GOVERNMENT OF ASSAM

STATE COUNCIL FOR TECHNICAL EDUCATION, ASSAM

Director of Technical Education, Assam.

DRAFT SYLLABUS OF 4th SEMESTER

Chemical Engineering

Semester- IV

S.No.	Course Code	Course Title	L	T	P	Credit
1	CHPC- 401	Instrumentation	3	0	0	3
2	CHPC- 402	Industrial Chemical Processes-II	3	0	0	3
3	CHPC- 403	Principles of Unit Operation- II	2	1	0	3
4	CHPC-404	Instrumentation Lab	0	0	2	1
5	CHPC-405	Industrial Chemical Processes-II Lab	0	0	2	1
6	CHPC-406	Principles of Unit Operation-II Lab	0	0	2	1
7	CHPE- 407	Petroleum Technology	2	0	0	2
9	SI-01	Internship	0	0	4	2
10	CHOE- 401	Industrial Robotics (TATA)/Infosys	2	0	0	2
11	CHOE-402	Bioenergy and Waste Management	2	0	0	2
12	PR-01	Minor Project	0	0	2	2
Total Credit						**20**

NOTE: Choose any one Subject code CHOE-401 or CHOE-402

S.No.	Course Code	Course Title	Internal Assessment (Theory)		ESE		Internal Assessment (Practical)		Practical Test		Total marks (Course)	Pass marks (Course)
			Total marks	Pass marks	Total marks	Pass marks	Total marks	Pass marks	Total marks	Pass marks		
1	CHPC- 401	Instrumentation	40	16	60	24					100	40
2	CHPC- 402	Industrial Chemical Processes-II	40	16	60	24					100	40
3	CHPC- 403	Principles of Unit Operation- II	40	16	60	24					100	40
4	CHPC-404	Instrumentation Lab					60	24	40	16	100	40
5	CHPC-405	Industrial Chemical Processes-II Lab					60	24	40	16	100	40
6	CHPC-406	Principles of Unit Operation-II Lab					60	24	40	16	100	40
7	CHPE- 407	Petroleum Technology	40	16	60	24					100	40
9	SI-01	Internship					60	24	40	16	100	40
10	CHOE- 401	Industrial Robotics (TATA)/Infosys	40	16	60	24					100	40
11	CHOE-402	Bioenergy and Waste Management	40	16	60	24					100	40
12	PR-01	Minor Project									100	40
		Total									**1000**	

Syllabus for Diploma in Chemical Engineering (NEP)
Semester: 4th

Course title: Instrumentation
Course code: CHPC- 401

Course outcome:
CO1: Understand the basic principles of measurement, describe instrument elements and characteristics, and identify different types of measurement errors and instrument symbols.

CO2: Understand different types of sensors and transducers, and interpret the working principles of indicating and recording systems.

CO3: Compare various temperature-measuring instruments and analyses their operating principles, characteristics, and applications.

CO4: Understand pressure measurement techniques, and evaluate the performance and suitability of manometers and elastic pressure transducers.

CO5: Analyze between direct and indirect liquid-level measurement methods, and apply special measurement techniques such as gas chromatography, pH measurement, and flow meters.

Teaching scheme:

Lecture	Tutorial	Total
3 hours/ week	-	3 hours

Examination scheme:

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
60	40	100	24	16	3

Detailed course content:

Chapter no.	Chapter Title	Contents	Duration (in hours)
1	Basic principles of Measurement	1.1 Definition and aim of measurement. 1.2 Elements and Functions of an Instrument. 1.3 Performance Characteristics. a. Static Characteristics b. Dynamic Characteristics 1.4 Errors in measuring instrument.	5

2	Sensor, Transducers, Indicating and Recording mean	2.1 Sensor a. Introduction b. Classification of sensors. 2.2 Transducer a. Introduction b. Classification of Transducer. 2.3 Indicating Means: Definition and Types 2.4 Recording Means: Definition and Types	5
3	Temperature Measurement	3.1 Introduction 3.2 Temperature scales 3.3 Expansion Thermometers. a. Bimetallic Thermometer b. Mercury & Alcohol Thermometer. c. Pressure spring Thermometer. 3.4 Thermocouple a. Principles of Thermo-electricity. b. Laws of Thermo-electricity 3.5 Resistance Thermometer. 3.6 Thermistors 3.7 Pyrometer a. Radiation Pyrometer b. Optical Pyrometer	10
4	Pressure Measurement	4.1 Introduction 4.2 Types of Pressure 4.3 Manometer a. U-Tube Manometer b. Inclined Tube Manometer c. Errors in Manometer 4.4 Elastic Pressure Transducers a. Bourdon Tube b. Bellow c. Diaphragm 4.5 Vacuum Measurement a. McLeod Gauge b. Pirani Gauge	10
5	Liquid level measurement	5.1 Introduction 5.2 Direct Liquid level Measurement. a. Sight Glass b. Hook Type c. Float Type	10

		5.3 Indirect Liquid Level Measurement a. Hydrostatic Pressure • Pressure Gauge Method • Air Bellows • Air Purge System b. Electrical Method • Capacitance Level Indicator • Radiation Level Detector • Laser Level Sensor • Ultrasonic Level Detectors	
6	Special methods of Measurement	6.1 Gas Chromatography 6.2 pH Meter 6.3 Flow Meters a. Vortex Flow Meter b. Ultrasonic Type Flow Meter	5

Book list :

1. Industrial instrumentation & control By S.K. Singh.
2. Outlines of Chemical instrumentation & process control by Dr. A. Suryanarayan.

Subject: Instrumentation Lab
Subject Code: CHPC-404

Course Outcomes:
CO 1: Understand the working of different temperature measuring instruments.
CO 2: Measure pressure using pressure gauge.
CO 3: Determine gas composition using gas chromatography.

Teaching Scheme

Lecture	Practical	Total
-	2 hours/ week	2 hours

Examination Scheme

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
40	60	100	16	24	1

Detailed course content:

Sl. No.	**Name of the Experiment**
1.	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.	Study of the construction and operation of a pressure gauge (Bourdon tube).
3.	Measurement of gas composition by gas Chromatograph.

Subject: Industrial Chemical Processes-II
Subject Code: CHPC- 402

Course Outcomes:
CO 1: Understand the manufacturing of pulp & paper
CO 2: Compare the different types of fertilizer and their manufacturing process
CO 3: Describe manufacturing of lime and cement and analyze composition and properties of cement
CO 4: Discuss manufacturing of miscellaneous commodity such as sugar and leather.

Teaching Scheme

Lecture	Tutorial	Total
3 hours/ week	-	3 hour/week

Examination Scheme

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
60	40	100	24	16	3

Detailed course content:

Chapter No.	**Chapter Title**	**Content**	**Duration**
1.	Pulp & Paper	a. Introduction b. Raw materials used c. Types of paper & pulp manufacturing processes d. Different types of paper, their properties & applications	6
2.	Fertilizer	2.1 Introduction 2.2 Different types of fertilizer 2.3 Production of urea and its uses 2.4 Production of ammonium sulphate and ammonium nitrate 2.5 Manufacturing of different types of phosphatic fertilizers 2.6 Production of NPK fertilizer and its uses	9
3.	Lime & Cement	3.1 Raw materials used for manufacturing of lime 3.2 Types of lime 3.3 Manufacturing of different types of lime 3.4 Uses of lime 3.5 Manufacturing of Ordinary Portland Cement (Dry and Wet process)	12

		3.6 Functions and properties of different ingredients present in Portland Cement 3.7 Properties of Portland cement 3.8 Other varieties of cement: composition, properties and uses	
4.	Sugar	4.1 Introduction 4.2 Raw materials 4.3 Manufacturing of sugar 4.4 Refining and purification of sugar 4.5 By-products of sugar manufacturing	6
5.	Leather	5.1 Introduction 5.2 Raw materials 5.3 Different types of hides and their methods of softening 5.4 Tanning process- vegetable and chemical tanning 5.5 Types of leather 5.6 Drying and finishing of leather	6
6.	Glass	6.1 Manufacturing process of glass 6.2 Different methods of finishing glass goods 6.3 Different types of glass, their properties & applications	6

Text/ Reference Books:

1. Dryden's Outlines of Chemical Technology by M. Gopala Rao & Marshall Sittig
2. Shreve's Chemical Process Industries by George T. Austin, McGrow Hill Instruments Edition

Subject: Industrial Chemical Processes-II (Lab)
Subject Code: CHPC-405

Course Outcomes:
CO 1: Analyze the composition and properties of cement by testing methods.
CO 2: Examine the characteristics of paper.
CO 3: Analysis of sugar

Teaching Scheme

Lecture	Practical	Total
-	2 hours/ week	2 hours

Examination Scheme

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
40	60	100	16	24	1

Detailed course content:

Sl. No.	Name of the Experiment
1.	Experiments on cement a. Composition of cement b. Testing of cement c. Properties of cement
2.	Experiments on paper and pulping a. Determination of moisture content b. Preparation of recycled paper
3.	Experiments on sugar a. Testing for reducing sugars using Benedict's reagent b. Fermentation process of sugar

Course Title: Principles of Unit Operation – II
Course code : CHPC- 403

Course Outcomes:
CO1 : Remember the basics of mass transfer and laws associated with it.

CO2 : Understand different types of distillation and components associated with industrial distillation column.

CO3 : Distinguish and identify different absorption, extraction process, and equipments used in these processes with applications.

CO4 : Understand the objectives of drying and various drying equipment for industries.

Teaching scheme:

Lecture	**Tutorial**	**Total**
2 hours/week	1 hour/week	3 hours/week

Examination scheme :

ESE	**Internal**	**Total**	**Pass (ESE)**	**Pass (Internal)**	**Credit**
60	40	100	24	16	3

Detailed Course content :

Chapter No.	**Chapter Title**	**Contents**	**Duration (in hours)**
1.	Mass Transfer	1.1 Introduction to mass transfer 1.2 Diffusivity 1.2.1. Diffusivity in Gases 1.2.2. Diffusivity in Liquids 1.2.3. Diffusivity in Solids 1.3 Fick's Law 1.4 Mass Transfer Coefficient	6

2.	Distillation	2.1 Introduction to distillation 2.2 Relative volatility 2.3 Raoult's Law 2.4 Types of Distillation 2.5 Reflux ratio 2.6 Working of Distillation tower 2.7 Components of Distillation towers 2.7.1. Trays 2.7.2. Re-boiler 2.7.3.Condensor 2.8 Applications	10
3.	Absorption	3.1 Principle of Absorption 3.2 Selection of Solvent 3.3 Absorption equipments 3.4 Applications	6
4.	Extraction	4.1 Introduction to Extraction 4.2 Solid-liquid Extraction 4.3 Liquid- Liquid Extraction 4.4 Extraction Equipment 4.5 Applications	10
5.	Drying	5.1 Introduction 5.2 Moisture Content 5.2.1. Free Moisture Content 5.2.2 Unbound Moisture Content 5.2.3 Bound Moisture Content 5.2.4 Equilibrium Moisture Content 5.2.5 Critical Moisture Content 5.3 Rate of Drying 5.4 Drying Equipments 5.5 Applications	8

Textbooks/ Reference Books:

1.Treybal, R.E.," Mass Transfer operation", McGraw Hill International Edition, 3rd Ed,1981.

2.McCabe, W.L., Smith, J, and Harriot, P.," Unit operation of Chemical Engineering", McGraw Hill International Edition, 6th Ed,2001.

3.Geankoplis, C.J., "Transport Process and Unit Operations", Prentice Hall 3rd Ed, India,1993

4.Dutta, B.K., "Principles of Mass Transfer and Separation Processes", Prentice Hall, India,2007.

5.Seader, J.D., Henley, J. E., Separation Process Principles" 2nd Ed, Wiley India edition,2010

Course Title: Principles of Unit Operation – II Laboratory
Course code : CHPC-406

Course Outcomes:

CO1 : Understand the separation process by distillation and absorption unit

CO2 : Evaluation of rate of drying and drying curve

Teaching Scheme:

Lecture	Practical	Total
-	2 hours/ week	2 hours

Examination Scheme:

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
40	60	100	16	24	1

List of experiment:

Sl. No.	**Name of the Experiment**
1.	Steam Distillation • To find out the vapour efficiency of carrier steam and steam required
2.	Differential distillation • To verify Rayleigh equation by carrying out a differential distillation
3.	Drying • To determine moisture content and rate of drying using tray dryer
4.	Study the construction and operation of bubble cap distillation column
5.	Study the construction and operation of absorption column and packing.

Course title: Petroleum Technology (Program Elective)
Course code: CHPE- 407

Course outcome:

1. **CO1:** Understand the fundamentals of the petroleum industry, including its history, significance, and key processes.
2. **CO2:** Understand the origin, accumulation, and trapping of petroleum, key reservoir rock properties, and the fundamental principles and significance of exploration methods for efficient hydrocarbon exploration.
3. **CO3:** Compare the working mechanisms of cable tool drilling and rotary drilling techniques used in oil well drilling.
4. **CO4**: Demonstrate a comprehensive understanding of oil well logging**,** including cementing, casing, and well completion techniques.
5. **CO5:** Apply appropriate recovery strategies based on reservoir characteristics to optimize oil extraction.

Teaching scheme:

Lecture	Tutorial	Total
2 hours/ week	-	2 hours

Examination scheme:

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
60	40	100	24	16	2

Detailed course content:

Chapter no.	Chapter Title	Contents	Duration (in hours)
1	Introduction to Petroleum Technology and its industry.	1.1 Introduction to petroleum industry & production process 1.2 Overview of petroleum industry 1.3 Origin of Crude Oil. 1.4 Properties of Liquid Petroleum 1.5 Gaseous Petroleum (natural gas)	3
2	Concepts of Petroleum geology and basic rock reservoir	2.1 Source of petroleum a. Sedimentary b. unconventional 2.2 Migration and accumulation of oil in sedimentary rocks 2.3 Reservoir rock properties: (Porosity, Permeability, wettability and fluid saturation) 2.4 Traps of oil and gas	8

3	Petroleum exploration methods	3.1 Surface Exploration methods and its various types: A. Geological Exploration B. Geochemical Exploration 3.2 Sub Surface Exploration methods:(Geophysical Exploration) a. Gravity Method b. Magnetic Method c. Electrical Method d. Seismic Method	5
4	Drilling Methods	4.1 Cable tool drilling a. Rig Components b. Principle of operation 4.2 Rotary Drilling a. Rig Components b. Drilling Fluids (Mud) and Their Properties c. Circulation System d. Hoisting System e. Rotary System f. Blowout Preventer (BOP) and Well Control 4.3 Directional Drilling 4.3 Offshore Drilling 4.4 Types of Rigs: a. Onshore Rigs b. Offshore Rigs	12
5	Well Logging	5.1 Objectives of Well logging 5.2 Types of well logging a. Driller's Log b. Sample Log c. Caliper Log d. Temperature Log e. Mud Log f. Acoustic Log	2
6	Oil well casing, cementing, well completion, and production operations.	6.1 Functions of Casing 6.2 Casing types and Casing Installation Process 6.3 Objectives of Cementing 6.4 Types of Cementing a. Primary b. Remedial cementing (Squeeze Cementing and plug Cementing)	10

		6.5 Objectives of Well Completion 6.6 Types of Well Completion a. Open Hole Completion b. Closed Hole Completion c. Liner Completion	
7	Recovery methods of petroleum	7.1 Primary recovery methods a. Solution gas drive b. Gas cap drive: c. Water drive d. Gravity drainage 7.2 Secondary recovery methods a. Water flooding b. Pressure Maintenance 7.3 Tertiary recovery methods a. Enhanced Oil Recovery (Thermal, Gas & Chemical flooding)	5

Book list :

1. Modern petroleum technology by G.D. Hobson & W. pohl
2. Petroleum Engineering By Cart Gatlin
3. Oil well drilling technology by Mc Cray & Colc
4. Oil well drilling engineering Book by H. Rabia.
5. Petroleum Technology: Enhanced Oil Recovery Techniques by Subrata Borgohain Gogoi

Course Title: Industrial Robotics by TATA (Open Elective)
Course code: CHOE-401

(Syllabus to be given by TATA)

Course Title: Sustainable production of Bioenergy (Open Elective)
Course code: CHOE-402

Course outcomes:

1. **CO1:** Explain sustainability and its need for the global energy scenario.
2. **CO2:** Identify biomass resources suitable for sustainable bio-energy production.
3. **CO3:** Apply green thermochemical and biochemical conversion techniques for bioenergy Production.

Teaching scheme:

Lecture	Tutorial	Total
2 hours/ week	-	2 hours

Examination scheme:

ESE	Internal	Total	Pass (ESE)	Pass (Internal)	Credit
60	40	100	24	16	2

Detailed course content:

Chapter no.	Chapter Title	Contents	Duration (in hours)
1	Introduction to Sustainability & Global Energy Scenario	1.1 Concept of sustainability in the energy sector. 1.2 Sustainable Development Goals (SDGs) relevant to energy. 1.3 Advantages of sustainable renewable energy over fossil fuels. 1.4 Energy demand, climate change, and energy justice.	5
2	Biomass Resources and Characterization	2.1 Lignocellulosic Biomass: Composition & Properties. 2.2 Algae and Microbial Biomass. 2.3 Sustainable biomass sourcing. 2.4 Biomass pre-treatment with minimum environmental impact 2.5 Physicochemical characterization.	6
3	Thermochemical Conversion Technologies with	3.1 Combustion and Co-firing 3.2 Pyrolysis and Biochar Production 3.3 Gasification: Syngas Production	8

	Sustainability Metrics	3.4 Hydrothermal Liquefaction (HTL) for Bio-Oil and Chemicals 3.5 Advantages of clean & low-emission processes	
4	Green Biochemical Conversion Technologies	4.1 Anaerobic Digestion 4.2 Fermentation: Ethanol, Butanol, and Acetone Production 4.3 Microbial Fuel Cells (MFCs) and Bio hydrogen Production 4.4 Enzymatic Hydrolysis	6
5	Cleaner production in bio-energy plants	5.1 Heat Recovery 5.2 Energy Integration 5.3 Water Recycling 5.4 Catalyst Reuse 5.5 Case studies: Sustainable biogas plants and others.	5

Textbooks and References

1. "Bioenergy: Biomass to Biofuels" by Anju Dahiya
2. “Introduction to Biomass Energy Conversions" by Sergio Capareda.
3. "Thermochemical Processing of Biomass: Conversion into Fuels, Chemicals, and Power" by Robert C. Brown.
4. "Sustainable Solid Waste Management" by Ni-Bin Chang, Ana Pires.
5. Relevant journal article and government reports.