DIRECTORATE OF TECHNICAL EDUCATION,
KAHILIPARA, GUWAHATI-19

DIPLOMA PROGRAMME IN

CHEMICAL ENGINEERING

NEW SYLLABUS

5TH SEMESTER

COURSE STRUCTURE OF 5thSEMESTER (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	CH-501	Instrumentation	3		3	70	10	20	30	33/100	25	25	17/50	150	4
2	CH-502	Industrial Chemical Process-II	3		3	70	10	20	30	33/100	25	25	17/50	150	4
3	CH-503	Petro Chemicals	3	1		70	10	20	30	33/100	-	-		100	4
4	CH-504	Principle of Unit Operation-III	3		3	70	10	20	30	33/100	25	25	17/50	150	4
5	CH-505	Chemical Engg Drawing-II			6						100	50	50/150	150	3
6	CH-510	Professional Practice - III	1		2						25	25	17/50	50	2
7		**Optional (any 1)**													
A	CH-506	Fertilizer Technology	3	1		70	10	20	30	33/100				100	4
B	Ch-507	Petroleum Technology	3	1		70	10	20	30	33/100				100	4
			16	2	17										
		Total	**35 hrs/ week**										**Total**	**850**	**25**

1. **Course Title : INSTRUMENTATION**
2. **Course Code** : **Ch-501**
3. **Semester : 5th**
4. **Course Outcome:**

- Define basic principles of measurement and describe different types of measuring instruments
- Briefly learn what is a Sensing Elements and their role as primary detector
- Define the working of Transducers and its classification
- Describe the various means for Indicating and Recording
- Describe various instruments used in measurement of Temperature and their construction
- Describe different types of Pressure measurement and working principle of the instruments used
- Describe different methods of Liquid level measurement
- Study the means of Flow measurement and calculation of the same
- Study few other Special methods of Measurement

COs		ILOs
1	Define basic principles of measurement and describe different types of measuring instruments	1.1 Define the aims of measurement 1.2 Classify the methods of measurement 1.3 Define functions of instruments 1.4 Classify instruments according to its types 1.5 Learn about the errors in measuring instrument 1.6 Define the Static and dynamic characteristics of instruments
2	Briefly learn what is a Sensing Elements and their role as primary	1. Define Thermal detectors and their uses 2. Describe about the uses of Hydro-

	detector	pneumatic sensor
3	Define the working of Transducers and its classification	1. How is Transducer used in measurement 2. Define the Actuating mechanism of a Transducer 3. Classify Transducer according to their working mechanism
4	Describe the various means for Indicating and Recording	1. Describe the different means of Indicating 2. Describe the different means of Recording 3. Different Operating mechanism in indicator and recorders 4. Describe the symbols and identifications used for instruments
5	Describe various instruments used in measurement of Temperature and their construction	1. Explain the different kinds of Temperature scales 2. Describe the working and construction of expansion thermometer 3. Define Thermistors and their uses 4. Define a Resistance thermometer 5. Define Thermocouples, Laws of thermo-electricity and brief about the construction and operations of radiation pyrometer and optical pyrometer
6	Describe different types of Pressure measurement and	1. Define Differential pressure, Atmospheric pressure, Absolute pressure and Vacuum

	working principle of the instruments used	2. Describe the working principles and construction of Manometer and Pressure-elements 3. Describe the working, construction and ranges of absolute pressure measuring instruments and brief about their field of application
7	Describe different methods of Liquid level measurement	1. Explain direct and indirect liquid level measurement methods. 2. Describe the Electrical conductivity method of liquid measurement 3. What are Capacitive level meters and Capacitance probe
8	Study the means of Flow measurement and calculation of the same	1. Describe the Principle of measurement of flow 2. Describe the construction and operation of various flow measuring instruments 3. Describe various differential pressure meter viz., orifice meter, venturimeter and pitot tube and calculate the flow from the readings 4. Describe variable area meter viz., Rota meter, Vortex flow meter 5. Describe Ultrasonic type flow meter
9	Study few other Special methods of Measurement	1. Various ways of measuring hydrogen ion concentration 2. Determination of dissolve oxygen content

		in a given sample 3. Define Gas chromatography and the parameters it measures

5. Teaching Scheme (in hours)

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

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	Basic principles of Measurement	1.7 Definition and aim of measurement 1.8 Classification of methods of measurement, functions of instruments 1.9 Types of instruments 1.10 Errors in measuring instrument 1.11 Instrument Error Combination 1.12 Static and dynamic characteristics of instruments	5
2.0	Sensing Elements	2.1 Introduction 2.2 Mechanical member as primary detector 2.3 Thermal detectors 2.4 Hydropneumatic sensor	2

3.0	Transducers	3.1 Transducer in measurement 3.2 Actuating mechanism 3.3 Transducer classification	1
4.0	Indicating and Recording means	4.1 Indicating means 4.2 Recording means 4.3 Operating mechanism in indicator and recorders 4.4 Symbols and identifications used for instruments	2
5.0	Temperature Measurement	5.1 Temperature scales 5.2 Thermometer 5.3 Working and construction of expansion thermometer (Mercury & glass, alcohol, bimetallic & pressure spring Thermometer) 5.4 Thermistors 5.5 Resistance thermometer 5.6 Thermocouples 5.7 Laws of thermo-electricity 5.8 Construction and operations of radiation pyrometer and optical pyrometer	10
6.0	Pressure Measurement	6.1 Differential pressure 6.2 Atmospheric pressure 6.3 Absolute pressure 6.4 Vacuum-definitions and units 6.5 Working principles and construction of Manometer, Pressure-elements (diaphragm and pressure-spring elements) 6.6 Their description and operation 6.7 Working and construction of absolute pressure measuring instruments-their ranges and field of application	8
7.0	Liquid level measurement	14.1 Direct liquid level measurement (Bob, tape, sight-glass, floats) 14.2 Indirect Liquid level measurement (bubbler, diaphragm, box & air trap system)	4

		14.3 Electrical conductivity method 14.4 Capacitive level meters 14.5 Capacitance probe	
8.0	Flow Measurement	8.1 Principle of measurement of flow 8.2 Construction and operation of flow measuring instruments 8.3 Differential pressure meter viz orifice meter 8.4 Venturimeter & pitot tube 8.5 Including simple numerical problems 8.6 Variable area meter viz Rota meter 8.7 Vortex flow meter 8.8 Ultrasonic type flow meter	5
9.0	Special methods of Measurement	18.1 Measurement of Hydrogen ion concentration 18.2 Dissolve oxygen meter 18.3 Gas chromatography	3

8. Distribution of Marks :

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Basic principles of measurement	3	X	10	13
2	Sensing elements	2	X	X	2
3	Transducers	X	3	X	3
4	Indicating and recording means	2	3	X	5
5	Temperature Measurements	4	X	10	14
6	Pressure Measurements	4	X	6	10
7	Liquid level measurements	4	3	X	7
8	Flow Measurements	3	X	5	8
9	Special methods of measurements	3	X	5	8
		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.

10.2 List of journals:

10.1 International Journal of Instrumentation technology

10.2 Flow measurements and Instrumentation 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 : INSTRUMENTATION LABORATORY**
2. **Course Code : Ch- 501 (P)** **Full Marks :50**
3. **Semester : 5th**
4. **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)

5. **Topics-**

UNIT	TOPIC/SUB-TOPIC
1.0	Temperature measuring instrument : Study of the construction and working principle of the following temperature measuring instruments and determination a) Mercury in glass thermometer (high temperature range) b) Alcohol thermometer c) Bimetallic thermometer d) Pressure spring thermometer e) Thermocouple
2.0	Flow Measuring Instrument : Study of construction and operation and determination of flow rate
2.1	through a pipe by- a) Orifice meter b) Venturi meter c) Pitot tube d) Rotameter
3.0	Pressure measuring Instruments : a) Study of the construction and operation of a pressure gauge (Bourdon tube) b) Determination of pressure by a gas Chromatograph.
4.0	Measurement of gas composition by gas Chromatograph.
5.0	Measurement of Ph valve by Ph meter
6.0	Measurement of TDS and DO.

1. **Course Title : INDUSTRIAL CHEMICAL PROCESS-II**
2. **Course Code : Ch-502**
3. **Semester : 5th**

4. **Course Outcome (CO)**

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

- Describe soaps and detergents.
- Describe plastics, its different types, different fabrication process.
- Explain hydrogenation of fats and oils.

COs		ILOs
1	Describe soaps and detergents.	1.1 Define soap and their raw materials. 1.2 Explain the differences among fatty oils (Vegetable and animal oil). 1.3 Explain the difference between mineral oil and essential oil. 1.4 Illustrate some applications of glycerol. 1.5 Explain the characteristics of detergents, 1.6 Explain synthetic detergents. 1.7 Give the difference between soap and synthetic detergent. 1.8 Describe the raw materials for detergents. 1.9 Explain the manufacturing of detergents. 1.10 Explanation of applications of detergents.

2	Describe plastics, its different types, different fabrication process.	1. Define Plastic. 2. Define polymerization. 3. Give difference between addition and condensation. 4. Explain about thermoplastic and thermosetting polymers. 5. Illustrate the raw materials for the production of plastic. 6. Describe the manufacturing process of plastics. 7. Explain Properties and applications of:- • Polyethylene • Polypropylene • Polymethyl metacryolate • Polyvinyl chloride • Polystyrene • Phenol formaldehyde resin • Urea formaldehyde • Melamine formaldehyde • Epoxy resin 8. Describe different fabrication process for product of plastics. 9. Explain the working principle of extruder. 10. Explain the working of injection molding. 11. Explain the working of compression molding.

3	Explain hydrogenation of fats and oils.	3.1 Define Vegetable oil. 3.2 Describe the chemical nature of vegetable oil. 3.3 Describe consistency of oil. 3.4 Describe different hydrogenation product of Vegetable oil and their applications in manufacturing Vanaspati type material and higher alcohol. 3.5 Illustrate the production of oil from oil seeds with the help of a block diagram. 3.6 Describe different process and operations involved in hydrogenation of oils. 3.7 Describe the properties of hydrogenation of oils. 3.8 Describe the properties of hydrogenated oil.

5. Teaching Scheme (in hours)

Lecture	Tutorial	Practical	Total
3hrs/week		3hrs/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	Soap and detergent	1.11 Introduction 1.12 Differences among fatty oils (Vegetable and animal oil) 1.13 Mineral oil and essential oil 1.14 Difference between oil and fat 1.15 Raw materials for soap 1.16 Recovery of glycerol and uses 1.6 Characteristics of a detergent 1.7 Names of synthetic detergent 1.8 Difference between soap and synthetic detergent 1.9 Raw materials for detergent manufacture 1.10 Manufacture of detergent and uses	10
2.0	Plastics	2.1 Polymerization 2.2 Addition and condensation 2.3 Thermoplastic and Thermosetting polymers 2.4 Definition of Plastic 2.5 Raw materials for the production of plastic 2.6 Manufacturing process of plastics 2.7 Properties and application of:- 2.7.1 Polyethylene 2.7.2 Polypropylene	15

		2.7.3 Polymethyl metacryolate 2.7.4Polyvinyl chloride 2.7.5 Polystyrene 2.7.6 Phenol formaldehyde resin 2.7.7 Urea formaldehyde 2.7.8 Melamine formaldehyde 2.7.9 Epoxy resin 2.8 Different fabrication process for product of plastics 2.9 Working principles of extruder 2.10 Injection moulding m/c 2.11Compression moulding m/c etc	
3.0	Hydrogenation of Fats and Oils	3.9 Introduction- Vegetable oil 3.10 Their chemical nature 3.11 Consistency of oil 3.12 Different hydrogenation product of Vegetable oil and their applications in manufacturing Vanaspati type material and higher alcohol (names only) 3.13 Production of oil from oil seeds with the help of block diagram 3.14 Different process and operations involved in hydrogenation of oils 3.15 Properties of hydrogenation of oils 3.16 Properties of hydrogenated oil	15

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Soaps &	9	3	12	24
2	Plastics	9	3	12	24

3	Hydrogenetation of fats & oil	7	3	12	22
		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) A textbook of Engineering Chemistry By S.S. Dara.

10.2 List of Journals:

i) International Journal of Chemical & process plant Safety

ii) Chemical News 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 : INDUSTRIAL CHEMICAL PROCESS-II (LAB)**
2. **Course Code : Ch-502 (p)** **Full Mark :50**
3. **Semester : 5th**
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	**FATS & OILS ANALYSIS**
	1.1) Analysis of vegetable oil in respect of
	a) Acid Value
	b) Saponification value
	c) Iodine Value
2	**ADHESIVE :**
	2.1) Preparation of glue & adhesive
3	**CEMENT : Testing of cement, composition and properties.**

1. **Course Title : PETROCHEMICALS**
2. **Course Code : Ch-503**
3. **Semester : 5th**

4. **Course Outcome :**

On completion of this course,

- The course provides an introduction with the petrochemical industry.
- The course develops knowledge of different types of petrochemicals.
- It explains the various types of manufacturing processes of petrochemicals.
- It provides knowledge on synthetic detergents, insecticides which includes their manufacturing process, properties and uses.
- It describes the manufacturing of different petrochemicals along with their properties and uses.
- It provides knowledge on different monomers along with its manufacturing process.
- The course describes the manufacturing process, properties and uses of various plastics, resins, rubber, varnishes and fibers.

COs	ILOs
An introduction with the petrochemical industry	1.Describe the history and future prospect of petrochemicals 2. Explain the Petro chemical industry in India
Knowledge of different types of petrochemicals	1.Explain the different types of petrochemicals 2.Define Aliphatic petrochemicals 3.Define Aromatic petrochemicals 4.Describe Inorganic petrochemicals
Various types of manufacturing processes of petrochemicals.	1.Describe the types of manufacturing processes of petrochemicals

	• Cracking and Reforming • Steam reforming and Hydrogenation • Dehydrogenation • Alkylation • Polymerization • Isomerization
Knowledge on synthetic detergents, insecticides which includes their manufacturing process, properties and uses	1.Explain the manufacturing process, properties and uses of • Synthetic detergents • Sulphonates 2.Describe the manufacturing process, properties and uses of • DDT • Gamaxene • Bleaching powder
Manufacturing of different petrochemicals along with their properties and uses	1.Describe the manufacturing processes Properties and uses of • Ethylene • Acetylene • Butadiene • Benzene • Toluene • Xylene

Different monomers along with its manufacturing process.	1.Explain the manufacturing process of different monomers like • Ethylene oxide • Vinyl chloride • Styrene • Methanol • Formaldehyde
Manufacturing process, properties and uses of various plastics, resins, rubber, varnishes and fibers	1.Explain the manufacturing processes of plastic, Properties & uses of • PVC • Polythene • Resins • Urea formaldehyde • Phenol formaldehyde • Melamine formaldehyde • Poly butyl alcohol 2. Explain the manufacturing processes of rubber, Properties & uses of • SBR • Poly Butadiene • Poly Chloroprene 3.Explain the manufacturing processes, properties and uses of different varnishes 4.Describe the manufacturing processes, properties and uses of different fibers like • Polyester fibre • Polyamide fibre

5. Teaching Scheme (in hours)

Lecture	Tutorial	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 Content

Chapter No	Chapter Title	Content	Duration (in hours)
1	Introduction	1.1 History and future prospect of petrochemicals 1.2 Petrochemical industry in India.	3
2	Type of Petro chemicals	2.1 Aliphatic 2.2 Aromatic 2.3 Inorganic	3
3.0	Process of manufacturing of Petrol-chemicals	3.1 Cracking and reforming 3.2 Steam reforming, hydrogenation 3.3 Dehydrogenation 3.4 Alkylation 3.5 Polymerization 3.6 Isomerization	4
4.0	Synthetic detergents	4.1 Synthetic detergents 4.2 Sulphonates	4

5.0	Insecticides	Manufacturing process Properties and uses- 5.1 DDT 5.2 Gamaxene 5.3 Bleaching Power	3
6.0	Manufacture of Petrochemicals	Manufacturing processes Properties and uses of 6.1 Ethylene 6.2 Acetylene 6.3 Butadiene 6.4 Benzene 6.5 Toluene 6.6 Xylene	4
7.0	Monomers	Manufacturing process of 7.1 Ethylene oxide 7.2 Vinyl chloride 7.3 Styrene 7.4 Methanol 7.5 Formaldehyde	4
8.0	Plastics and Resins	Manufacturing processes of plastic, Properties & uses of 8.1 PVC 8.2 Polythene 8.3 Resins 8.4 Urea formaldehyde 8.5 Phenol formaldehyde 8.6 Melamine formaldehyde 8.7 Polybutyl alcohol	5
9.0	Rubber	Manufacturing processes of 9.1 SBR 9.2 Polybutadiene 9.3 Polychloroprene properties and uses	4

10.0	Varnish	10.1 Manufacturing processes, properties and uses of different Varnishes	2
11.0	Fibres	Manufacturing processes properties and uses of- 11.1 Polyester fibre 11.2 Polyamide fibre	4

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1,2	Introduction & type of petrochemicals	X	X	10	10
3	Posses of Manufacturing of petrochemicals	5	X	X	5
4,5	Synthetic Detergents & Insecticides	5	X	8	13
6,7	Manufacture of Petrochemicals & Monomers	5	3	4	12
8,9	Plastic, Resins & Rubbers	5	3	7	15
10,11	Varnish and Fibers	5	3	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 Resource :

10.1 Book list :

i) A text book on Petrochemicals by Dr. B.K. Bhaskar Rao.

10.2 List of Journals :

i) Journal in applied petrochemicals Research

ii) International Journals of Chemicals & Petrochemicals.

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 : PRINCIPLES OF UNIT OPERATION –III**
2. **Course code : Ch-504**
3. **Semester : 5th**
4. **Course Outcome:**

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

- Assimilate the fundamentals of evaporation and different evaporators used in chemical industries.
- Perceive the principle of crystallization and different crystallizer used in chemical industries.
- Explain filtration, its principle and application in chemical industries.
- Elaborate adsorption, its two types, its industrial application; different types of adsorbents.
- Comprehend the fundamentals of sedimentation and settling; their scope in industrial application.

CO s		ILO s
1	Assimilate the fundamentals of evaporation and different evaporators used in chemical industries.	1. Define evaporation 2. Explain Single & multiple-effect evaporators. 3. Describe construction (With diagrams) operation and application of different evaporators: ❖ Horizontal tube ❖ Vertical tube ❖ Film type ❖ Short tube & Long tube. 4. Explain different feeding techniques - their advantages Capacity and economy

		of evaporators.
2	Perceive the principle of crystallization and different crystallizer used in chemical industries.	1. State principles of crystallization 2. Outline the classification of crystallizers used in chemical industries 3. Explain construction and operation of: ❖ Batch Crystallization (Tank and agitated) ❖ Continuous crystallizer (Swanson Walker Crystallizer) ❖ Other types of crystallizer (Krystal Crystallizer and Vacuum crystallizer).
3	Explain filtration, its principle and application in chemical industries.	1. State filtration and its scope. 2. Narrate different filter medium and filtering aids 3. Solve problems on constant rate and constant pressure filtration 4. Explain operation and industrial application of different types of filters: ❖ Plate and frame filter press ❖ Rotary drum filter ❖ Rotary vacuum filter ❖ Moore filter

4	Elaborate adsorption, its two types, its industrial application; different types of adsorbents.	1. Define adsorption 2. State application of adsorption 3. Narrate types of adsorbents 4. Specify parameters affecting the adsorption rate. 5. Explain physical adsorption and chemisorptions 6. Narrate different adsorption materials and their industrial application
5	Comprehend the fundamentals of sedimentation and settling; their scope in industrial application.	1. State sedimentation and settling 2. Specify purpose 3. Narrate methods of operation 4. Describe different equipment for settling and sedimentation 5. Explain Gravity sedimentation and thickening equipment (Dorr thickener) and its application.

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	Evaporation	1.1 Introduction 1.2 Single & multiple -effect evaporators 1.3 Construction (With diagrams) operation and application different evaporators like Horizontal tube 1.4 Vertical tube 1.5 Film type 1.6 Short tube & Long tube 1.7 Different feeding techniques-their advantages Capacity and economy of evaporators	10
2.0	Crystallization	2.1 Principles of crystallization 2.2 Classification 2.3 Construction and operation of Batch Crystallization (Tank and agitated) 2.4 Continuous crystallizer (Swanson Walker Crystallizer) 2.5 Other types of crystallizer (Krystal Crystallizer and Vacuum crystallizer); their field of application	10

3.0	Filtration	3.1 Introduction 3.2 Definition and Scope 3.3 Different medium and filtering aids 3.4 Construction 3.5 Operation and industrial application of different types of filters like-Plate and frame filter press 3.6 Rotary drum filter 3.7 Rotary vacuum filter 3.8 Moore filter	10
4.0	Adsorption	4.1 Introduction 4.2 Application of adsorption 4.3 Types of adsorbents 4.4 Parameters affecting the adsorption rate 4.5 Physical adsorption and chemi-sorptions 4.6 Different adsorption materials and their industrial application	5
5.0	Sedimentation and Settling	5.1 Introduction 5.2 Purpose 5.3 Methods of operation 5.4 Different equipments for settling and sedimentation 5.5 Gravity sedimentation and thickening -equipment (Dorr thickener) and its application	5

8. Distribution of marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Evaporation	5	3	10	18
2	Crystallization	5	2	10	17
3	Filtration	7	2	9	18
4	Adsorption	5	X	7	12
5	Sedimentation and Settling	3	2	X	5
		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) Introduction to Chemical engineering by Walter.L.Badger and Julius Banchero, (Tata Mc Graw Him).

ii) Unit operation of Chemical engineering by warren L.McCabe C. Smith and Peter Harriot.

10.2 List of journals :

i) International Journal of heat & mass transfer

ii) Chemical news 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 : PRINCIPLES OF UNIT OPERATION III(LAB)**
2. **Course Code : Ch- 504 (p)** **Full Marks :50**
3. **Semester : 5th**
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	**Filtration**
1.1	Study of the construction and operation of filter press
2	**Crystallization ;**
2.1	Study of Swenson Walker Crystallizer
3	**Evaporation**
3.1	Study of the construction and operation of Single effect evaporator.
3.2	Study of the construction operation and an industrial application of multiple effect evaporator
4	**Adsorption**
4.1	Study the construction, operation and industrial use of water purification by adsorption.
4.2	Study the construction, operation and uses of gas mixture recovery unit by adsorption.
5	**Sedimentation**
5.1	Determination of sedimentation rate by setting method
5.2	To study construction of hydraulic classifier
5.3	Study about Dorr thickener.

1. **Course Title : CHEMICAL ENGINEERING DRAWING II (LAB)**
2. **Course Code : Ch- 505 (P)**
3. **Semester : 5th**

4. **Course Outcomes(COs)**

On completion of the course the students will be able to

- Draw free hand and scale diagrams of shell and tube heat exchanger (single, multipass).
- Draw free hand sketch of evaporators.
- Draw free hand sketch of filters.
- Draw free hand sketch of columns.
- Draw free hand sketch of dryers.
- Draw free hand sketch of controllers.

COs	ILOs
CO-1 Draw free hand and scale diagrams of shell and tube heat exchanger (single, multipass).	1. Explain shell and tube exchanger and its uses. 2. Draw free-hand diagram of shell and tube exchanger (single and multipass). 3. Draw scaled diagram of shell and tube exchanger (single and multipass).
CO-2 Draw free hand sketch of evaporators.	1. Explain different types of evaporators. 2. Draw free-hand sketch of tubular evaporators.
CO-3 Draw free hand sketch of filters.	1. Explain different types of filters. 2. Draw free hand-sketch of

	a. Plate and frame filter. b. Rotary filter. c. Drum filter.
CO-4 Draw free hand sketch of columns.	1. Explain distillation and absorption columns. 2. Draw free-hand sketch of a. Fractional distillation column b. Absorption column with details of packing c. Scaled drawing of a bubble cap column with details of bubble cap plate.
CO-5 Draw free hand sketch of dryers.	1. Explain different types of dryers. 2. Draw free hand sketch of a. Tray drier b. Drum drier c. Rotary drier
CO-6 Draw free hand sketch of controllers.	1. Explain different types of controllers. 2. Draw free hand sketch of a. Temperature controller. b. Pressure controller. c. Flow controller. d. Liquid level controller.

5. Teaching Scheme (in hours)

Lecture/ Practical		Total
Lecture/ Practical	**Tutorial**	
6 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)						
					100	50	50/150	150	3

7. Detailed Course Content

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	Shell & tube heat	1.1 Shell and tube heat exchanger single pass multipass (Scale drawing)	5
2.0	Evaporator	2.1 Evaporators-Free hand sketching of tubular evaporators	5
3.0	Filtration	3.1 Filtration-Free hand sketching of 3.1.1 Plate and frame filter press 3.1.2 Rotary filter 3.1.3 Drum filter	5
4.0	Distillation & absorption Column	4.1 Free hand sketch of a 4.1.1 Fractional distillation column 4.1.2 Absorption column with details of packing 4.1.3 Scaled drawing of a bubble cap Column with details of bubble cap plate	10
5.0	Dryers	5.1 Free hand sketch of a 5.1.1 Tray drier 5.1.2 Drum drier 5.1.3 Rotary drier	5
6.0	Control Equipments	6.1 Free hand sketch of different control equipment 6.1.1 Temperature controller 6.1.2 Pressure controller 6.1.3 Flow controller 6.1.4 Liquid level controller	10

8. Distribution of marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Shell & tube heat exchanger	6	3	6	15
2	Evaporator	3	3	6	12
3	Filtration	5	X	5	10
4	Distillation & absorption Column	6	X	6	12
5	Dryers	2	X	5	7
6	Control Equipments	3	3	8	14
		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) Introduction of Chemical Engineering By walter.L.Badger & Julius Banchero.
ii) Unit operation of Chemical Engineering By Warren L .McCabe. C Smith and Peter Harriot.
iii) Outlines of Chemical Instruments & Process Controler By Dr. A. Suryanarayan

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 : FERTILIZER TECHNOLOGY**
2. **Course Code : Ch-506**
3. **Semester : 5th**

4. **Course Outcome**:

- Briefly introduce about the role of fertilizer in modern day
- Describe the production of Ammonia
- Describe the production of Sulphuric Acid
- Describe the production of Nitrogen based fertilizers

COs		ILOs
1	Briefly introduce about the role of fertilizer in modern day	1. Describe the role of fertilizers in agriculture 2. Give a picture of the growth of fertilizer industry and present state of fertilizer industry in India 3. Describe different kinds of fertilizers
2	Describe the production of Ammonia	1. Describe the process of Removal of sulphur compounds and production of ammonia 2. Describe various methods for the production of hydrogen from different feed stocks
3	Describe the production of Sulphuric Acid	1. Describe briefly about the wet and dry processes of Sulphuric Acid production 2. Describe the major equipment used in the sulphuric acid plant and

		mention their material of construction
4	Describe the production of Nitrogen based fertilizers	1. Give a brief introduction about the production of Urea, Ammonium Sulphate, Ammonium Nitrate 2. Provide a detailed discussion with flow sheet of various industrial processes available for the production of the above

5. Teaching Scheme (in hours)

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

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	Introduction	1.1 Role of fertilizers in agriculture 1.2 Growth of fertilizer industry and present state of fertilizer industry in India 1.3 Different kinds of fertilizers	3
2.0	Production of Ammonia	2.1 Process 2.2 Removal of sulphur compounds	8

		2.3 Various methods for the production of hydrogen from different feed stocks 2.4 Removal of carbon di-oxide from various synthetic mixtures 2.5 Final purification of synthetic mixture gas by methanation nitrogen wash etc	
3.0	Production of Sulphuric Acid	3.1 Introduction 3.2 Processes (wet and dry) 3.3 Brief description of major equipment used in the sulphuric acid plant with their material of construction	5
4.0	Production of Urea	4.1 Introduction 4.2 Detailed discussion with flow sheet of various industrial processes available for the production of urea	5
5.0	Production of Ammonium Sulphate	5.1 Introduction 5.2 Detailed discussion with flow sheet of industrial process for the production of ammonium sulphate	7
6.0	Production of Nitric Acid	6.1 Introduction 6.2 Detailed discussion with flow sheet of various industrial processes available for the production of nitric acid	7
7.0	Production of Ammonium Nitrate	8.1 Introduction 8.2 Detailed discussion with process flow sheet of processes for the production of ammonium nitrate 8.3 Role of various activities used in ammonium nitrate production for stabilizing the product	5

8. Distribution Course Content

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	Introduction	4	X	X	4
2	Production of Ammonia	4	3	5	12
3	Production of Sulphuric Acid	3	X	8	11
4	Production of Urea	3	X	8	11
5	Production of Ammonium Sulphate	4	3	5	12
6	Production of Nitric Acid	3	3	5	11
7	Production of Ammonium Nitrate	4	X	5	9
		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. Gopala Rao & Marshall Sitting.

ii) Shreve's Chemical process industries By George T Austin

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 : PETROLEUM TECHNOLOGY**
2. **Course Code : Ch-507**
3. **Semester : 5th**
4. **Course Outcome (CO):**

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

- Draw a complete picture about the nature of petroleum, its chemical composition and properties;
- Develop an understanding on different rock properties;
- Have an understanding of the different exploration and extraction methods based on the location of the drilling site;
- Have a brief idea about the different methods selected for petroleum exploration and also an understanding of important working mechanisms of Drilling/ Well casing/ well completion.

COs	ILOs
CO 1: Draw a complete picture about the nature of petroleum, its chemical composition and properties.	1. Detailed explanation about the classification of petroleum and its chemical and physical properties.
CO 2: Develop an understanding on different rock properties.	1. Explain about the source of petroleum and its migration and accumulation. 2. State the properties of reservoir rocks and porosity. 3. Explain in details the permeability, fluid saturation, and the structural traps. 4. Discuss about the stratigraphic

	combination of various rocks.
CO 3: Have an understanding of the different exploration and extraction methods based on the location of the drilling site.	1. Explain in details about the geological and geophysical exploration methods, 2. State the magnetic, seismic and geochemical methods of prospecting. 3. In-depth explanation and discussion of cable-tool drilling, rotary drilling.
CO 4: Have a brief idea about the different methods selected for petroleum exploration and also an understanding of important working mechanisms of Drilling/ Well casing/ well completion.	1. State and explain the functioning of well logging, different kinds of logs involved and devices used. 2. Discuss the different types of well cementing techniques, casing types and specifications. 3. Explain open hole, perforated completions and permanent types. 4. State different reservoir driving mechanisms, capillary forces and combination drives. 5. Explain techniques of oil recovery, and the principles of polymer flooding.

5. Teaching Scheme (in hours)

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

Chapter No	Chapter Title	Content	Duration (in hours)
1.0	The nature of Petroleum	1.1 Chemical composition 1.2 Properties of liquid petroleum 1.3 Gaseous petroleum (natural gas)	3
2.0	Concepts of Petroleum geology and basic rock properties	2.1 Source of petroleum 2.2 Migration and accumulation oil 2.3 Reservoir rock properties 2.4 Porosity 2.5 Permeability and fluid saturation 2.6 Traps-structural 2.7 Stratigraphic 2.8 Combination	5
3.0	Petroleum exploration methods	3.1 Direct indication 3.2 Geological 3.3 Exploration 3.4 Methods 3.5 Geophysical exploration gravitational 3.6 Magnetic 3.7 Seismic and geochemical methods of prospecting	5
4.0	Drilling Methods	4.1 Cable tool drilling-introduction- i) Equipments and basic technique ii) Current application of cable tools 4.2 Rotary Drilling-introduction i) Composition ii) Function and general nature of rotary drilling fluid	7

5.0	Well Logging	5.1 Driller's log 5.2 Sample log mud log 5.3 Electric log 5.4 Radio log 5.5 Miscellaneous logging devices 5.6 Core analysis and drill stem testing	4
6.0	Oil well cementing and casing practices	6.1 Primary oil well cementing technique 6.2 Squeeze 6.3 Cement types 6.4 Casing types and specifications	6
7.0	The well completion	7.1 Open hole completions 7.2 Conventional perforated completions 7.3 Sand exclusion type 7.4 Permanent types	5
8.0	Reservoir Studies	8.1 Reservoir driving mechanisms 8.2 Depletion drive external gas 8.3 Water drive gravity segregation 8.4 Capillary forces and combination drives 8.5 Improving oil recovery by fluid injection-water flooding 8.6 Polymer flooding (principles only)	5

8. Distribution of Marks

Chapter No.	Chapter Title	Types of Question			Total Marks
		Objective Type (Compulsory)	Short Question	Descriptive Question	
1	The nature of Petroleum	4	3	X	7
2	Concepts of Petroleum geology and basic rock properties	3	3	8	14
3	Petroleum exploration methods	3	3	6	12
4	Drilling Methods	4	X	9	13

5	Well Logging	3	X	X	3
6	Oil well cementing and casing practices	3	X	6	9
7	The well completion	3	X	X	3
8	Reservoir Studies	2	X	7	9
		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) Modern petroleum technology by G.D. Hobson & W. pohl
ii) Petroleum Engineering By Cart Gatlin
iii) Oil well drilling technology by Mc Cray & Colc
iv) Modern Petroleum refineries By B.K.B. Rao.

10.2 List of journals:

i) Journal of petroleum Engineering & 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 : Professional Practice – III**
2. **Course Code : CH- 510**
3. **Semester – 5th**
4. **Course Outcome**:

- Study about the functioning of an industry as a team effort.
- Lecture from resource person on specific topic
- Search and report various topics assigned
- Embed presentation skills

COs		ILOs
1	Study about the functioning of an industry as a team effort.	1. Visit of an industry and grouping up in teams to study various aspects 2. Collective report submission of the same citing the observations
2	Lecture from resource person on specific topic	1. Meeting leading to resources persons citing various demands of human resource of an industry 2. Having a feedback of those industries which were visited earlier
3	Search and report various topics assigned	1. Information search through manufacturer's catalogue, websites, magazine, books, etc and thereafter submit a report
4	Embed presentation skills	1. Specified seminar topics with reports are to be submitted so as to improve the presentation skills

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: 12

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

- Sugar factory
- Paint industry
- Chemical industry
- Dairy Plant

7.2 GUEST LECTURE(S): 10

Lectures by Professional/ Industrial Experts to be organized from any two of the following areas:

- Interview Techniques
- Alternate fuels- CNG/LPG, Biodiesel, Ethanol, Hydrogen
- Piping Technology
- Modern Drilling Techniques.

7.3 INFORMATION SEARCH 10

Information search can be done through manufacturer's catalogue, websites, magazine, books, etc and submit a report on any one topic.

Following topics are suggested:

- Types of pumps- characteristics and application
- Heat Exchangers
- Gaseous Fuels- manufacturing, uses and advantages
- Modern Refractories
- Refrigeration process
- Temperature measuring tools used in industries
- List of Products obtain from crude oil and its applications
- Filters

7.4 SEMINAR **13**

Seminar topic should be related to the subjects of fifth semester. Each student should submit a report of at least 10 pages and deliver a seminar (Presentation time – 10 min)

Mini Project/ Activities: (any one)

- Prepare a model out of card board/ wood/ thermocol/ metal such as:
  i. Liquid level measurement
  ii. Rotary Drilling
  iii. Oil Migration
  iv. Rotary Drum Filter
- Soap Making
- Plastic molding