DIRECTORATE OF TECHNICAL EDUCATION,
KAHILIPARA, GUWAHATI-19

DIPLOMA PROGRAMME IN

CHEMICAL ENGINEERING

NEW SYLLABUS

6TH SEMESTER

COURSE STRUCTURE OF 6thSEMESTER (CHEMICAL)

Sl No	Code No	Subject	Study Scheme			Evaluation Scheme									
			Contact hour/week			Theory					Practical			Total Marks (Theory+ Practical)	Credit
							Sessional(SS)								
			L	T	P	ESE	TA	HA	Total (TA+HA)	Pass (ESE+SS)	Practical Test (PT)#	Practical Assessment (PA)@	Pass (PT+PA)		
1	**Hu-601**	Industrial management & Entrepreneurship	3			70	10	20	30	33/100				100	3
2	**CH-601**	Automatic Process Control (APC)	3		3	70	10	20	30	33/100	25	25	17/50	150	4
3	**CH-602**	Industrial Chemical Process-III (ICP-III)	3	1		70	10	20	30	33/100				100	4
4	**CH-603**	Principle Of Unit Operation-IV (PUO-IV)	3		3	70	10	20	30	33/100	25	25	17/50	150	4
5	**CH-611**	Project & Seminar		1	6						100	50	50/150	150	3
6	**CH-612**	Grand Viva		2							50		17/50	50	2
7	**CH-610**	Professional Practice - IV	1		2						25	25	17/50	50	2
8		Optional (any one)													
A	**CH-604**	Petroleum Refining	3			70	10	20	30	33/100				100	3
B	**CH-605**	Paper Technology	3			70	10	20	30	33/100				100	3
			16	2	16										
		Total	34										**Total**	**850**	**25**

Course Title :Industrial Management and Entrepreneurship

1. Course Code: **Hu – 601**
2. Semester: **VI**
3. **Aim of the Course:**
    1. To acquaint the students with managerial activities
    2. To provide introductory knowledge of Cost Accounting
    3. To introduce students with industrial legislation
    4. To explain the scope for self-employment
    5. To compare and contrast different forms of business organization
    6. To identify the opportunities to start a small scale industry
4. **Course Outcomes**:

    On completion of the course on IME, students will be able to

    - CO_1 = explain managerial activities.
    - CO_2 = describe leadership qualities and decision making process.
    - CO_3 = state the elements of costs.
    - CO_4 = explain important industrial laws.
    - CO_5 = define different forms of business organisations
    - CO_6 = identify entrepreneurial abilities for self employment through small scale industries.

5. **Teaching Scheme (in hours)**

Lecture	Tutorial	Practical	Total
42 hrs	**3 hrs**	**--**	**45 hrs**

6. **Examination Scheme:**

Theory				Practical				Total Marks
Examination Full Marks	Sessional Full Marks	Total Marks	Pass Marks	Examination		Sessional		
70	30	100	33	--	--	--	--	100

7. **Detailed Course Content**:

Chapter No.	Chapter Title	Content	Intended Learning Outcomes	Duration (in hours)
				42 hrs
1.0	**Introduction to Management :**	i) Meaning and Concept ii) Functions of Management iii) Principles of Management	i) Explain functions and principles of management	3
2.0	**Leadership Decision Making & Communication :**	i) Definition of Leader ii) Functions of a leader iii) Decision making – Definition iv) Decision making process v) Communication – definition, importance & types	i) Develop leadership qualities ii) Demonstrate decision making abilities	4
3.0	**Introduction to Cost :**	i) Definition and classification of Cost ii) Elements of Cost iii) Break Even Analysis	i) State elements of costs ii) Explain Break Even Analysis	3
4.0	**Human Resource Management:**	i) Meaning of manpower planning ii) Recruitment and Selection procedure iii) Payment of wages – factors determining the wage iv) Methods of payment of wages – Time rate and Piece rate v) Labour Turnover – definition, its causes, impact and remedy	i) State selection procedure of employees ii) Distinguish Time rate and Piece rate system of wage payments iii) Explain causes and	5

			impact of labour turnover	
5.0	**Industrial Legislation :**	i) Need of Industrial legislation ii) Indian Factories Act – 1948 – Definition of Factory, main provisions regarding health, Safety and Welfare of Workers iii) Industrial Dispute Act – 1947 – Definition of Industrial dispute, Machineries for settlement of Industrial dispute in India	i) Identify the needs and importance of industrial laws	5
6.0	**Production Management :**	i) Meaning of Production ii) Production Management – definition, objectives, functions and scope iii) Inventory Management, Basic idea	i) State the objectives and functions of Production management	3
7.0	**Marketing Management:**	i) Meaning and functions of marketing ii) e- Commerce iii) Channels of distribution iv) Wholesale and retail trade	i) state the functions of wholesalers and retailers	2
8.0	**Entrepreneur and Entrepreneurship:**	i) Definition of Entrepreneur and Entrepreneurship ii) Qualities required by an entrepreneur iii) Functions of an entrepreneur iv) Entrepreneurial motivation	i) State the qualities and functions of an entrepreneur	3
9.0	**Forms of Business Organization:**	i) Sole Trader – meaning, main features, merits and demerits ii) Partnership – definition, features, merits and demerits	i) Differentiate different forms of Business organization ii) compare and	5

		iii) Joint Stock Company – Definition, types, features, merits and demerits	contrast features, merits and demerits of different business organizations.	
10.0	**Micro and Small Enterprises:**	i) Definition of Micro & Small enterprises ii) Meaning and characteristics of Micro and Small enterprise iii) Scope of SSI with reference to self-employment iv) Procedure to start SSI – idea generation, SWOT analysis v) Selection of site for factories	i) Define micro and small enterprises ii) Explain the procedure to start a small enterprise	4
11.0	**Support to Entrepreneurs**	a) Institutional support: i) Introduction ii) Sources of information and required application forms to set up SSIs iii) Institutional support of various National & State level organizations – DICC, NSIC, IIE, MSME - DI, Industrial Estates b) Financial support: i) Role of Commercial banks, RRB, IDBI, ICICI, SIDBI, NEDFi, and State Financial Corporations ii) Special incentives and subsidies for Entrepreneurship Development in the North East	i) identify the supporting agencies to entrepreneurs ii) Explain the role of financial support organizations	5
	Class Test			3 hrs
	Total			**45 hrs**

(9) TABLE OF SPECIFICATIONS for Industrial Management & Entrepreneurship

Sl. No	Topic (a)	**Time allotted in hours (b)**	**Percentage Weightage (c)**	**Knowledge**	**Compre-hension**	**Application**	**HA**
1	Introduction to Management	3	7	2	3	0	0
2	Leadership & Decision Making	4	9.5	3	4	0	0
3	Introduction to Cost	3	7	3	2	0	0
4	Human Resource Management	5	12	6	2	0	0
5	Industrial Legislation	5	12	4	4	0	0
6	Production Management	3	7	3	2	0	0
7	Marketing Management	2	5	4	0	0	0
8	Entrepreneur & Entrepreneurship	3	7	3	2	0	0
9	Forms of Business Organization	5	12	3	5	0	0
10	Micro & Small Enterprises	4	9.5	4	3	0	0
11	Support to Entrepreneurs	5	12	4	4	0	0
Total		**42**	**100**	**39**	**31**	**0**	**70**

K = Knowledge C = Comprehension A = Application HA = Higher Than Application (Analysis, Synthesis, Evaluation)

$$\mathbf{C}=\frac{b}{\sum b}\times 100$$

10.Distribution of Marks:

DETAILED TABLE OF SPECIFICATIONS FOR IME

Sl. No	Topic	OBJECTIVE TYPE				SHORT ANSWER TYPE					ESSAY TYPE					Grand
		K	C	A	T	K	C	A	HA	T	K	C	A	HA	T	Total
1	Management	1	0	0	1	1	0	0	0	1	0	3	0	0	3	5
2	Leader &Decision	1	0	0	1	2	1	0	0	3	0	3	0	0	3	7
3	Cost	1	1	0	2	2	1	0	0	3	0	0	0	0	0	5
4	HRM	2	1	0	3	1	1	0	0	2	3	0	0	0	3	8
5	Laws	3	0	0	3	0	0	0	0	0	1	4	0	0	5	8
6	Product Manage	2	1	0	3	1	1	0	0	2	0	0	0	0	0	5
7	Market	2	0	0	2	2	0	0	0	2	0	0	0	0	0	4
8	Entrepreneurship	1	1	0	2	2	1	0	0	3	0	0	0	0	0	5
9	Forms of BO	2	1	0	3	0	0	0	0	0	1	4	0	0	5	8
10	MSME	2	0	0	2	0	0	0	0	0	2	3	0	0	5	7
11	Support to Entp.	3	0	0	3	1	0	0	0	1	0	4	0	0	4	8
	Total	**20**	**5**	**0**	**25**	**12**	**5**	**0**	**0**	**17**	**7**	**21**	**0**	**0**	**28**	**70**

K = Knowledge C = Comprehension A = Application

HA = Higher Than Application Higher than Application (Analysis, Synthesis, Evaluation) Total

10. Suggested implementation Strategies: Modified syllabus may be implemented with effect from January, 2020 (Starting with the present batch (2018) of 2nd Semester students)

11. Suggested learning Resource:

a. **Book list** :

Sl. No.	Title of Book	Name of Author(s)	Publisher
1	Industrial Management	S.C. Jain H.S. Bawa	DhanpatRai& Co. (P) Ltd. New Delhi-110006
2	Business Organisation and Entrepreneurship Development	S.S. Sarkar R.K. Sharma Sashi K. Gupta	Kalyani Publishers, New Delhi-110002
3	Entrepreneurial Development	S. S. Khanka	S. Chand & Co. Ltd. New Delhi-110055
4	Business Methods	R.K. Sharma Shashi K Gupta	Kalyani Publishers, New Delhi
5	Entrepreneurship Development and Management	Dr. R.K. Singhal	S.K. Kataria& Sons, New Delhi-110002
6	Business Administration & Management	Dr. S. C. Saksena	SahityaBhawan, Agra
7			
8			

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b. List of Journals
c. Manuals
d. Others

Course Title : AUTOMATIC PROCESS CONTROL

1. **Course Code : Ch-601**
2. **Semester : 6th**

4. **Course Outcome (CO):**

On completion of the course, the student will be able to:

- Define the science of automatic process control;
- Distinguish Controlling elements, Transmission systems and Final control elements and their application;
- Demonstrate the working mechanism of different process controls employed for temperature, pressure, liquid level control;
- Develop an understanding and working mechanisms of the automatic valves employed in various industries.

COs	ILOs
CO 1: Define the science of automatic process control.	1. Detailed explanation about the elements of servo mechanism, loop feedback control, open control loop. 2. Understanding of different process variables, set point control types of controllers and on-off controllers.
CO 2: Distinguish Controlling elements, Transmission systems and Final control elements and their application.	1. Explain about the concept of working and construction of self-operated controller, Level controller, Pneumatic controller 2. State about the functioning of Hydraulic controller-its function and working

	Principles Electrical controller, thermo static valves. 3. Explain in details about Pneumatic, Hydraulic and Electrical transmissions.
CO 3: Demonstrate the working mechanism of different process controls employed for temperature, pressure, liquid level control.	1. Explain in details about Function of final control elements in process control and Different type of automatic control valves. 2. State about Sliding stem and rotating shaft control valve and Working principles and construction of Pneumatic, Hydraulic & Electrical control valve actuator. 3. Explain about the Final control elements and power failure. 4. In-depth explanation and discussion of Effects and precautions to be considered.
CO 4: Develop an understanding and working mechanisms of the automatic valves employed in various industries.	1. State and explain the Control of fluid flow, pressure, furnace pressure, and Liquid level control and Control of Thermal process. 2. Explain about the Major features and advantages of distributed control.

5. Teaching Scheme (in hours)

Lecture	Tutorial	Practical	Total
3 hrs/week		3 hrs/week	6 hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test (PT)#	Practical Assessment (PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
70	10	20	30	33/100	25	25	17/50	150	4

7. Detailed Course Contents

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	Science of Automatic Control	1.1 Elements of servo mechanism 1.2 Simple single loop feed-back control system 1.3 Open control loop 1.4 Definition of different process variables 1.5 Desired value or set point control or manipulated variables 1.6 Types of control action and properties of P ,.I. and D. Single loop regulator system 1.7 On- off controller	10
2.0	Controlling Elements	2.1 Working and construction of self operated controller (pressure regulator 2.2 Level controller 2.3 Thermo static valves) 2.4 Pneumatic controller - its function and working principles 2.5 Hydraulic controller-its function and working Principles Electrical controller -its function and working principles	10

3.0	Transmission System	3.1 Pneumatic transmission 3.2 Hydraulic transmission 3.3 Electrical transmission	9
4.0	Final Control Elements	4.1 Function of final control elements in process control 4.2 Different type of automatic control valves 4.3 Sliding stem and rotating shaft control valve 4.6 Working principles and construction of Pneumatic, Hydraulic & Electrical control valve actuator 4.7 Final control elements 4.8 Power failure 4.9 Effects and precautions to be considered	4
5.0	Application of control Engineering	5.1 Control of fluid flow 5.2 Control of pressure 5.3 Control of furnace pressure 5.4 Liquid level control 5.5 Control of Thermal process	5
6.0	Distributed digital control System	6.1 Introduction 6.2 Major features and advantages of distributed control	2

8. Distribution of Marks:

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type	Short Question	Descriptive Question	
1	Science of Automatic Control	5	3	10	18
2	Controlling Elements	8	X	6	14
3	Transmission System	2	3	7	12
4	Final Control	5	X	X	5
5	Application of control Engineering	3	3	5	11
6	Distributed digital	2	X	8	10

	control System				
		25	9	36	70

9. Suggested implementation of Teaching:

- Course related presentations and video discussion in class.
- Lecture and Notes
- Class Test, Viva.

10. Suggested Learning Resources

10.1 Book List:

i) Industrial instrumentation & control By S.K. Singh.

ii) Outlines of Chemical instrumentation & process control by Dr. A. Suryanarayan

iii) Automatic process control By Donald P.Eckman

10.2 List of Journals :

i) Journal of Control and Instrumentation

11. Question Pattern:

- Objective type question of type fill up the blanks or of very short type or combination of all = 10 questions = 10 x 1 = 10 marks.
- Short questions of 2 or 3 marks per question = 15 marks
- Descriptive questions of 5 marks or above (max 10 marks per question) = 45 marks

1. **Course Title : AUTOMATIC PROCESS CONTROL (LAB)**
2. **Course Code : Ch- 601(P)** **Full Mark :50**
3. **Semester : 6th**
4. **Hours : 45**

5. **Skills to be developed-**

Intellectual skills-

i) Proper observation and study
ii) Proper selection of measuring instruments (wherever required)
iii) Verify the principles
iv) Read and interpret graphs (where necessary)
v) Use results in practical problems.
vi) Make observation notes and draw diagrams.

Motor skills-

i) Proper handling of machineries and equipments.
ii) Observe reactions (wherever necessary)
iii) Note results
iv) Draw graphs or calculate results/outcomes (as needed)

6. **Topics-**

UNIT	TOPIC/SUB-TOPIC
1	**Details of equipments of flow control elements**
2	**Details of equipments of temperature control elements**
3	**Details of equipments of pressure control elements**
4	**Details of equipments of level control elements**
5	**Experiments done with feed back**
6	**Theory of gas chromatograph**

1. **Course Title : INDUSTRIAL CHEMICAL PROCESS III**
2. **Course Code : Ch-602**
3. **Semester : 6th**

4. **Course Outcome (CO)**

On completion of the course the students will be able to:

- Describe manufacturing of pulp & paper (Kraft's process), describe different types of paper.
- Describe different types of fertilizers, describe NPK fertilizers with applications.
- Describe Lime manufacturing process, their raw materials and applications.
- Describe manufacture of ordinary Portland cement (Dry & Wet process). Illustrate the chemical properties of Portland Cement., their composition; properties and uses.
- Describe sugar and its raw materials. Demonstrate the manufacturing process of sugar.
- Describe leather, its raw materials and different types.
- Describe glass manufacturing process, its raw materials and properties.
- Describe adhesives, classifications of adhesives. Describe uses of adhesives in different structural materials.

COs		ILOs
1	Describe manufacturing of pulp & paper (Kraft's process), describe different types of paper.	1.1 Describe the raw materials of pulp and paper. 1.2 Describe manufacturing of pulp. 1.3 Describe manufacturing of paper by Kraft's process. 1.4 Describe different types of paper.

2	Describe different types of fertilizers, describe NPK fertilizers with applications.	1. Define fertilizers. 2. Describe different types of fertilizers. 3. Define nitrogenous fertilizer. 4. Define phosphatic fertilizer. 5. Define potassium fertilizer. 6. Define mixed fertilizer. 7. Describe the production of ammonium Sulphate. 8. Describe the production of ammonium nitrate. 9. Describe the production of urea. 10. Describe super phosphate. 11. Describe triple super phosphate. 12. Describe NPK Fertilizers.
3	Describe Lime manufacturing process, their raw materials and applications.	1. Define lime. 2. Describe raw materials of lime. 3. Describe manufacturing of lime. 4. Describe applications of lime.
4	Describe manufacture of ordinary Portland Cement (Dry & Wet process). Illustrate the chemical properties of Portland Cement., their composition; properties and uses.	1. Describe manufacturing of ordinary Portland cement (Dry & Wet process). 2. Describe the functions and properties of different ingredients present in Portland cement. 3. Describe the process of setting and hardening of cement. 4. Illustrate the chemical properties of Portland cement. 5. Describe cement composition and their properties and applications.

5	Describe sugar and its raw materials. Demonstrate the manufacturing process of sugar.	1. Describe sugar and its raw materials. 2. Describe manufacturing of sugar with flow sheet. 3. Explain the principles of manufacturing sugar from sugarcane. 4. Explain refining and purification of sugar.
6	Describe leather, its raw materials and different types.	1. Describe the raw materials of leather. 2. Describe different types of hides and methods of softening of leather. 3. Describe the tanning process-vegetable and chemical tanning. 4. Describe different types of leather. 5. Explain drying and finishing of leather.
7	Describe glass manufacturing process, its raw materials and properties.	1. Define glass. 2. Describe manufacturing of glass. 3. Explain the preparation of glass in a glass furnace. 4. Describe different methods of finishing glass goods. 5. Describe different types of glass. 6. Describe raw materials of glass and their properties.

8	Describe adhesives, classifications of adhesives. Describe uses of adhesives in different structural materials.	1. Define adhesives. 2. Describe classifications of adhesives. 3. Describe different natural and synthetic adhesives of commercial importance. 4. Explain chemical nature of adhesives. 5. Illustrate special properties and applications of adhesives. 6. Describe advantages of adhesive bonding. 7. Describe applications of adhesives in different structural materials.

5. Teaching Scheme (in hours)

Lecture	Tutorial	Practical	Total
3 hrs/week	1 hr/week		4 hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test (PT)#	Practical Assessment (PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
70	10	20	30	33/100				100	4

7. Detailed Course Contents

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	Pulp & paper	1.5 Introduction 1.6 Raw materials 1.7 Manufacture of Pulp 1.8 Manufacture of paper (Kraft's process) 1.9 Different types of paper	5
2.0	Fertilizer	2.1 Introduction 2.2 Different types of fertilizers 2.2.1 Nitrogenous 2.2.2 Phosphatic 2.2.3 Potassium 2.2.4 Mixed 2.3 Nitrogenous Fertilizer 2.3.1 Production of Ammonium Sulphate 2.3.2 Ammonium Nitrate and 2.3.3 Urea their application as fertilizer 2.4 Phosphetic Fertilizer-raw materials 2.4.1 Production of Phosphetic acids 2.4.2 Super Phosphate 2.4.3 Triple Super Phosphate 2.5 NPK Fertilizer – Production and uses	8
3.0	Lime	3.1 Raw materials 3.2 Manufacture of lime 3.3 Uses	2
4.0	Cement	4.1 Manufacture of ordinary Portland Cement (Dry & Wet process) 4.2 Functions and properties of different ingredients present in Portland Cement 4.3 Setting and hardening of cement, 4.4 Chemical properties of Port- land Cement 4.5 Other varieties of cement- composition; properties and uses	5

5.0	Sugar	5.1 Introduction 5.2 Raw materials 5.3 Sugar manufacture flow sheet explanation 5.4 Principles of manufacturing sugar from sugarcane 5.5 Refining and purification of sugar 5.6 By-products	5
6.0	Leather	8. Introduction 9. Raw materials 10. Different types of hides and methods of softening 11. Tanning process-vegetables and chemicals tanning 12. Types of Leather 13. Drying and finishing of leather	5
7.0	Glass	7. Manufacture of Glass 8. Preparation of Glass in a glass Furnace 9. Spraying of glass annealing etc 10. Different methods of finishing glass goods 7.5 Different types of glass-their raw materials and properties	5
8.0	Adhesive	8.1 Introduction 8.2 Definition of Adhesives, 8.3 Classifications of adhesives 8.4 Names of different natural and synthetic adhesives of commercial importance 8.5 Their chemical nature 8.6 Special properties and applications 8.7 Advantages of adhesive bonding 8.8 Uses of adhesives in different structural materials	5

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Pulp & paper	3	4	6	13
2	Fertilizer	5	2	6	13
3	Lime	3	X	7	10
4	Cement	5	X	5	10
5	Sugar	3	X	7	10
6	Leather	3	X	5	8
7,8	Glass & Adhesive	3	3	X	6
		25	9	36	70

9. Suggested implementation of Teaching:

- Course related presentations and video discussion in class.
- Lecture and Notes
- Class Test, Viva.

10. Suggested learning Resource

10.1 Book list:

i) Dryden's outlines of Chemical technology By M.Goapala Rao & Marshall Sitting.

ii) Shreve's Chemical process industries by George T Austin. Mc Grow Hill Instruments Edition's.

10.2 List of Journals:

i) Chemical Engineering Journal.

11. Question Pattern:

- Objective type question of type fill up the blanks or of very short type or combination of all = 10 questions = 10 x 1 = 10 marks.
- Short questions of 2 or 3 marks per question = 15 marks
- Descriptive questions of 5 marks or above (max 10 marks per question) = 45 marks

1. **Course Title : PRINCIPLE OF UNIT OPERATION – (IV)**
2. **Course Code : Ch-603**
3. **Semester : 6th**

4. **Course Outcome:**

After completion of this course, the students will be able to

- Define size reduction; identify and select suitable and appropriate equipment for size reduction based on the properties of materials being used.
- Describe mechanical separation and its types; demonstrate the working principle and operational method of different separators.
- Describe mixing as separation technique and understand the properties of liquids, solids and gases based on the modes of experiments conducted on them.
- Describe different types of conveying equipments and explain different materials required for conveying.

CO		ILO
1	Define size reduction; identify and select suitable and appropriate equipment for size reduction based on the properties of materials being used.	1. Explain size reduction and its necessity. 2. Explain energy and power requirements for size reduction and crushing efficiency. 3. Define Kick's law, Rittinger's law and Bond's law. 4. Classify size reduction equipment. 5. Describe different size reduction equipments ✓ Jaw crusher ✓ Ball mill ✓ Hammer mill ✓ Tube mill ✓ Double mill

2	Describe mechanical separation and its types; demonstrate the working principle and operational method of different separators.	1. Explain the necessity of mechanical separation. 2. Classify different methods of mechanical separation. 3. Explain particle-size measurement by screen analysis, screen effectiveness and capacity. 4. Describe different types of screening equipments ✓ Grizzlies ✓ Trommels ✓ Vibrating screens ✓ Revolving screens. 5. Describe working principle and construction of ✓ Froth flotation. ✓ Suspended batch centrifuge for centrifugal separation. ✓ Cyclone separator. ✓ Electrostatic separator for electrostatic separation. ✓ Magnetic drum separator for electromagnetic separation. 6. Explain filtration and its types. 7. Describe working principle and construction of pressure filter- Plate and frame filter press.
3	Describe mixing as separation technique and understand the properties of liquids, solids and gases based on the modes of experiments	1. Explain mixing as separation technique. 2. Explain mixing of liquids with liquids by impellers, propellers, turbines, paddles, agitated vessel.

	conducted on them.	3. Explain mixing of gases with liquids by mechanically agitated vessel. 4. Explain mixing of viscous masses by double arm kneader, banbury mixers, pug mills, muller mixers. 5. Explain mixing of solids with solids by ribbon blenders, tumblers.
4	Describe different types of conveying equipments and explain different materials required for conveying.	1. Describe belt conveyors and chain conveyors for transportation. 2. Describe screw conveyors and pneumatic conveyors. 3. Describe range of materials required for handling conveyors.

5. Teaching Scheme (in hours)

Lecture	Tutorial	Practical	Total
3 hrs/week		3 hrs/week	6 hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test (PT)#	Practical Assessment (PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
70	10	20	30	33/100	25	25	17/50	150	4

7. Detailed Course Content

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	Size reduction	1.1 Introduction 1.2 Purpose of size reduction 1.3 Mechanisms of size reduction 1.4 Energy and power requirements of size reduction 1.5 Rittinger's law 1.6 Bond's law classification of size reduction equipment 1.7 Description and working of different size reduction equipments viz Jaw crusher ball-mill tube-mill double-roll-crusher 1.8 Hammer-mill	15
2.0	Mechanical Separation	2.1 Purpose of separation 2.2 Different methods of separation 2.3 Screening and types of screens description of screening equipments 2.4 Froth floatation 2.5 Centrifugal settling process cyclone separators 2.6 Electrostatic and electromagnetic separation 2.7 Filtration 2.8 Filter press	15
3.0	Mixing	3.1 Object of mixing 3.2 Important properties of materials which influence mixing (i) Mixing of liquid with liquid (ii) Mixing of gaseous with liquid (iii) Mixing of Viscous masses (iv) Different types of mixing equipments their /construction and operations	5

4.0	Conveying	4.1 Description of different types of conveying equipment viz. belt conveyors ,chain conveyors, etc 4.2 Screw conveyors, pneumatic conveyors, Materials of constructing of different conveyers for handing different materials	5

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Size reduction	6	3	10	19
2	Mechanical Separation	7	2	9	18
3	Mixing	6	2	10	18
4	Conveying	6	2	7	15
		25	9	36	70

9. Suggested implementation of Teaching:

- Course related presentations and video discussion in class.
- Lecture and Notes
- Class Test, Viva.

10. Suggested learning Resources

10.1 Book list

i) Dryden's outlines of Chemical technology By M.Gopala Rao & Marshall Sitting.

ii) Shreve's Chemical process industries by George T Austin. Mc Grow Hill Instruments Edition's.

iii) Mechanical operation for Chemical Engineering By C.M. Narayanan B.C. Bhattacharya.

10.2 List of Journals:

i) Chemical Engineering Journal

12. Question Pattern:

- Objective type question of type fill up the blanks or of very short type or combination of all = 10 questions = 10 x 1 = 10 marks.
- Short questions of 2 or 3 marks per question = 15 marks
- Descriptive questions of 5 marks or above (max 10 marks per question) = 45 marks.

1. **Course Title : UNIT OPERATION IV (LAB)**
2. **Course Code : Ch-603 (p)** **Full Mark : 50**
3. **Semester : 6th**
4. **Hours : 45**

5. **Skills to be developed-**

Intellectual skills-

i) Proper observation and study
ii) Proper selection of measuring instruments (wherever required)
iii) Verify the principles
iv) Read and interpret graphs (where necessary)
v) Use results in practical problems.
vi) Make observation notes and draw diagrams.

Motor skills-

i) Proper handling of machineries and equipments.
ii) Observe reactions (wherever necessary)
iii) Note results
iv) Draw graphs or calculate results/outcomes (as needed)

6. **Topics-**

UNIT	TOPIC/SUB-TOPIC
1.0	**Study of the construction and operation of Jaw Crusher.**
2.0	**Study of the construction and operation of Double-roll Crusher.**
3.0	**Study of the construction and operation of Ball-Mill.**
4.0	**Sieve analysis of a given sample.**
5.0	**Study of the construction and operation of a Hammer mill.**
6.0	**Study of the construction and operation of a Paddle mixer.**
7.0	**Study of the construction and operation of Wilfley table**
8.0	**Study of the construction and operation of froth floatation cell**

1. **Course Title : PETROLEUM REFINING ENGINEERING**
2. **Course Code : Ch-604**
3. **Semester : 6th**

4. **Course Outcome:**

- Briefly introduce and narrate the history of Petroleum industry
- Define Crude Oil, its sources and its properties
- Describe the different pretreatments required for refining of petroleum
- Study the different test of crude oil and its product to know its properties
- Describe in details the production of petroleum products
- Define the uses and requirement of Vacuum Distillation Unit
- Define manufacturing of Lubrication oil
- Define manufacturing of Wax and the various grades of the produced wax and their uses
- Define specification of Petroleum
- Define Cracking of Petroleum and its necessity
- Elaborate what you mean by Solvent Refining
- Explain different treatments of Petroleum Products
- Elaborate the Safety, Prevention and Maintenance procedures in a refinery

COs		ILOs
1	Briefly introduce and narrate the history of Petroleum industry	1. Provide a general overview on the history of the petroleum Industry with special reference to India 2. Classify different oil refineries of India according to their refining capacities 3. Briefly study about the different oil fields of Assam

2	Define Crude Oil, its sources and its properties	1. Describe the theories of origin of Crude oil 2. What are the various sources of Crude oil 3. What is the chemical composition of crude 4. Define the physical appearance of crude 5. Classify crude according to various parameters
3	Describe the different pretreatments required for refining of petroleum	1. Define desalting and dehydration of crude 2. Define various desalting methods viz., mechanical, chemical and electrical desalting 3. Define Pour point depression
4	Study the different test of crude oil and its product to know its properties	1. Study the different properties of crude oil and its products and define different tests and know about their significance
5	Describe in details the production of petroleum products	1. Define fractionation of crude 2. Define the working of an Atmospheric distillation unit 3. Define Bubble cap columns and different types of plates 4. Elaborate the different products

		obtained from the Atmospheric distillation unit
6	Define the uses and requirement of Vacuum Distillation Unit	1. Define Vacuum Distillation Unit 2. Brief about the products from Vacuum Distillation unit and their study about their uses
7	Define manufacturing of Lubrication oil	1. Describe the manufacturing process of lubricating oil 2. How is lube oil treated 3. What are the various additives added to lube
8	Define manufacturing of Wax and the various grades of the produced wax and their uses	1. Describe the manufacturing process of Wax 2. What are the various grades of wax 3. Give a detailed note on their specification 4. What are the end uses of wax
9	Define specification of Petroleum	1. Give details about the specification of different products of petroleum
10	Define Cracking of Petroleum and its necessity	1. Define secondary process of petroleum refining 2. Define different types of cracking 3. Define Delayed Coking unit with special reference to its by-products and their uses

		4. Define Fluidized Catalytic Cracking unit and mention the products obtained from it 5. Define Hydroc raking unit
11	Elaborate what you mean by Solvent Refining	1. Describe Solvent relining and their extraction process 2. Study about the refining of Kerosene by Edeleanu process
12	Explain different treatments of Petroleum Products	1. What are the chemical treatment used for petroleum products citing examples of Sulfuric acid Treatment, Clay Treatment, etc 2. Define Merox sweetening process and Contact process etc to remove sulfur from crude and its products
13	Elaborate the Safety, Prevention and Maintenance procedures in a refinery	1. What are safety measures to be taken in a refinery 2. Describe about fire protection in a refinery 3. Give details about maintenance of equipments used in a refinery

5. Teaching Scheme (in hours)

Lecture	Tutorial	Total
3 hrs/week		3 hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test (PT)#	Practical Assessment (PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
70	10	20	30	33/100				100	3

7. Detailed Course Content

Chapter No	Chapter Title	Content	Duration (in hours)
1	Introduction and History of petroleum Industry	1.1 History of the petroleum Industry with special reference to India 1.2 Different oil refineries of India and their capacities 1.3 Oil fields of Assam	3
2	Crude Oil	2.1 Crude Oil Definition 2.2 Source of Crude oil (Origin of Crude oil theories) 2.3 Composition of crude (chemical composition) 2.4 Physical appearance of crude 2.5 Classification of crude	3
3	Different pretreatments of petroleum	3.1 Pretreatment of crude by desalting and dehydration 3.2 Mechanical, Chemical and Electrical desalting procedure 3.0 Pour point depression	3

4	Different Properties and test of crude oil/product	4.1 Different Properties of crude oil/products and different tests and significance 4.2 Reid vapor pressure, octane number, cetane number, smoke point, power point, Flash point fire point, viscosity, viscosity- index, calorific value, diesel-index, carbon residue etc	3
5	Production of petroleum	5.1 Fractionation of crude 5.2 Atmospheric distillation unit 5.3 Bubble cap columns, different types of plates 5.4 Different products obtained from the Atmospherics distillation unit 5.5 Definition of different products and their uses (LPG) gasoline, Kerosene Light-diesel oil, High speed diesel oil etc	4
6	Vacuum Distillation	6.1 Vacuum Distillation Unit 6.2 Products from vacuum Distillation unit and their uses	3
7	Lubrication oil	7.1 Manufacturing Process of lubricating oil 7.2 Treatment of lube oil 7.3 Various additives added to lube	3
8	Wax	8.1 Manufacturing Process of Wax 8.2 Grades of wax and specification 8.3 Uses of wax	3
9	Specification of Petroleum	9.1 Specification of Different petroleum Products	3
10	Cracking of Petroleum	10.1 Secondary process (Cracking) 10.2 Thermal Cracking and Catalytic Cracking 10.3 Delayed Coking unit, By products obtained from D.C.U., Coke etc 10.4 Fluidized Catalytic Cracking unit and products obtained from it 10.5 Hydro raking unit	3

11	Solvent Refining	11.1 Solvent relining and extraction process 11.2 Refining of Kerosene by Edeleanu process. (Extraction by sulfur dioxide)	3
12	Different Treatments of Petroleum Products	12.1 Chemical Treatment of petroleum products 12.2 Sulfuric acid Treatment 12.3 Clay Treatment 12.4 Merox sweetening process, Contact process etc to remove sulfur from crude and its products.)	3
13	Safety, Prevention and Maintenance	13.1Safety in the refinery 13.2 Fire protection in the refinery 13.3 Maintenance of equipments	3

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1,2	History of petroleum industry and crude oil	5	X	4	9
3,4	Different pretreatments of petroleum & Different Properties and test of crude oil/product	5	X	6	11
5,6	Production of petroleum & Vacuum Distillation	4	X	7	11
7,8	Lubrication oil & Wax	5	3	5	13
9,10	Specification of Petroleum & Cracking of Petroleum	4	3	5	12
11,12	Solvent Refining &	2	X	9	11

	Different Treatments of Petroleum Products				
13	Safety, Prevention and Maintenance	X	3	X	3
		25	9	36	70

9. Suggested implementation of Teaching:

- Course related presentations and video discussion in class.
- Lecture and Notes
- Class Test, Viva.

10. Suggested learning Resources :

10.1 Book list:

i) Modern petroleum Refineries process By B.K. Bhaskar Rao.

ii) Petroleum Refinery Engineering By W.I Nelson.

10.2 List of Journals:

i) Journal of oil and gas research

ii) Journal of petroleum Engineering and Technology

11. Question Pattern:

- Objective type question of type fill up the blanks or of very short type or combination of all = 10 questions = 10 x 1 = 10 marks.
- Short questions of 2 or 3 marks per question = 15 marks
- Descriptive questions of 5 marks or above (max 10 marks per question) = 45 marks

1. **Course Title : PAPER TECHNOLOGY**
2. **Course Code : Ch-605**
3. **Semester :6th**
4. **Course Outcome (CO):**

On completion of the course, the student will be able to:

- Gain information about the pulp and paper industry;
- Have a detailed overview of the basic constituents used in Paper manufacturing industries;
- Attain in-depth knowledge of pulping, bleaching, sizing and coloring processes;
- Develop an understanding of the whole procedure of paper making and provide an analytical approach towards the treatment of the raw materials involved in paper making.

COs	ILOs
CO 1: Gain information about the pulp and paper industry	1. Detailed explanation about growth and development of pulp and paper industry.
CO 2: Have a detailed overview of the basic constituents used in Paper manufacturing industries.	1. Explain about cellulose, lignin and it's various types; 2. Define chemical and physical properties along with lignin isolation; 3. Explain about the chemical constituents and physical properties of pulp wood.

CO 3: Attain in-depth knowledge of pulping, bleaching, sizing and coloring processes.	1. Define pulping by different processes; 2. Detailed explanation about chemical, sulphite, alkaline, mechanical, semi-chemical pulping; 3. Define the process of bleaching and it's properties along with the various requirements for different pulps; 4. Explain the various dyes used for coloring along with their properties and the various factors of coloring affecting dyeing.
CO 4: Develop an understanding of the whole procedure of paper making and provide an analytical approach towards the treatment of the raw materials involved in paper making.	1. Define fiber preparation. 2. Explain the use of pulpers, beaters, refiners and define them. 3. Explain sheet formation. 4. Define paper machine, its construction and operation; along with wet pressing and drying of paper. 5. Explain internal sizing and different types. 6. Define the various sizing process and commercial grade papers. 7. Explain surface sizing, and various properties and types. 8. Define the various equipments used and the detailed processes associated with them.

5. Teaching Scheme (in hours)

Lecture	Tutorial	Total
3 hrs/week		3 hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test (PT)#	Practical Assessment (PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
70	10	20	30	33/100				100	3

7. Detailed Course Content

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	Introduction	1.1 Growth and development of pulp and paper industry	2
2.0	Cellulose and lignin	2.1 Its sources; different types of cellulose 2.2 Chemical Properties and physical structure, Isolation of lignin 2.3 Physical Properties and chemical constituents	3
3.0	Pulp Wood	3.1 Physical properties of wood 3.2 Chemical components	2
4.0	Pulping	4.1. Introduction to pulping by different processes 4.1.1 Chemical pulping 4.1.2 Sulphite pulping 4.1.3Alkaline pulping 4.1.4 Mechanical pulping 4.1.5 Semi chemical pulping	5

5.0	Bleaching	5.1 Process of bleaching and its properties 5.2 Bleaching requirements for different pulps	3
6.0	Fiber Preparation	6.1 Use of Beaters and pulpers and refiners 6.2 Description of Beaters and pulpers and refiners	5
7.0	Sheet formation	7.1 Paper machine 7.2 Its operation and construction Formation of an paper machine wire 7.3 Wet pressing 7.4 Drying of paper	5
8.0	Internal Sizing	8.1 Introduction to sizing 8.2 Definition of sizing process 8.3 Types of sizing agent used 8.4Commercial grades of sized papers	5
9.0	Surface Sizing	9.1 Effects of surface on properties of paper 9.2 Types of surface sizing agents used 9.3 Its processes and description of equipments used for surface sizing	5
10.0	Coloring	10.1 Different dye stuff used for coloring with their properties 10.2 Method of coloring factors affection dyeing	5

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1,2	Introduction &Cellulose and lignin	3	2	X	5
3	Pulp Wood	3	X	X	3
4	Pulping	4	3	5	12
5	Bleaching	4	X	X	4
6	Fiber Preparation	3	2	6	11
7	Sheet formation	1	X	6	7
8	Internal Sizing	3	X	6	9

9	Surface Sizing	1	2	6	9
10	Coloring	3	X	7	10
		25	9	36	70

9. Suggested implementation of Teaching:

- Course related presentations and video discussion in class.
- Lecture and Notes
- Class Test, Viva.

10. Suggested learning Resource

10.1 Book list:

i) Shreve's: Chemical process Industries By George T Austin. Mc Grow Hill International Edition's.

ii) Drydens outline of Chemical technology By M.Gopala Rao & Marshall Sitting

iii) A textbook of Engineering Chemistry By S.S. Dara.

10.2 List of Journals:

i) Chemical news journal

ii) International journal of Chemical and process plant safety

11. Question Pattern:

- Objective type question of type fill up the blanks or of very short type or combination of all = 10 questions = 10 x 1 = 10 marks.
- Short questions of 2 or 3 marks per question = 15 marks
- Descriptive questions of 5 marks or above (max 10 marks per question) = 45 marks

1. **Course Title : PROJECT & SEMINAR**
2. **Course Code : Ch- 611**
3. **Semester : 6th**
4. **Course outcome:**

- Students will be able to learn about the different aspects of a chemical industry and study its feasibility.

COs	ILOs
Students will be able to learn about the different aspects of a chemical industry and study its feasibility	1. Students will study about market survey, site selection, different processes involved, raw materials, organization and manpower requirements and economy of the project, Feasibility study of a chemical industry. 2. Prepare a report on a process industry with special emphasis on the following points. **i)** Feasibility of the industry with reference to the availability of raw materials and market demand. **ii)** Different processes or techniques available for selection of a particular process with reasons thereof. **iii)** Detailed description of the selected process with flow sheet diagram.

	iv) Materials and equipment needed in the process Plant layout. **v)** Location of the plant with reasons. **vi)** Manpower requirement **vii)** Conclusion.

5. Teaching Scheme (in hours)

Lecture	Tutorial	Practical	Total
	1hr/week	6hrs/week	7hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test(PT)#	Practical Assessment(PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
					50	100	50/150	200	5

7. Detailed Course Content

They will have to prepare a report on a process industry where they will be able to know about market survey, site selection, different processes involved, raw materials, organization and manpower requirements and economy of the project, Feasibility study of a chemical industry. Students will then prepare a report on a process industry with special emphasis on the following points.

viii) Feasibility of the industry with reference to the availability of raw materials and market demand.

ix) Different processes or techniques available for selection of a particular process with reasons thereof.

x) Detailed description of the selected process with flow sheet diagram.

xi) Materials and equipment needed in the process Plant layout.

xii) Location of the plant with reasons.

xiii) Manpower requirement

xiv) Conclusion.

Course Title : Professional Practice – IV

1. **Course Code : CH- 610**
2. **Semester – 6th**
3. **Course outcome:**

- Learn about functioning of an industry
- Acquire information from different resource persons on specific topic
- Group discussions among the students on different topics
- Seminars on given topic to share knowledge
- Mini projects on related topics
- Prepare models on relevant topics
- Enrich in bringing group activities

COs	ILOs
Learn about functioning of an industry	1. The industrial visit should be arranged in the following areas/industries: (any two) • Refrigeration and air condition manufacturing workshop • Food Processing unit • Cosmetic Manufacturing unit • Drinking Water bottling Plant • Paper industry 2. Report submission of the same citing the observations within a stipulated time

Acquire information from different resource persons on specific topic	1. Lectures by Professional/Industrial Experts should be organized from any 4 of the following areas, • Gas-solid separation techniques employed in industries. • Nanotechnology • Environmental pollution and control • Biotechnology • Packing Technology • Alternate fuels • Total Productive Maintenance 2. A brief report is to be submitted on the guest lecture by each student as a part of team work.
Group discussions among the students on different topics	1. The students should discuss in group of 6 to 8 students and write a brief report on the same, as a part of team work on the following topics • CNG Vs LPG as a fuel. • Rain water harvesting. • Disaster management. • Safety in day to day life. • Energy saving in institute • Impact of plastic in modern

	world.
Seminars on given topic to share knowledge	1. Seminar topic should be related to the subjects of sixth semester/Topics from guest lectures. 2. Each student should submit a report of at least 10 pages and deliver a seminar (Presentation time – 10 min for a group of 2 students)
Mini projects on related topics	1. Students should submit a mini projects on any one of the following topics • Thermocouple based temperature controller. • Design and drawing of simple water purifier • Bio-fertilizer • Recycling of waste plastic
Prepare models on relevant topics	1. Models of material handling route systems or modular course on any one of the suggested or alike relevant topic be undertaken by a group of students (min 10) • Soap making • Candle and Chalk making

	• Plastic molding • Drinking water testing
Enrich in bringing group activities	1. Certain group activities leading to better knowhow of a situation

5. Teaching Scheme (in hours)

Lecture	Tutorial	Practical	Total
1 hrs/week		2 hrs/week	3 hrs/week

6. Examination Scheme

Theory					Practical			Total Marks (Theory+Practical)	Credit
ESE	Sessional(SS)			Pass (ESE+SS)	Practical Test(PT)#	Practical Assessment(PA)@	Pass (PT+PA)		
	TA	HA	Total (TA+HA)						
-	-	-	-	-	25	25	17/50	50	2

7. ACTIVITIES

7.1 INDUSTRIAL VISITS: 8

Structured industrial visits be arranged and report of the same shall be submitted by the individual students, to form a part of the team work. The industrial visit may be arranged in the following areas/industries: (any two)

- Refrigeration and air condition manufacturing workshop
- Food Processing unit
- Cosmetic Manufacturing unit
- Drinking Water bottling Plant
- Paper industry

7.2 GUEST LECTURE(S): 8

Lectures by Professional/Industrial Experts to be organized from any 4 of the following areas. The brief report to be submitted on the guest lecture by each student as a part of team work.

- Gas-solid separation techniques employed in industries.

- Nanotechnology
- Environmental pollution and control
- Biotechnology
- Packing Technology
- Alternate fuels
- Total Productive Maintenance
-

7.3 GROUP DISCUSSION: 4

The students should discuss in group of 6 to 8 students and write a brief report on the same, as a part of team work. The topic of discussion may be selected by the faculty members. Some of the suggested topics are (any one)-

- CNG Vs LPG as a fuel.
- Rain water harvesting.
- Disaster management.
- Safety in day to day life.
- Energy saving in institute
- Impact of plastic in modern world.

7.4 SEMINAR 8

Seminar topic should be related to the subjects of sixth semester/Topics from guest lectures. Each student should submit a report of at least 10 pages and deliver a seminar (Presentation time – 10 min for a group of 2 students)

7.5 MINI PROJECTS: (IN A GROUP OF 4-5 STUDENTS) 6

- Thermocouple based temperature controller.
- Design and drawing of simple water purifier
- Bio-fertilizer
- Recycling of waste plastic

7.6 MODELS OF MATERIAL HANDLING ROUTE SYSTEMS OR MODULAR COURSE ON ANY ONE OF THE SUGGESTED OR ALIKE RELEVANT TOPIC BE UNDERTAKEN BY A GROUP OF STUDENTS (MIN 10) 9

- Soap making
- Candle and Chalk making
- Plastic molding
- Drinking water testing

7.7 STUDENT ACTIVITIES: 5

Students in a group of 3 to 4 shall perform any two of the following activities. (Other similar activities may be considered) and write a report as a part of team work.

- Collection of data regarding loan facilities or other facilities available through different organizations/ banks to budding entrepreneurs.
- Survey and interviews of successful entrepreneurs in nearby areas.
- Survey of opportunities available in thrust areas identified by government or DIC.
- Survey of data regarding different types of pumps with specifications from manufacturers, local market, end users. (any other engineering products may be considered for survey)
- Survey of fertilizers and pesticides used by farmers.

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