers and the other equipment for gas absorption; Leaching and extraction fundamentals; Equipment for leaching and extraction; Liquid-liquid extraction; Equipment for liquid-liquid extraction;

DETAIL DESCRIPTION**Theory:****1. Understand diffusion and mass transfer.**

- 1.1 Define diffusion, diffusivity, thermal diffusion and forced diffusion.
- 1.2 Distinguish between mass transfer and heat transfer.
- 1.3 Describe mass transfer with examples.
- 1.4 State Fick's law of molecular diffusion.
- 1.5 Describe diffusion in gas phase.
- 1.6 Explain the mechanism of diffusion through a stationary gas.

2. Understand the mechanism of diffusion.

- 2.1 State Maxwell's law of diffusion.
- 2.2 Describe the diffusivities of various vapors.
- 2.3 Describe the mechanism of diffusion in the liquid phase.
- 2.4 Explain equimolecular counter diffusion.

3. Understand the theories of mass transfer.

- 3.1 Describe the film theory of mass transfer.
- 3.2 Describe the penetration theory of mass transfer.
- 3.3 Explain the mass transfer coefficient.
- 3.4 Explain counter current mass transfer and transfer units.

4. Understand the basic concepts of distillation.

- 4.1 Define distillation.
- 4.2 Describe vapor - liquid equilibrium and equilibrium data.
- 4.3 Describe partial pressures of a mixture.
- 4.4 Explain the term volatility and relative volatility.
- 4.5 Relate the term volatility with boiling point.
- 4.6 State the Dalton's law of partial pressure.
- 4.7 Explain the Raoult's law of vapor pressure.

- 4.8 Explain Henry's law and its limitation.
- 4.9 Describe boiling point diagram and equilibrium diagram.

5. Understand the different methods of distillation.

- 5.1 Classify the distillation.
- 5.2 Sketch the different types of distillation.
- 5.3 Describe simple distillation or differential distillation.
- 5.4 Describe flash or equilibrium distillation.
- 5.5 Describe rectification distillation.

6. Understand the fractionating column and calculation of number of stages in a distillation column.

- 6.1 Draw a neat sketch of a fractionating column and indicate its different parts and accessories.
- 6.2 Explain the rectifying section, stripping section and flashing section.
- 6.3 Discuss the methods for calculation of number of plates required in a distillation column.
- 6.4 Explain how the Lewis-Sorel method used in calculating no. of stages in a distillation column.
- 6.5 Write the sequential steps for calculating the number of plates in a distillation column by McCabe and Thiele method with neat sketch.

7. Understand the different features of distillation operations.

- 7.1 Define Reflux.
- 7.2 Describe reflux ratio and its importance.
- 7.3 Explain the minimum reflux ratio, total reflux ratio and optimum or economic reflux ratio.
- 7.4 Explain the number of plates required at total reflux and minimum reflux.
- 7.5 Explain the optimum reflux ratio with neat sketch.
- 7.6 Describe the optimum location of feed plate in a continuous still.
- 7.7 Describe the light and heavy key components in the distillation of multi component mixtures.

8. Understand the special types of distillation.

- 8.1 Describe azeotropes with examples.
- 8.2 Describe the methods of azeotropic distillation.
- 8.3 Describe extractive distillation and its application.
- 8.4 Describe steam distillation.

9. Understand the plate columns.

- 9.1 Describe plate columns.
- 9.2 Describe different types of trays in plate columns.
- 9.3 Describe bubble cap trays, sieve trays and valve trays.
- 9.4 Describe the factors determining column performance.
- 9.5 Describe different types of plate efficiency.

10. Understand the basic concepts and mechanism of absorption of gases.

- 10.1 Define absorption of gases.
- 10.2 Describe the condition of equilibrium between liquid and gas.
- 10.3 Express the material balance in gas absorption.
- 10.4 Describe factors which influencing the rate of absorption.
- 10.5 Describe the absorption of gases associated with chemical reaction.
- 10.6 Describe the absorption of gases accompanied by the liberation of heat

11. Understand the packed towers and plate towers.

- 11.1 Describe the construction of a packed tower.
- 11.2 Describe the tower packing and their properties.

- 11.3 Describe flooding and loading point of absorption tower.
- 11.4 Describe the capacity of packed towers.
- 11.5 Describe the plate tower.
- 11.6 Explain the transfer unit and Height Equivalent of Transfer Unit (HETU).
- 11.7 Describe the spray towers used for absorption of gases.

12. Understand the leaching and extraction fundamentals and the equipment of leaching and extraction

- 12.1 Define leaching and extraction.
- 12.2 Describe the factors influencing the rate of extraction.
- 12.3 Make a list of organic solvent in leaching operations.
- 12.4 Make a list of equipment for leaching.
- 12.5 Explain the three consecutive basic steps involved in normal leaching operation.
- 12.6 Draw a neat sketch of a batch type extractor and indicate its different component.
- 12.7 Describe the working principle of Bollman continuous moving bed extractor with neat sketch.
- 12.8 Describe the leaching of coarse solid by using Dorr classifier.
- 12.9 Describe the methods of leaching of fine solids.
- 12.10 Describe a Dorr agitator.

13. Understand the liquid-liquid extraction and the equipment uses for liquid-liquid extraction

- 13.1 Define liquid-liquid extraction.
- 13.2 Explain the basic principles and techniques of liquid-liquid extraction.
- 13.3 Explain the applications of liquid-liquid extraction.
- 13.4 Discuss the importance of liquid-liquid extraction.
- 13.5 List the extraction equipment.
- 13.6 Describe the mixer settler.
- 13.7 Describe the spray columns with neat sketch.
- 13.8 Describe packed columns for liquid-liquid extraction.
- 13.9 Describe solvent extraction (Liquid-liquid) centrifuge.

PRACTICAL

1. Study the simple distillation by using laboratory distillation apparatus.

- 1.1. Collect and arrange the components of simple distillation apparatus (Round bottom flask, condenser, receiver etc).
- 1.2. Collect and arrange hose pipe, stand with clamp, tripod stand, wire net, gas burner etc).
- 1.3. Organize the components properly and construct a full distillation unit.
- 1.4. Arrange copper sulfate salt and mix with water in a beaker.
- 1.5. Put the mixture in the round bottom flask.
- 1.6. Fire the gas burner and heat the mixture contained in the round bottom flask.
- 1.7. Collect the distillate (water) in a receiver.
- 1.8. Ask questions, answers and share each other.

2. Draw and indicate the different components of a fractionating column.

- 2.1 Collect and arrange the drawing board, pencil, rubber, scale, geometry box etc.
- 2.2 Put the drawing paper on the board.
- 2.3 Makes margin accordingly.
- 2.4 Replicate the fractionating column on the paper.

2.5 Point out the different elements of the fractionating column.

3. Study the pilot plant fractionating column and the functions of its accessories.

3.1 Participate all the learners in front of pilot plant fractionating column.

3.2 Observe the pilot plant fractionating column.

3.3 Respond the demonstration of the pilot plant fractionating column by the trainer.

3.4 Attain to the knowledge about the different accessories of the pilot plant fractionating column.

3.5 Ask questions, answers and share each other.

4. Draw a neat sketch of a gas absorption tower and indicate its different parts.

4.1 Collect and arrange the drawing board, pencil, rubber, scale, geometry box, set square etc.

4.2 Put the drawing paper on the board.

4.3 Makes margin accordingly.

4.4 Replicate the gas absorption tower.

4.5 Point out the different elements of the gas absorption tower.

4.6 Ask questions, answers and share each other.

5. Determine the loading and flooding point using air water contact tower.

5.1 Arrange the air-water contact tower (Absorption tower).

5.2 Open the water inlet line.

5.3 Start the compressor and regulate the air-inlet line.

5.4 Increase the air velocity (flow rate) through the column step by step.

5.5 Observe the column and hold the air velocity (flow rate) when the water level in the column become stagnant.

5.6 Perform/Record this condition i.e. air velocity (flow rate) known as loading point.

5.7 Again increase the air velocity (flow rate) through the column step by step.

5.8 Observe the column and hold the air velocity (flow rate) when the water level in the column become increasing and no water can escape from bottom of the column.

5.9 Perform/Record this condition i.e. air velocity (flow rate) known as flooding point.

6. Study the extraction of oil from oil seeds by using an extraction unit (soxhlet apparatus).

6.1 Collect and arrange the components of extraction units (Round bottom flask, soxhlet apparatus and condenser).

6.2 Sequentially assemble the each component.

6.3 Load the proper substance (crushed oil seeds) in a sample compartment (thimble).

6.4 Arrange hose pipe to the condenser such that the tap water enters bottom of the condenser and passes through condenser come out from upper part of condenser.

6.5 Pour the solvent in the sample compartment of the soxhlets apparatus through a funnel and collect into the round bottom flask.

6.6 Heat the round bottom flask such that the solvent will be vaporized and passes through vapor tube into reflux condenser. After condensing the solvent it drips into the thimble, extracts the solute (oil) from seeds and gradually raises up, after certain level the whole liquid returns to the round bottom flask.

6.7 The cycle of solvent should be continued as many times as possible so as to get efficient extraction.

7. Determine the percentage of oil present in a sample of oil seed by extraction method using an extraction unit (soxhlet apparatus).

7.1 Weigh out the sample seeds of oil.

- 7.2 Extract the oil from seeds by using soxhlet's apparatus.
- 7.3 Collect and evaporate the whole extracted liquid (mixture of oil and solvent).
- 7.4 Weigh out the oil in the container.
- 7.5 Calculate the percentage (%) of oil extracted/present in seeds.

8. Draw a batch plant extractor and indicate its different parts.

- 8.1 Collect and arrange the drawing board, pencil, rubber, scale, geometry box, setsquare etc.
- 8.2 Put the drawing paper on the board.
- 8.3 Make margin accordingly.
- 8.4 Replicate the batch plant extractor.
- 8.5 Point out the different elements of the batch plant extractor.
- 8.6 Ask questions, answers and share each other about batch plant extractor.

9. Draw a neat sketch of a Bollmann extractor and indicate its different components.

- 9.1 Collect and arrange the drawing board, pencil, rubber, scale, geometry box, setsquare etc.
- 9.2 Put the drawing paper on the board.
- 9.3 Make margin accordingly.
- 9.4 Replicate the Bollmann extractor.
- 9.5 Point out the different elements of the Bollmann extractor.
- 9.6 Ask questions, answers and share each other about Bollmann extractor.

REFERENCE BOOKS

- 1. Introduction to chemical engineering; Badger and Banchero; McGraw Hill Book Co. Ltd; Newyork.
- 2. Chemical engineering vol-1 and Vol-2 ; J. M. Coulson and J. F. Richardson; Pergamon Press Ltd; England.
- 3. Unit operation of chemical engineering; W. L. McCabe and J. C Smith; McGraw Hill Book Co. Ltd; Newyork.
- 4. Unit operations of chemical engineering—vol – I & Vol II. P. Chattopadhyay; Khanna Publishers, Delhi.
- 5. Food engineering operations; Brennan, Butters, Cowell and Lilly; Applied Science Publishers Ltd; London.
- 6. Chemical engineering hand book; Perry; McGraw Hill Book Company Ltd; Newyork.

AIMS

- To be able to understand the basic concepts glass manufacturing industries.
- To be able to understand the basic concept of ceramic industries.
- To be able to understand the basic concept fermentation Industries.
- To be able to understand the basic concept of manufacturing of organic acid.
- To be able to understand the Propylene (C₃ compounds).
- To be able to understand the rubber compounds.
- To be able to understand pesticides.
- To be understand the basic concept of pharmaceutical industry.

SHORT DESCRIPTION

Basic concept of glass; Raw materials of glass, Fabrication of glass; Basic concept of ceramic; Raw materials of ceramics; Ceramic body preparation; Shaping of ceramic products; glazing and decoration of ceramic products; Basic concept of Fermentation; Basic concept of Rubber; Nitrite rubber; butyl rubber; Rubber compound; pesticides and pharmaceutical industries.

DETAIL DESCRIPTION:**Theory:****1. Understand the basic concept of glass**

- 1.1 Define glass.
- 1.2 Explain the classification of glass raw materials.
- 1.3 Describe raw materials in glass batch.
- 1.4 Describe the physical and chemical properties of glass.
- 1.5 Mention the effect of different constituents in glass.
- 1.6 Explain silica glass, soda-lime glass, lead-alkali silicate glass, borosilicate glass and alumina silicate glass.
- 1.7 Explain optical glass, translucent glass, and safety glass, fiber glass, photosensitive glass, colored glass, glass ceramic, sintered glass and metal glass.

2. Understand the Fabrication, annealing and finishing of glass.

- 2.1 Explain preparation of molten glass in pot furnace and tank furnace.
- 2.2 State the basic process for glass fabrication.
- 2.3 Explain pressing and blowing process.
- 2.4 Explain drawing and floating process for manufacture of sheet glass.
- 2.5 Describe Colburn process and Foucault process for manufacturing of sheet glass.
- 2.6 Define annealing and finishing of glass.

3. Understand the basic concept of ceramic.

- 3.1 Define ceramics.
- 3.2 Mentioned the different types of ceramic products and their uses.
- 3.3 State the classification of raw materials used for manufacturing of ceramic articles.
- 3.4 Explain filler, clay, fluxing and other important materials.
- 3.5 Discuss the properties of plastic and non plastic material.
- 3.6 Discuss different types of clay.

4. Understand the ceramic body preparation, glazing and decorating.

- 4.1 Describe the body preparation (clay roll/casting slip) with flow diagram.
- 4.2 State the shaping process of white wares.
- 4.3 Describe plastic body preparation using jiggering process.
- 4.4 Describe plastic body preparation using jollying process.
- 4.5 Describe drain casting process.
- 4.6 Describe pressure casting process.
- 4.7 Discuss the body preparation in dry state (dust pressing).
- 4.8 Mention the advantage of body preparation in dry state.
- 4.9 State glaze, its composition and application.
- 4.10 Explain decoration of ceramic products.

5. Understand Fermentation Industries.

- 5.1 State enzymes.
- 5.2 Define fermentation.
- 5.3 Explain conditions of fermentation.
- 5.4 State differences between catalyst and enzyme.
- 5.5 Define industrial alcohol.
- 5.6 State the sources of industrial alcohol.
- 5.7 Explain manufacture of industrial alcohol from starch.
- 5.8 Explain manufacture of industrial alcohol from molasses.
- 5.9 Explain rectified spirit.

6. Understand Citric acid and Oxalic acid.

- 6.1 State citric acid.
- 6.2 Draw the process diagram for production of citric acid from lemon.
- 6.3 Explain the uses of citric acid.
- 6.4 State oxalic acid.
- 6.5 Describe the manufacturing process of oxalic acid by the fermentation of glucose.
- 6.6 Explain uses of oxalic acid.

7. Understand Propylene (C₃ compounds).

- 7.1 Define isopropanol (Isopropyl alcohol), acetone & cumene (Isopropyl benzene).
- 7.2 Define fermentation.
- 7.3 Draw the process diagram of isopropanol (Isopropyl alcohol) by indirect hydration of propylene.
- 7.4 Draw the process diagram of acetone by dehydrogenation of isopropanol.
- 7.5 Draw the process diagram of cumene (Isopropyl Benzene) via propylene alkylation of benzene.
- 7.6 Explain the application of isopropyl alcohol (IPA), acetone and cumene.

8. Understand the rubbers.

- 8.1 Define natural rubbers (NR), synthetic rubbers and rubber latex.
- 8.2 Explain tapping preservation, and coagulation of rubber latex.
- 8.3 Explain hydrogenated rubber and cyclized rubber.
- 8.4 Describe the method of preparation of styrene butadiene rubber (SBR).
- 8.5 State uses of different types of rubber

9. Understand the nitrite rubber, butyl rubber, rubber compound and processing.

- 9.1 Define nitrite rubber and isobutylene rubber (IBR).
- 9.2 Describe the method of preparation of nitrite rubber.
- 9.3 Describe the method of preparation of isobutylene isoprene rubber (IIR).
- 9.4 Define vulcanization of rubber.
- 9.5 Make a list of different types of rubber components.
- 9.6 Describe the fillers used in rubber vulcanization.

10. Understand the rubber products.

- 10.1 Make a list of important rubber products.
- 10.2 Describe the method of making tires.
- 10.3 Describe the method of making belts and hoses.
- 10.4 Describe cellular rubber products.
- 10.5 Discuss different applications of rubbers.

11. Understand Pesticides.

- 11.1 Define pesticides.
- 11.2 State the classification of pesticides.
- 11.3 Describe the Benzene Hexachloride (BHC).
- 11.4 Draw the flow chart for manufacture of 2,4-D.
- 11.5 Draw the flow chart for manufacture of Parathion.
- 11.6 Mention the uses of Parathion.

12. Understand Pharmaceutical Industry.

- 12.1 State Background of social significance of pharmaceutical industry.
- 12.2 State the Economics of pharmaceutical industry.
- 12.3 Describe the production methods of drugs.
- 12.4 Define antibiotics.
- 12.5 State the sources of antibiotics.
- 12.6 Explain classification of antibiotics.
- 12.7 Draw the process diagram for production of Penicillin by fermentation.
- 12.8 Describe the production method/process diagram for the production of chloramphenicol.

PRACTICAL:**1. Determine the moisture in silica sand.**

- 1.1 Collect sample of silica sand, electronic balance, crucible, electric oven, desiccators, hand gloves.
- 1.2 Start the oven and set the temperature at 110 °C.
- 1.3 Weigh the crucible including lid and note it.
- 1.4 Weigh out silica sand including crucible.
- 1.5 Heat the sample in oven at 110 °C for one hour.
- 1.6 After one hour stop oven, collect the crucible and cool the sample in desiccators.
- 1.7 Weigh out the crucible including sand and lid.
- 1.8 Find out amount of moisture and calculate the % of moisture content.
- 1.9 Clean the work place properly.

2. Analyze silica sand using shaker machine.

- 2.1 Collect sample of silica sand, bucket, a big spoon, platform balance, metal brush, shaker machine including screen of different mesh no.
- 2.1 Arrange the screen from course to fine mesh no.
- 2.2 Weigh out about 500 gm of silica sand.
- 2.3 Put silica sand on top screen and place the screen-set on shaker machine.
- 2.4 Run the machine for 2-3 minutes, collect the sand from each screen and weigh out.
- 2.5 Calculate the mesh % from each screen.
- 2.6 Clean the work place properly.

3. Draw the sectional diagram of a Tank furnace.

- 3.1 Select and collect appropriate materials, tools and equipments.
- 3.2 Replicate the tank furnace.

3.3 Label the different parts of tank furnace including dimension.

3.4 Briefly describe the working process.

3.5 Submit to the proper personal.

3.6 Store tools and equipment properly.

4. Draw the flow diagram for making plastic body and casting sleep.

4.1 Select and collect appropriate materials, tools and equipment.

4.2 Draw the neat sketch for preparation of a plastic body and casting sleep.

4.3 Indicate the direction using arrow head with straight line and label the different parts.

4.4 Briefly describe the working process.

4.5 Submit to the proper personal.

4.6 Store tools and equipment properly.

5. Determine the water of plasticity of a sample of China clay, Ball clay and Bijoypure clay.

5.1 Collect clay sample, mortar and pastel, screen, balance including weight box, burette and water.

5.2 Put sum sample on pestle and grind properly with the help of mortar.

5.3 Screen the grinded sample and put 100 gram on pastel.

5.4 Collect water slowly from the burette and mix properly.

5.5 Stop water when the sample becomes appropriate for plastic shaping.

5.6 Calculate the water of plasticity using formula

5.7 Clean the work place properly.

6. Draw net sketch for making a conical Flask step by step.

6.1 Select and collect appropriate materials, tools and equipment.

6.2 Draw a neat sketch for the preparation of a conical flask step by step using blow process.

6.3 Indicate its different parts.

6.4 Briefly describe the working process.

6.5 Submit to the proper personal.

6.6 Store tools and equipment properly.

7. Prepare citric acid from lemon juice.

7.1 collect cooking pot, glass container, table spoon, coffee filter, oven-safe container, lemon and calcium hydroxide.

7.2 Extract lemon juice from lemon.

7.3 Measure one cup of lemon juice and put in a cooking pot.

7.4 Add one tea spoon of calcium hydroxide in it and cook.

7.5 Pour the heated solution into a glass container and cooled.

7.6 Pour the cooled solution into a coffee filter.

7.7 Remove the calcium citrate particles from the inside of the coffee filter using a spoon.

7.8 Place the powder in an oven-safe container.

7.9 Clean the work place properly.

8. Draw the flow diagram for producing sheet glass using Foucault process.

8.1 Select and collect appropriate materials, tools and equipment.

8.2 Draw a neat sketch for producing sheet glass using Foucault process.

8.3 Label its different parts.

8.4 Briefly describe the working process for making sheet glass.

8.5 Submit to the proper personal.

8.6 Store tools and equipment properly.

9. Draw the flow diagram of DDT.

9.1 Select and collect appropriate materials, tools and equipment.

- 9.2 Draw a neat sketch of DDT.
- 9.3 Indicate the name of different unit process.
- 9.4 Briefly describe the working process.
- 9.5 Submit to the proper personal.
- 9.6 Store tools and equipment properly.

10. Draw the process diagram for production of Penicillin by fermentation.

- 10.1 Select and collect appropriate materials, tools and equipment.
- 10.2 Draw a flow diagram for manufacturing penicillin.
- 10.3 Indicate the name of different unit process and parts.
- 10.4 Briefly describe the working process.
- 10.5 Submit to the proper personal.
- 10.6 Store tools and equipment properly.

REFERENCE BOOKS

1. Industrial chemistry(Including Chemical Engineering) By- B.K.Sharma.
2. Polymer Science and Technology; By- Premamoy Gosh.
3. Shreves Chemical Process Industries; By- George T Auston.
4. Natural Rubber Science and Technology ; By- A. D. Robert.
5. The Applied Science of Rubber ; By- W. J. S. Naunton.
6. Plastics, Polymer Science and Technology ; By- M. D. Brijlal
7. Industrial Chemistry ; By- Rogers
8. Chemical Technology; By- Shukla & Panday.
9. Dryden outlines of chemical technology. By-M Gopala & Marshall sitting
10. ইন্ডাস্ট্রিয়াল কেমিস্ট্রি লেখক- সৈয়দ আহসান হাবিব ও মোঃ সাহাবউদ্দিন মৃধা (সামছ রসায়ন পাবলিকেশন)

AIMS

- To be able to understand the basic concept of natural gas, fertilizer and fertilizer industries.
- To be able to understand the chemical conversion involved in the natural gas and fertilizer industries.
- To be able to develop knowledge, skill and attitude in drawing the flowcharts and production methods of natural gas and fertilizer.
- To be able to develop knowledge, skill and attitude in demonstrating the production of natural gas and fertilizer products.
- To be able to perform the experiments of natural gas and fertilizer.

SHORT DESCRIPTION

Concept of natural gas; Bio-gas, Purification of natural gas, Transportation and distribution of natural gas, Converted forms of natural gas; Uses of natural gas; Basic concept of fertilizer; concept of reformer; CO₂ Converter, CO₂ removal and methanation unit, manufacturing process of ammonia, Urea; Super phosphate, TSP; Mixed fertilizer; Complex fertilizer and.

DETAIL DESCRIPTION

Theory:

1. Understand the concept of natural gas.

- 1.1 Define the term natural gas.
- 1.2 Describe the properties of natural gas.
- 1.3 State the composition of dry and wet natural gas.
- 1.4 Explain condensate of natural gas.
- 1.5 Describe the overall composition of natural gas obtain in Bangladesh.
- 1.6 Describe about the gas fields in Bangladesh.

2. Understand the concept of bio-gas or fermentation gas.

- 2.1 Define bio-gas.
- 2.2 List the raw materials of bio-gas.
- 2.3 Describe the gas obtain from cow dung fermentation.
- 2.4 Describe the gas obtain from house hold and other waste fermentation.
- 2.5 State approximate composition of bio-gas.
- 2.6 Describe a bio-gas plant with diagram.
- 2.7 Describe the uses of bio-gas.
- 2.8 Explain the future prospect of bio-gas plant in Bangladesh.

3. Understand transportation, distribution and purification of natural gas.

- 3.1 Define transportation and distribution of natural gas.
- 3.2 Describe the method of transportation of natural gas with diagram.
- 3.3 State the method of distribution of natural gas with diagram.
- 3.4 Define sour gas.
- 3.5 Describe the method of desulphurization of natural gas.
- 3.6 Explain the purification method of natural gas with flow chart.
- 3.7 Make list of by products of natural gas purification plant.

4. Understand different form of natural gas and uses of natural gas.

- 4.1 Define the following terms; CNG, NGL, LPG, LNG.

- 4.2 State the properties and nature of LPG, LNG, CNG, NGL.
- 4.3 Describe the uses and application of natural gas.
- 4.4 State the uses and application of LPG, CNG, LNG, NGL
- 4.5 List the advantages of natural gas over liquid and solid fuel.
- 4.6 Explain the economic value of natural gas of development of Bangladesh.

5. Understand the basic conception of fertilizer.

- 5.1 Define fertilizers and nitrogenous fertilizer.
- 5.2 List of different fertilizers used in Bangladesh.
- 5.3 Describe the importance of fertilizer into agriculture.
- 5.4 State the industrial use of fertilizers.
- 5.5 List the raw materials of nitrogenous and other fertilizer.
- 5.6 Explain the nitrogen value of fertilizer.
- 5.7 List the urea and non-urea fertilizer industry in Bangladesh.
- 5.8 Explain the future prospect of fertilizer industry in Bangladesh.

6. Understand the units of ammonia plant.

- 6.1 List the important units of ammonia plant.
- 6.2 Describe the function of primary and secondary reformer.
- 6.3 Mention the chemical reaction involved into primary and secondary reformer.
- 6.4 Explain the working principle of CO₂ shift converter with chemical reaction.
- 6.5 Describe the function CO₂ absorber and de-absorber.
- 6.6 State the absorbent (Benfield solution/MEA) used in CO₂ absorber.
- 6.7 State the function of Methenator with chemical reaction.
- 6.8 Draw a neat sketch of ammonia converter and label its parts.

7. Understand the manufacturing process of ammonia.

- 7.1 List the raw material of ammonia production.
- 7.2 List of the reaction involved in manufacture of ammonia by synthesis process.
- 7.3 Describe the method of production of ammonia by synthesis process.
- 7.4 Draw the flow sheet for the production of ammonia by synthesis process.
- 7.5 Describe the method of production of ammonia from natural gas.
- 7.6 Draw the flow sheet for the production of ammonia from natural gas.
- 7.7 Explain the influence of temperature and pressure to yield of ammonia.
- 7.8 Describe the function of catalyst into different units of ammonia plant.

8. Understand the concept of ammonia converter and storage.

- 8.1 Define ammonia converter/ reactor.
- 8.2 Describe converter used in ammonia plant.
- 8.3 Draw a sketch of ammonia converter and label its different parts and accessories.
- 8.4 State liquid ammonia.
- 8.5 Describe the characteristics of ammonia storage tank.
- 8.6 Explain the function of refrigeration unit in storage of ammonia in super cool temperature.
- 8.7 Describe the safety precaution of ammonia handling and ammonia storage system.

9. Understand the manufacture of urea.

- 9.1 Mention the raw materials of urea manufacturing.

- 9.2 List the major units of Urea plant.
- 9.3 Describe the method of manufacturing of urea by synthesis process with flow diagram
- 9.4 Mention the chemical reaction involved in urea manufacturing.
- 9.5 Draw a sketch of prilling tower and describe the operation process.
- 9.6 Explain prilled and granular urea.
- 9.7 Describe the moisture and bi-urate value of urea.
- 9.8 Explain bulk urea storage and bagging process.
- 9.9 Describe the uses of urea.

10. Understand the manufacturing of other nitrogenous fertilizer.

- 10.1 List the basic raw materials of ammonium nitrate fertilizer.
- 10.2 Draw flow sheet for the production of ammonium nitrate fertilizer.
- 10.3 Describe the methods of manufacturing of ammonium nitrate.
- 10.4 Describe the methods of manufacturing of ammonium sulfate.
- 10.5 Draw flow sheet for the production of ammonium sulfate fertilizer.
- 10.6 Mention the uses of ammonium nitrate and ammonium sulfate fertilizer.

11. Understand the manufacture of phosphate fertilizer.

- 11.1 Define phosphate fertilizer.
- 11.2 State the Types of phosphate fertilizer.
- 11.3 List the raw materials of manufacturing of super phosphate and triple super phosphate.
- 11.4 Mention the chemical reaction of super phosphate and triple super phosphate production.
- 11.5 Describe the method of manufacturing of super phosphate with flow sheet.
- 11.6 Describe the method of manufacturing of triple super phosphate with flow sheet.
- 11.7 Describe the uses of Super phosphate and triple super phosphate.

12. Understand the production of mixed and complex fertilizers.

- 12.1 Define mixed and complex fertilizers.
- 12.2 Describe the manufacturing process of mixed (N-P-K) fertilizer.
- 12.3 Draw the flow chart for manufacturing process of mixed (N-P-K) fertilizer.
- 12.4 Describe the manufacturing process of complex (nitro-phosphate) fertilizer.
- 12.5 Draw the flow chart for manufacturing process of complex (nitro-phosphate) fertilizer.
- 12.6 Describe DAP (Di ammonium phosphate) fertilizer.
- 12.7 Compare between complex and mixed fertilizer.
- 12.8 Mention the uses of mixed and complex fertilizer.

PRACTICAL:

1. Draw a bio-gas plant and briefly describe the process.

- 1.1. Select and collect appropriate materials, tools and equipments.
- 1.2. Draw a neat sketch of a bio-gas plant.
- 1.3. Label its different parts.
- 1.4. Briefly describe the working process.
- 1.5. Submit to the proper personnel.
- 1.6. Store tools and equipment properly.
- 1.7. Clean the work place properly.

2. Draw the flow chart for the purification of natural gas and briefly describe the process.

- 2.1. Arrange the appropriate materials, tools and equipments.
- 2.2. Draw the flow chart of purification of natural gas.
- 2.3. Locate its different parts.
- 2.4. Briefly describe the natural gas purification process.
- 2.5. Submit to the proper personnel.
- 2.6. Collect the tools, equipment and keep them safely.
- 2.7. Clean the work place properly.

3. Draw the flow chart for the manufacturing of ammonia by synthesis process.

- 3.1. Select and collect appropriate materials, tools and equipments.
- 3.2. Draw the flow chart of ammonia manufacturing by synthesis process.
- 3.3. Label its different parts.
- 3.4. Briefly describe the process flow chart.
- 3.5. Submit to the proper personnel.
- 3.6. Store tools and equipment properly.
- 3.7. Clean the work place properly.

4. Draw a neat sketch of ammonia synthesis converter and label the important parts.

- 4.1. Select and collect appropriate materials, tools and equipments.
- 4.2. Sketch a ammonia synthesis converter.
- 4.3. Label its different parts.
- 4.4. Briefly describe the working principle of synthesis converter.
- 4.5. Make report and Submit to the proper personnel.
- 4.6. Store tools and equipment properly.
- 4.7. Clean the work place properly.

5. Draw the neat sketch of ammonia storage tank with safety instrument.

- 5.1. Select and collect appropriate materials, tools and equipments.
- 5.2. Draw a neat sketch of ammonia storage tank with safety instrument.
- 5.3. Label its different parts.
- 5.4. Briefly describe about ammonia storage tank.
- 5.5. Submit to the proper personnel.
- 5.6. Store tools and equipment properly
- 5.7. Clean the work place properly.

6. Draw the flow chart for the manufacturing of urea from ammonia and Carbon dioxide.

- 6.1. Select and collect appropriate materials, tools and equipments
- 6.2. Draw the flow chart for the manufacturing of urea from ammonia and Carbon dioxide
- 6.3. Label its different unit and parts.
- 6.4. Briefly describe the urea manufacturing process.
- 6.5. Submit to the proper personnel
- 6.6. Store tools and equipment properly
- 6.7. Clean the work place properly.

7. Draw a neat sketch of urea synthesis reactor and label its important parts and accessories.

- 7.1. Select and collect appropriate materials, tools and equipments
- 7.2. Draw a neat sketch of urea synthesis reactor

- 7.3. Label its different parts.
- 7.4. Briefly describe the principle of operation of urea reactor.
- 7.5. Make a report and Submit to the proper personnel
- 7.6. Store tools and equipment properly
- 7.7. Clean the work place properly.

8. Draw a sketch diagram of prilling tower and label its important parts and accessories.

- 8.1. Select and collect appropriate materials, tools and equipments
- 8.2. Draw a sketch diagram of prilling tower
- 8.3. Label its different parts.
- 8.4. Briefly describe the operation procedure of a prilling tower.
- 8.5. Submit to the proper personnel
- 8.6. Store tools and equipment properly
- 8.7. Clean the work place properly.

9. Draw the flow sheet for manufacturing of ammonium nitrate.

- 9.1. Select and collect appropriate materials, tools and equipments
- 9.2. Draw the flow sheet for manufacturing of ammonium nitrate
- 9.3. Label its different unit and parts.
- 9.4. Briefly describe ammonium nitrate production procedure.
- 9.5. Submit to the proper personnel
- 9.6. Store tools and equipment properly
- 9.7. Clean the work place properly.

10. Draw the flow sheet for manufacturing of ammonium sulfate.

- 10.1. Select and collect appropriate materials, tools and equipments
- 10.2. Draw the flow sheet for manufacturing of ammonium sulfate
- 10.3. Label its different parts.
- 10.4. Briefly describe the manufacturing process of ammonium sulfate.
- 10.5. Submit to the proper personnel
- 10.6. Store tools and equipment properly
- 10.7. Clean the work place properly.

11. Draw the flow sheet for production of triple super phosphate.

- 11.1. Select and collect appropriate materials, tools and equipments
- 11.2. Draw the flow sheet for production of triple super phosphate
- 11.3. Label its different parts.
- 11.4. Briefly describe the process of triple super phosphate production.
- 11.5. Submit to the proper personnel
- 11.6. Store tools and equipment properly
- 11.7. Clean the work place properly.

12. Draw the flow sheet for manufacturing of nitro-phosphate fertilizer.

- 12.1. Select and collect appropriate materials, tools and equipments
- 12.2. Draw the flow sheet for manufacturing of nitro-phosphate fertilizer.
- 12.3. Label its different parts.
- 12.4. Briefly describe the manufacturing process of nitro-phosphate fertilizer.

- 12.5. Submit to the proper personnel
- 12.6. Store tools and equipment properly
- 12.7. Clean the work place properly

13. Visit a fertilizer factory and prepare a report.

- 13.1. Visit all units of the fertilizer factory.
- 13.2. Note down the relation between the units.
- 13.3. Make a complete report and submitted to proper personnel.

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- 3. Industrial chemistry. By-Rogers
- 4. Dryden outlines of chemical technology. By-M Gopala & Marshall sitting
- 5. Modern applied chemistry. By-A N Zamree, Rotaaliker and Lomte
- 6. Chemical technology. By- Sukla & Pauday.

AIMS

- To be able to understand the basic concepts of Electro Chemistry.
- To be able to understand Electro Potential and Electro Chemical Mechanism of corrosion.
- To be able to understand the basic concepts of corrosion and its effect.
- To be able to understand the different form of corrosion.
- To be able to understand corrosion control and prevention of corrosion.
- To be able to develop knowledge, skill and attitude of the selection of the materials of construction for the production transportation and storage of selected corrosive chemicals.
- To be able to perform the experiments of corrosion.

SHORT DESCRIPTION

Electro-Chemistry; Electrode, Electrolytes, Electrolysis, Anode, Cathode, Anions, Cations, Electrode Potential, Electro Chemical mechanism of corrosion, Storage battery (lead-acid battery)

Basic concept of corrosion and its effect; Different types of corrosion; Dry Corrosion; Wet corrosion; Atmospheric corrosion; High temperature corrosion; Forms of corrosion; Galvanic Corrosion; Filiform corrosion; Uniform corrosion; Underground and biological corrosion; Stress corrosion; Pitting corrosion; Stray current corrosion; erosion corrosion; corrosion fatigue and other forms of corrosion; Applications of corrosion; Environmental effect of corrosion; Methods of corrosion control and prevention; Materials of construction for the selected corrosive environments; Corrosion testing;

DETAIL DESCRIPTION**Theory:****1. Understand the basic concept of electro chemistry.**

- 1.1 Explain the following terms: Electrochemistry, Electrodes, Electrolytes, Non-electrolytes, Electrolysis, Electrolytic conductors, Anode and Cathode, Cations and Anions, Faraday, coulomb, Ampère, Electrolytic decomposition.
- 1.2 Describe the mechanism of electrolysis.
- 1.3 Describe the electrolysis of molten sodium chloride and aqueous sodium chloride.
- 1.4 Describe the electrolysis of aqueous hydrochloric acid.
- 1.5 Describe the electrolysis of aqueous sulfuric acid.
- 1.6 Explain Faraday's law of electrolysis.
- 1.7 Explain the electro plating process, electro refining and electro typing.
- 1.8 Describe the manufacturing process of a storage battery (lead-acid battery-current flow through an electrolytes)
- 1.9 Explain the battery capacity and battery rating.

2. Understand the electro potential and Electro Chemical Mechanism of Corrosion.

- 2.1 Define electrode potential.
- 2.2 Describe electro motive force (EMF) series and its application.
- 2.3 Describe galvanic series and its limitations.
- 2.4 Explain followings polarization at the electrodes.
 - (i) Concentration polarization
 - (ii) Polarization due to over voltage.
 - (iii) Polarization due to resistance of films.
- 2.5 Describe over voltage over potential of by hydrogen.
- 2.6 Describe the internal and external factors and origin of potential difference on metal surface.
- 2.7 Describe anode and cathode reactions of electro chemical corrosion.

- 2.8 Describe hydrogen evolution mechanism of electro chemical corrosion.
- 2.9 Describe oxygen absorption mechanism of electro chemical corrosion.
- 2.10 Explain hydrogen damage.

3. Understand the basic and modern concept of corrosion and its effects.

- 3.1 Define Corrosion.
- 3.2 Explain the modern concepts of corrosion.
- 3.3 Explain the different between corrosion and erosion.
- 3.4 Explain the corrosive environment.
- 3.5 Describe the effects of corrosion.
- 3.6 Describe the annual cost of corrosion in Bangladesh and its effects in national economy.
- 3.7 Explain the role of chemical engineers in prevention and control of corrosion.

4. Understand different forms of corrosion.

- 4.1 Define dry corrosion and wet corrosion with example.
- 4.2 List different forms of corrosion.
- 4.3 Explain liquid metal corrosion.
- 4.4 Describe the formation of growth of films in dry corrosion.
- 4.5 Mention the growth laws of dry corrosion.
- 4.6 Describe the complex oxide films of dry corrosion.
- 4.7 Describe the action of gases in dry corrosion.

5. Understand the Galvanic Corrosion, Filiform, passivity and passivation.

- 5.1 Define galvanic series and EMF series.
- 5.2 Explain the metallurgical aspects of corrosion.
- 5.3 Explain the mechanism of galvanic corrosion.
- 5.4 Explain the environmental distance and area effects on galvanic corrosion.
- 5.5 Explain cell corrosion.
- 5.6 Explain filiform corrosion.
- 5.7 Explain passivity and passivation.

6. Understand the atmospheric, underground, biological corrosion, stray current, pitting, inter granular and cavitation corrosion.

- 6.1 Explain atmospheric corrosion.
- 6.2 Explain Soil or underground corrosion.
- 6.3 Explain biological corrosion.
- 6.4 Describe stray current corrosion.
- 6.5 Describe pitting and its auto-catalytic nature.
- 6.6 Describe inter granular corrosion.
- 6.7 Describe cavitation corrosion.

7. Understand the stress corrosion, corrosion fatigue and other form of corrosion.

- 7.1 Describe erosion corrosion.
- 7.2 Describe stress corrosion.
- 7.3 Describe corrosion fatigue.
- 7.4 Describe caustic embattlement.
- 7.5 Describe dezincification and graphitization.
- 7.6 Describe high temperature corrosion.

8. Understand the applications of corrosion prevention methods.

- 8.1 Explain that a piece of metal, (say zinc or Iron) when partially immersed in an electrolyte solution of sodium chloride is corroded at a part immersed to a greater depth.
- 8.2 Explain that roughened metal surfaces corrode more-rapidly than polished one.
- 8.3 Explain that the copper is not attacked by non-oxidizing dilute acid solutions in the absence of oxygen, but it is appreciably corroded by those acid in aerated solution.

- 8.4 Explain that DE aeration of water reduce corrosion in boilers and water lines.
- 8.5 Explain that metals frequently corrode under a scale deposit or a piece of wood when exposed to aqueous media.
- 8.6 Explain that lead is fairly well resistant to dilute cold hydrochloric acid, but it is attacked by the hot hydrochloric acid.

9. Understand the environmental effects on corrosion.

- 9.1 Describe the effects of oxygen and oxidizer on corrosion.
- 9.2 Describe the effects of velocity on corrosion.
- 9.3 Describe the effects of temperature in corrosion.
- 9.4 Describe the effects of friction on corrosion.
- 9.5 Describe the effects of corrosive concentration on corrosion.
- 9.6 Describe the effects of galvanic coupling on corrosion.

10. Understand the methods of corrosion control and prevention.

- 10.1 Explain the corrosive environment.
- 10.2 List the important method of corrosion control and prevention.
- 10.3 Describe the methods of prevention and control of corrosion by design and fabrication procedure.
- 10.4 Describe the method of prevention and control of corrosion by modifying the corrosive environment.
- 10.5 Describe the method of prevention and control of corrosion by the application of inhibitors.
- 10.6 Describe the method of prevention and control of corrosion by the purification and alloying of metals.
- 10.7 Describe the method of prevention and control of corrosion by the cathodic and anodic protection.
- 10.8 Describe the method of prevention and control of corrosion by the application of protective coatings.

11. Understand the material of construction for selected corrosive environment.

- 11.1 Pulp and paper manufacturing industry.
- 11.2 Hydrochloric acid manufacturing industry.
- 11.3 Sodium Hydroxide manufacturing industry.
- 11.4 Chlorine gas manufacturing industry.
- 11.5 Fertilizer (TSP, Urea) manufacturing industry.
- 11.6 Water treatment plant.

12. Understand the corrosion testing.

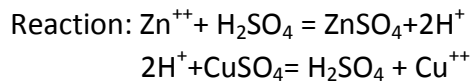
- 12.1 Define corrosion testing.
- 12.2 List the different testing of corrosion.
- 12.3 Explain the field test of corrosion.
- 12.4 Explain the semi pilot plant test of corrosion.
- 12.5 Explain the actual plant test of corrosion.
- 12.6 Explain the coupling test of corrosion.

PRACTICAL

- 1. Study the concentration cell corrosion by experiment.
 - 1.1 Collect high resistance volt meter.
 - 1.2 Collect two Beaker (glass).
 - 1.3 Make a Solution of electrolytes.
 - 1.4 Immersed two electrode in the solution.
 - 1.5 Connect the Battery with electrode.
 - 1.6 Measure the electrode potential.
- 2. Study the electro chemical theory of corrosion Anode and Cathode reaction by experiment.
 - 2.1 Select and collect tow electrode,(Zinc & Copper)
 - 2.2 Make two solution of electrolytes,(ZnSO_4 , CuSO_4)
 - 2.3 Connect the Battery with Anode (Zinc) and Cathode (Copper).

2.4 Setting the Anode (Zinc) in H_2SO_4 Solution Container and Cathode (Copper) in CuSO_4 Solution.

2.5 Observe two Reaction: $\text{Zn} + \text{H}_2\text{SO}_4$ &
 $\text{Cu} + \text{CuSO}_4$



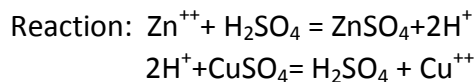
3 Study the Anode and Cathodes in corrosion reaction by experiment.

3.1 Collect two glass Container (Beaker)

3.2 Collect two solution of Electrode.

3.3 Collect two Electrode (H_2SO_4 & Cu SO_4).

3.4 Connect the Battery with two electrode (Anode & Cathode)



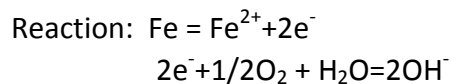
4 Study the corrosion in oxygen concentration cells by experiment.

4.1 Collect NaCl Solution

4.2 Collect two Electrodes

4.3 Collect a DC Circuit

4.4 Collect two Beakers.



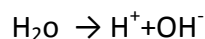
5 Study the separation sodium metal from sodium chloride solution electrolysis method by experiment.

5.1 Collect two Beaker.

5.2 Collect NaCl Solution.

5.3 Kept two Electrode (Anode & Cathode) in NaCl Solution.

5.4 Collect a Battery and Connect with two Electrode.



Cl^- will added with Anode and Na^+ will added Cathode.

6 Study the cathodic protection of corrosion control by experiment.

6.1 Collect two Metal pieces. like as Al , Cu .

6.2 Collect Insulator.

6.3 Connect the Battery with Al , (Anode) and Cu (Cathode).

6.4 Kept the Anode Plate on Insulator.

6.5 Anode Plate Must be Corroded and Copper Plate not be Corroded. Because Copper Plate is work as a Cathode.

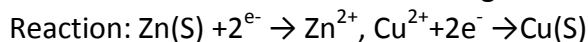
7 Study the galvanic action on couples by experiment.

7.1 Collect two Beaker.

7.2 Collect two Electrolytes (ZnSO_4 and Cu SO_4).

7.3 Collect two Electrode and Connect with the Battery.

7.4 Connect the Volt Meter with Salt Bridge.



8 Study the stress corrosion by experiment.

8.1 Collect a Metal Piece or wire.

8.2 Give the Stress in Metal Piece or wire.

8.3 Observe the Situation of wire.

8.4 After Few days wire will be tear.

9 Study the electroplating by experiment.

9.1 Collect the metal Piece and Solution.

9.2 Connect the work Piece with Battery (Negative Pole).

9.3 Make Copper Solution.

9.4 Immersed the work Piece in Copper Solution.

10 Study the corrosion control by application of protective coating by experiment.

10.1 Collect Paint, (Aluminum, Oil, Cement and Cellulose paint)

10.2 Collect Sprayer and Brush (for Aerosol and Brushing)

10.3 Clean the Work Piece.

10.4 Spray Paint on the work Piece (Metal/Non Metal).

11 To identify the different parts of storage battery (lead-acid).

11.1 Collect the Storage Battery (lead acid)

11.2 Collect the Hand Tools.

11.3 Open or Broken the Battery.

11.4 Wash and Clean the Battery by Clean Water.

11.5 Putout Different Parts of Battery (like as Separator, Plate)

11.6 Sketch and write the name of Different, Parts (Case & Plate).

12 To manufacture a storage battery (lead-acid battery) by experiment.

12.1 Collect Battery Case, acid, lead Plate, Soldering iron.

12.2 Collect blow lamp, Pitch and separator.

12.3 Arrange the Cathode and Anode Plate in Series.

12.4 Connect Anode Plate and Cathode Plate Separately.

12.5 Kept Both Plate Series in the Battery Case.

12.6 Dropping the Electrolytes in the Battery Case or Container.

12.7 Close the Battery by Cover and Side sealed. With Molten Pitch.

12.8 Charge the Battery by (DC Current).

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5. Modern Electroplating; Allen G. gray.
6. Corrosion in Action; F.L. Laque. T.P. May and H.H Uhlig.
7. Electro chemical Engineering; L.C. Mantell

AIMS

- To be able to understand the basic concepts of plastics and polymer industries.
- To be able to understand the chemical conversion involved in the plastics and polymer industries.
- To be able to understand the polymerization
- To be able to understand the plastic and synthetic fibers.
- To be able to understand the plastic processing.
- To be able to understand the plastics compounding and molding.
- To be able to develop knowledge, skills and attitudes in demonstrating the production of plastics, plastics wastes and polymer products.
- To be able to perform the experiments of plastics and plastic wastes products.
- To be able to perform the experiments of polymer products.

SHORT DESCRIPTION

Polymer science; polymerization; Plastic and plastics materials, polyethylene, polystyrene and acrylic plastic; polyvinyl chloride (PVC); polyamides and polyesters; phenolic resins and amino resins; additives and fillers of plastic; technology of plastics processing; calendaring, thermoforming and reinforcement of plastics; plastics recycling and waste management.

DETAIL DESCRIPTION**Theory:****1. Understand the basic concept of polymer science.**

- 1.1. Define monomer, polymer co-polymer, homopolymer and random polymer.
- 1.2. Explain the structural feature of polymer.
- 1.3. Write the classification of polymer.
- 1.4. Discuss the properties of polymer.
- 1.5. Make the list of 10 important polymers with monomer and repeat unit.
- 1.6. Describe high polymer.

2. Understand the polymerization.

- 2.1. State polymerization.
- 2.2. Describe the mechanism of chain growth polymerization.
- 2.3. Explain addition polymerization, reaction polymerization, co-polymerization, ring opening polymerization and free radical polymerization.
- 2.4. Describe condensation polymerization.
- 2.5. Explain degree of polymerization.
- 2.6. Discuss bulk, solution, suspension and emulsion, polymerization.
- 2.7. Explain polymerization technique.
- 2.8. Describe intermolecular forces in monomers and polymers.
- 2.9. Make important list of plastics and polymers and their uses.

3. Understand the Basic concept of Plastic and plastics materials.

- 3.1. Define plastics, elastomers and fibers.
- 3.2. Mention the properties of plastics.
- 3.3. Define plastic materials.

- 3.4. Make list the example of plastic materials.
- 3.5. Discuss the classification of plastic.
- 3.6. Explain the thermosetting resins and thermo plastics with examples.
- 3.7. Explain ethenoid plastics and resin.
- 3.8. Write the manufacturing methods of ethenoid plastics.

4. Understand the polyethylene as a molding resin

- 4.1. Define polyethylene.
- 4.2. Explain Low Density Polyethylene (LDPE) and High Density Polyethylene (HDPE).
- 4.3. Describe the manufacture of high pressure polyethylene with flow chart.
- 4.4. Mention the uses of polyethylene.
- 4.5. Define propylene and polypropylene
- 4.6. Mention the properties of polypropylene.
- 4.7. Describe the manufacture of Acrylonitrile from propylene ammonia by oxidation with flow diagram.

5. Understand polystyrene and acrylic plastic as molding resin.

- 5.1. Define polystyrene.
- 5.2. Describe polymerization of styrene.
- 5.3. Mention the properties of polystyrene.
- 5.4. Define acrylic plastics and acrylic fibers.
- 5.5. Describe the manufacturing method of Poly Vinyl Acetate (PVA) with flow chart.

6. Understand the Poly Vinyl Chloride (PVC) as molding resin.

- 6.1. Define vinyl and poly vinyl chloride.
- 6.2. Describe the method of polymerization of vinyl chloride.
- 6.3. Describe the compounding and processing of Poly Vinyl Chloride (PVC) with flow chart.
- 6.4. Explain the properties of polyvinyl chloride.
- 6.5. Mention the uses of PVC

7. Understand the polyamides and polyesters as molding resin.

- 7.1. Define polyamide.
- 7.2. Explain nylon 6; nylon 11; nylon 12 and nylon 66.
- 7.3. Describe the method of preparation of polyhexa methylenedipamide (i.e nylon 66) with flow chart.
- 7.4. Describe the properties and uses of nylon polyamides.
- 7.5. Define polyester.
- 7.6. Mention the properties of polyester.
- 7.7. Describe the method of preparation of polyesters with flow chart.
- 7.8. Discuss the uses of polyester.

8. Understand the phenolic resins and amino resins as molding resin.

- 8.1. Define phenolic resins and amino resins.
- 8.2. Explain the chemistry of resin formation.
- 8.3. Describe the method of manufacturing of phenolic molding powders with flow chart..
- 8.4. Describe the manufacturing method of phenol formaldehyde resin with flow chart.
- 8.5. Describe the manufacturing method of urea formaldehyde resin with flow chart.
- 8.6. Describe the manufacturing method of melamine formaldehyde resin with flow chart.
- 8.7. Mention the uses of phenolic resin, urea formaldehyde resin and melamine formaldehyde resin.

9. Understand the additives and fillers of plastic.

- 9.1. Make a list of additives in plastics.
- 9.2. Explain the fillers used in plastics.
- 9.3. Discuss the plasticizers used in plastics.
- 9.4. Explain the stabilizers used in plastics.
- 9.5. Describe the coloring matters used in plastics.

10. Understand the technology of plastics processing.

- 10.1. Define shaping of plastics.
- 10.2. List the different method of shaping of plastics.
- 10.3. List the different types of molding techniques used in plastics.
- 10.4. Describe the compression molding of plastics.
- 10.5. Describe injection molding and blow molding of plastics.
- 10.6. Describe the extrusion method of forming.

11. Understand the calendaring, thermoforming and reinforcement of plastics.

- 11.1. Explain calendaring of plastics.
- 11.2. Describe the method of thermoforming of plastics.
- 11.3. Describe the method of lamination and reinforcement of plastics.
- 11.4. Make a list the application of plastics as a coatings.
- 11.5. Discuss casting and spinning of fibers.

12. Understand the plastics recycling and waste management.

- 12.1. Define plastics waste recycling.
- 12.2. Explain the source of plastics waste.
- 12.3. Explain the collection procedure of waste plastics.
- 12.4. Describe sorting and segregation methods of waste plastics.
- 12.5. Describe the recycling techniques of waste plastics.
- 12.6. Describe the separation procedure of fuel (such as gasoline and diesel) from waste plastic.
- 12.7. Discuss environmental issues and guidelines for recycling of plastics wastes.

PRACTICAL:

1. Perform the physical and chemical test for polymer.

- 1.9. Select and collect appropriate materials, tools and equipment.
- 1.10. Perform the physical test of polymer.
- 1.11. Perform the chemical test of polymer.
- 1.12. Briefly describe the working procedure for testing.
- 1.13. Submit the report to proper personnel.
- 1.14. Store tools and equipment properly.
- 1.15. Clean the work place properly.

2. Perform the physical and chemical test for plastics.

- 2.6 Select and collect appropriate materials, tools and equipment.
- 2.7 Perform the physical test of plastics.
- 2.8 Perform the chemical test of plastics.
- 2.9 Briefly describe the working procedure for testing.
- 2.10 Submit the report to proper personnel.
- 2.11 Store tools and equipment properly.
- 2.12 Clean the work place properly.

3. Draw a flow diagram for the manufacturing of polyethylene from ethylene.

- 3.1 Select and collect appropriate materials, tools and equipment.
- 3.2 Draw a manufacturing flow chart of polyethylene with appropriate materials and tools.
- 3.3 Label its different units.
- 3.6 Briefly describe the working process.
- 3.7 Submit the report to proper personnel.
- 3.8 Store tools and equipment properly.
- 3.9 Clean the work place properly.
- 4. Draw a flow diagram for the manufacturing of polyvinyl acetate (PVA).**
 - 4.7 Select and collect appropriate materials, tools and equipment.
 - 4.8 Draw a manufacturing flow chart of polyvinyl acetate (PVA) with appropriate materials and tools.
 - 4.9 Label its different units.
 - 4.10 Briefly describe the working process.
 - 4.11 Submit the report to proper personnel.
 - 4.12 Store tools and equipment properly.
 - 4.13 Clean the work place properly.
- 5. Draw a flow diagram for the manufacturing of polyvinyl chloride (PVC).**
 - 5.1 Select and collect appropriate materials, tools and equipment.
 - 5.2 Draw a manufacturing flow chart of polyvinyl chloride (PVC) with appropriate materials and tools.
 - 5.3 Label its different units.
 - 5.4 Briefly describe the working process.
 - 5.5 Submit the report to proper personnel.
 - 5.6 Store tools and equipment properly.
 - 5.7 Clean the work place properly.
- 6. Draw a flow diagram for the manufacturing of polyhexamethylenedipamide (nylon 66).**
 - 6.1 Select and collect appropriate materials, tools and equipment.
 - 6.2 Draw a manufacturing flow chart of polyvinylhexamethylenedipamide (nylon 66) with appropriate materials and tools.
 - 6.3 Label its different units.
 - 6.4 Briefly describe the working process.
 - 6.5 Submit the report to proper personnel.
 - 6.6 Store tools and equipment properly.
 - 6.7 Clean the work place properly.
- 7. Draw a flow diagram for the manufacturing of melamine formaldehyde resin.**
 - 7.1 Select and collect appropriate materials, tools and equipment.
 - 7.2 Draw a manufacturing flow chart of melamine formaldehyde resin with appropriate materials and tools.
 - 7.3 Label its different units.
 - 7.4 Briefly describe the working process.
 - 7.5 Submit the report to proper personnel.
 - 7.6 Store tools and equipment properly.
 - 7.7 Clean the work place properly.
- 8. Draw a neat sketch of a injection molding machine and mold parts and indicate its different components.**
 - 8.1 Select and collect appropriate materials, tools and equipment.
 - 8.2 Draw a neat sketch of injection molding machine and mold parts.
 - 8.3 Point out the different elements of the molding machine and mold parts.
 - 8.4 Briefly describe the working process.

- 8.5 Submit the report to proper personnel.
- 8.6 Store tools and equipment properly.
- 8.7 Clean the work place properly.
- 9. Draw a neat sketch of a compression molding press and mold parts and indicate its different components.**
 - 9.1 Select and collect appropriate materials, tools and equipment.
 - 9.2 Draw a neat sketch of compression molding press and mold parts.
 - 9.3 Point out the different elements of the compression molding machine and mold parts.
 - 9.4 Briefly describe the working process.
 - 9.5 Submit the report to proper personnel.
 - 9.6 Store tools and equipment properly.
 - 9.7 Clean the work place properly.
10. Visit a polymer industry and prepare a report.
11. Visit a plastic waste recycling plant and prepare a report.

REFERENCE BOOKS

7. Polymer Science and Technology; by Premamoy Gosh.
8. Plastics Theory and Practics ; by Winding and Harche.
9. Plastic Technology Handbook ; by M. Chanda and S. K. Roy.
10. Plastics, Polymer Science and Technology ; by M. D. Brijlal.
11. Plastic materials – J. A. Brydson.
12. Plastic materials handbook – A.S. Athalye.
13. Plastic Materials & Processing-Brent Strong
14. Dryden's Outline & Chemical Technology; by M. Gopala Rao and MasshalSotting.
15. Industrial Chemistry (including chemical engineering) by B. K. Sharma.
16. Shreves Chemical Process Industries; by George T Auston
17. Chemical engineering hand book; Perry; McGraw Hill Book Company Ltd; Newyork.
18. Recycling & Plastics Waste Management – Suresh k. Dameja.

AIMS

- To be able to develop knowledge for preparing different types of Projects related to Chemical Engineering.
- To be able to select a suitable project.
- To be able to perform the job to make the project.
- To be able to prepare a final report of the project.

STEPS OF THE PROJECT**1. Project Initiation:**

- a) Think deeply about the projects you can make.
- b) State the rational/social contribution of the project.
- c) Discuss among the classmates for the selection of project.
- d) Select the group members (3-5 members) for each group.
- e) Discuss detail about the project with your teacher and finalize the name of the project.

2. Project planning:

- a) Make a work plan for the completion of the project.
- b) Draw/Design the Project.
- c) List the necessary tools, instruments and equipment.
- d) Collect the raw materials for the project with quantity and specifications.

3. Project Execution:

- a) Estimate the costing of the project.
- b) Make approval of budget.
- c) Break down the work planning.

4. Project performance and control:

- a) Show skills in preparation of the project.
- b) Maintain the necessary safety measures.
- c) Take necessary action to complete the project in time.
- d) Discuss with your teacher time to time and inform him about the progress of the project.

5. Closure of the Project:

- a) After completion of the project write a final report.
- b) Show the power point presentation in front of teacher and students.
- c) Open discussion/question and answer.
- d) Face the Viva board.
- e) Submit the project and project report to your teacher.

REFERENCE BOOKS

- | | |
|--|--|
| 1. Perry's Chemical Engineering Hand Book. | by - Perry and Chilton. |
| 2. Elementary Chemical Engineering. | by – Peters. |
| 3. Shreve's Chemical Process Industries | by-George T .Austin. |
| 4. Dryden's Outlines of Chemical Technology. | by-M. Gopala Rao and Marshall Sitting. |
| 5. Unit Operations of Chemical Engineering. | by-W.L.McCabe and J.N. Jarker. |
| 6. Introduction to Chemical Engineering. | by-Badger and Banchero. |

AIMS

- To be able to understand the concept of entrepreneurship & entrepreneur.
- To be able to understand the concept of environment for entrepreneurship.
- To be able to understand the sources of venture ideas in Bangladesh.
- To be able to understand the project selection.
- To be able to understand business planning.
- To be able to understand the insurance and premium.
- To be able to understand the MDG & SDG.

SHORT DESCRIPTION

Concepts of entrepreneurship & entrepreneur; Entrepreneurship & economic development; Environment for entrepreneurship; Entrepreneurship in the theories of economic growth; Sources of ventures ideas in Bangladesh; Evaluation of venture ideas; Financial planning; Project selection; Self employment; Entrepreneurial motivation; Business plan; Sources of assistance & industrial sanctioning procedure; Concept of SDG; SDG 4,8 .

DETAIL DESCRIPTION**Theory :****1. Understand the basic concept of entrepreneurship & entrepreneur.**

- 1.1 Define entrepreneurship & entrepreneur.
- 1.2 Discuss the characteristics and qualities of an entrepreneur.
- 1.3 Mention the classification of entrepreneur.
- 1.4 Discuss the necessity of entrepreneurship as a career.
- 1.5 Discuss the prospect of entrepreneurship development in Bangladesh.

2. Understand the concept of entrepreneurship and economic development.

- 2.1 Define economic development.
- 2.2 Discuss the economic development process.
- 2.3 Discuss the capital accumulation or rate of savings.
- 2.4 Discuss the role of entrepreneur in the technological development and their introduction into production Process.
- 2.5 Discuss the entrepreneur in the discovery of new product.
- 2.6 Discuss the discovery of new markets.

3. Environment for entrepreneurship development:

- 3.1 Define the micro environment.
- 3.2 Discuss individual income, savings and consumption.
- 3.3 Define macro environment.
- 3.4 Discuss political, socio-cultural, economical, legal and technological environment.
- 3.5 Difference between micro and macro environment .

4. Understand the concept of entrepreneurship in the theories of economic growth.

- 4.1 Define entrepreneurship in the theories of economic growth.
- 4.2 Discuss the Malthusian theory of population and economic growth.
- 4.3 Discuss the stage theory of growth.
- 4.4 Discuss the Schumpeterian theory of economic development.
- 4.5 Discuss the entrepreneurship motive in economic development.

5. Understand the sources and evaluation of venture ideas in Bangladesh.

- 5.1 Define sources of venture ideas in Bangladesh.
- 5.2 Discuss different types of sources of venture ideas in Bangladesh.
- 5.3 Define evaluation of venture ideas.
- 5.4 Discuss the factors that influence the selection of venture idea.

6. Understand the concept of project selection and financial planning.

- 6.1 Define project.
- 6.2 Discuss the idea of project.
- 6.3 Describe the guide lines for project ideas.
- 6.4 Discuss the sources of project ideas.
- 6.5 Discuss the evaluation of project ideas.
- 6.6 Describe the technical aspect of project.
- 6.7 Define financial planning.
- 6.8 Discuss the long term financial plan.
- 6.9 Discuss the short term financial plan.

7. Understand the concept of self employment.

- 7.1 Define self employment.
- 7.2 Describe different types of employment.
- 7.3 Describe the importance of business as a profession.
- 7.4 Discuss the reasons for success and failure in business.

8. Understand the business plan and the concept of the environment for entrepreneurship.

- 8.1 Define business plan.
- 8.2 Describe the importance of business plan.
- 8.3 Discuss the contents of business plan.
- 8.4 Define environment of business.
- 8.5 Describe the factors which effect environment on entrepreneurship

9. Understand the concept of sources of assistance & industrial sanctioning procedure.

- 9.1 Define sources of assistance.
- 9.2 Describe different types of sources of assistance.
- 9.3 Discuss the aid of sources.
- 9.4 Discuss the industrial policy.
- 9.5 Define foreign aid.

10. Understand the insurance and premium.

- 10.1 Define insurance and premium
- 10.2 Describe the essential conditions of insurance contract.
- 10.3 Discuss various types of insurance.
- 10.4 Distinguish between life insurance and general insurance.

11. Understand the concept of Sustainable Development Goals (SDG)

- 11.1 Define Sustainable development
- 11.2 State UN targets of MDG
- 11.3 State UN targets of SDG
- 11.4 Describe the importance of SDG
- 11.5 Explain the objectives of SDG
- 11.6 State the Challenges to achieve SDGs
- 11.7 Explain the actions to face the challenges of SDGs
- 11.8 State the of 7th 5 years plan
- 11.9 Mention the link of 7th 5 years plan with SDGs
- 11.10 Write down the 5 ps of sustainable development goals

12. Understand SDG 4,8 and 17

- 12.1 Describe SDG 4 and its targets
- 12.2 State the elements of Quality education for TVET
- 12.3 Describe the gender equality and equal access of TVET for economic growth
- 12.4 Describe SDG 8 and its targets
- 12.5 Explain Green development, Green Economy, Green TVET & Green Jobs
- 12.6 Explain the role an entrepreneur for achieving SDG

Reference book :

- 1. A hand book of new entrepreneur-by p.c jain.
- 2.A manual on business opportunity Identification and selection-by j.B patel and S S modi.
- 3.Uddokta unnoyan Nirdeshika -Md.Sabur khan.
- 4.Entrepreneurship- bashu and mollik.
- 5.Business Entrepreneurship-kage faruke.
- 6. Website, Youtube and Google