



**DIPLOMA IN ENGINEERING AND
TECHNOLOGY**

1076

**DEPARTMENT OF CHEMICAL ENGINEERING
(FULL TIME)**

SEMESTER PATTERN

N – SCHEME

IMPLEMENTED FROM 2020 - 2021

CURRICULUM DEVELOPMENT CENTRE

**DIRECTORATE OF TECHNICAL EDUCATION
CHENNAI-600 025, TAMIL NADU**

DIPLOMA IN CHEMICAL ENGINEERING (FULL TIME)

N-SCHEME

(Implemented from academic year 2020-21 onwards)

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CHENNAI-600025.

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CHENNAI-600113.

Members

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Lecturer / Chemical Engineering
Institute of Chemical Technology
Tharamani, Chennai-600113.

Selvi.G.REKHA

Lecturer / Chemical Engineering
Institute of Chemical Technology
Tharamani, Chennai-600113.

Dr.V.JAYAKUMAR

HOD / Chemical Engineering
Mothilal Nehru Government
Polytechnic College
Lawspet, Puducherry-605008.

Thiru. RAMESH

Principal
Annai JKK Sampooraniammal
Polytechnic College
Erode-638506.

Tmt. SHYAMALA

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CPCL Polytechnic College
Manali , Chennai-600068.

Dr. R.RAVI

Professor / Chemical Engineering
Annamalai University
Annamalainagar-608002.

Thiru. D. MANOVA JEEVADOS

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Chennai Petroleum Corporation Ltd
Manali, Chennai-600068.

Thiru. KINGSLEY STANLY

Manager
Chennai Petroleum Corporation Ltd
Manali, Chennai-600068.

**DIPLOMA COURSES IN ENGINEERING/TECHNOLOGY
(SEMESTER SYSTEM)**

(Implemented from 2020 - 2021)

N – SCHEME

REGULATIONS*

**Applicable to the Diploma Courses other than Diploma in Hotel Management & Catering Technology.*

1. Description of the Course:

a. Full Time (3 years)

The Course for the Full Time Diploma in Engineering shall extend over a period of three academic years, consisting of 6 semesters* and the First Year is common to all Engineering Branches.

b. Sandwich (3½ years)

The Course for the Sandwich Diploma in Engineering shall extend over a period of three and half academic years, consisting of 7 semesters* and the First Year is common to all Engineering Branches. The subjects of three years full time diploma course being regrouped for academic convenience.

During 4th and/or during 7th semester the students undergo industrial training for six months / one year. Industrial training examination will be conducted after completion of every 6 months of industrial training.

c. Part Time (4 years)

The course for the Part Time Diploma in Engineering shall extend over a period of 4 academic years containing of 8 semesters*, the subjects of 3 year full time diploma courses being regrouped for academic convenience.

*** Each Semester will have 16 weeks duration of study with 35 hrs. / Week for Regular Diploma Courses and 18 hrs. / Week for Part-Time Diploma Courses.**

The Curriculum for all the 6 Semesters of Diploma courses (Engineering & Special Diploma Courses viz. Textile Technology, Leather Technology, Printing Technology, Chemical Technology etc.) have been revised and revised curriculum is applicable for the candidates admitted from 2020 – 2021 academic year onwards.

2. Condition for Admission:

Condition for admission to the Diploma courses shall be required to have passed in The S.S.L.C Examination of the Board of Secondary Education, Tamil Nadu.

(Or)

The Anglo Indian High School Examination with eligibility for Higher Secondary Course in Tamil Nadu.

(Or)

The Matriculation Examination of Tamil Nadu.

(Or)

Any other Examinations recognized as equivalent to the above by the Board of Secondary Education, Tamil Nadu.

Note: In addition, at the time of admission the candidate will have to satisfy certain minimum requirements, which may be prescribed from time to time.

3. Admission to Second year (Lateral Entry):

A pass in HSC (academic) or (vocational) courses mentioned in the Higher Secondary Schools in Tamil Nadu affiliated to the Tamil Nadu Higher Secondary Board with eligibility for University Courses of study or equivalent examination & Should have studied the following subjects.

A pass in 2 Years ITI with appropriate Trade or Equivalent examination.

Sl. No	Courses	H.Sc Academic	H.Sc Vocational		Industrial Training Institutes Courses
		Subjects Studied	Subjects Studied		
			Related subjects	Vocational subjects	
1.	All the Regular and Sandwich Diploma Courses	Physics and Chemistry as compulsory along with Mathematics / Biology	Maths / Physics / Chemistry	Related Vocational Subjects Theory & Practical	2 years course to be passed with appropriate Trade

2.	Diploma Course in Commercial Practice	English & Accountancy English & Elements of Economics English & Elements of Commerce	English & Accountancy, English & Elements of Economics, English & Management Principles & Techniques, English & Typewriting	Accountancy & Auditing, Banking, Business Management, Co-operative Management, International Trade, Marketing & Salesmanship, Insurance & Material Management, Office Secretaryship.	-
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- For the Diploma Courses related with Engineering/Technology, the related / equivalent subjects prescribed along with Practicals may also be taken for arriving the eligibility.
- Branch will be allotted according to merit through counseling by the respective Principal as per communal reservation.
- For admission to the Textile Technology, Leather Technology, Printing Technology, Chemical Technology and Commercial Practice Diploma courses the candidates studied the related subjects will be given first preference.
- *Candidates who have studied Commerce Subjects are not eligible for Engineering Diploma Courses.*

4. Age Limit: No Age limit.

5. Medium of Instruction: English

6. Eligibility for the Award of Diploma:

No candidate shall be eligible for the Diploma unless he/she has undergone the prescribed course of study for a period of not less than 3 academic years in any

institution affiliated to the State Board of Technical Education and Training, Tamil Nadu, when joined in First Year and two years if joined under Lateral Entry scheme in the second year and passed the prescribed examination.

The minimum and maximum period for completion of Diploma Courses are as given below:

Diploma Course	Minimum Period	Maximum Period
Full Time	3 Years	6 Years
Full Time (Lateral Entry)	2 Years	5 Years
Sandwich	3½ Years	6½ Years
Part Time	4 Years	7 Years

This will come into effect from N Scheme onwards i.e. from the academic year 2020-2021.

7. Subjects of Study and Curriculum outline:

The subjects of study shall be in accordance with the syllabus prescribed from time to time, both in theory and practical subjects.

The curriculum outline is given in Annexure – I.

8. Examinations:

Board Examinations in all subjects of all the semesters under the scheme of examinations will be conducted at the end of each semester.

The internal assessment marks for all the subjects will be awarded on the basis of continuous internal assessment earned during the semester concerned. For each subject 25 marks are allotted for internal assessment. Board Examinations are conducted for 100 marks and reduced to 75.

The total marks for result are $75 + 25 = 100$ Marks.

9. Continuous Internal Assessment:

A. For Theory Subjects:

The Internal Assessment marks for a total of 25 marks, which are to be distributed as follows:

i) Subject Attendance

5 Marks

(Award of marks for subject attendance to each subject Theory/Practical will be as per the range given below)

80%	-	83%	1 Mark
84%	-	87%	2 Marks
88%	-	91%	3 Marks
92%	-	95%	4 Marks
96%	-	100%	5 Marks

ii) Test

10 Marks

2 Tests each of 2 hours duration for a total of 50 marks are to be conducted. Average of the these two test marks will be taken and the marks to be reduced to:

05 Marks

The Test – III is to be the Model Examination covering all the five units and the marks obtained will be reduced to :

05 Marks

TEST	UNITS	WHEN TO CONDUCT	MARKS	DURATION
Test I	Unit – I & II	End of 6 th week	50	2 Hrs
Test II	Unit – III & IV	End of 12 th week	50	2 Hrs
Test III	Model Examination: Covering all the 5 Units. (Board Examinations-question paper-pattern).	End of 16 th week	100	3 Hrs

From the Academic Year 2020 – 2021 onwards.

Question Paper Pattern for the Test - I and Test – II is as follows. The tests should be conducted by proper schedule. Retest marks should not be considered for internal assessment.

Without Choice:

Part A Type questions:	6 Questions × 1 mark	06 marks
Part B Type questions:	7 Questions × 2 marks	14 marks
Part C Type questions:	2 Questions × 15 marks	30 marks
	Total	50 marks

iii) Assignment**5 Marks**

For each subject Three Assignments are to be given each for 20 marks and the average marks scored should be reduced for 5 marks.

iv) Seminar Presentation**5 Marks**

The students have to select the topics either from their subjects or general subjects which will help to improve their grasping capacity as well as their capacity to express the subject in hand. The students will be allowed to prepare the material for the given topic using the library hour and they will be permitted to present seminar (For First and Second Year, the students will be permitted to present the seminar as a group not exceeding six members and each member of the group should participate in the presentation. For the Third Year, the students should present the seminar individually.) The seminar presentation is mandatory for all theory subjects and carries 5 marks for each theory subject. The respective subject faculty may suggest topics to the students and will evaluate the submitted materials and seminar presentation. (2 ½ marks for the material submitted in writing and 2 ½ marks for the seminar presentation). For each subject minimum of two seminars are to be given and the average marks scored should be reduced to 5 marks.

All Test Papers, Assignment Papers / Notebooks and the seminar presentation written material after getting the signature with date from the students must be kept in safe custody in the department for verification and audit. It should be preserved for one semester after publication of Board Exam results and produced to the flying squad and the inspection team at the time of inspection/verification.

B. For Practical Subjects:

The Internal Assessment mark for a total of 25 marks which are to be distributed as follows:-

a) Attendance	: 5 Marks
(Award of marks same as theory subjects)	
b) Procedure/ observation and tabulation/ Other Practical related Work	: 10 Marks
c) Record writing	: 10 Marks
TOTAL	: 25 Marks

- *All the Experiments/Exercises indicated in the syllabus should be completed and the same to be given for final Board examinations.*
- The observation note book / manual should be maintained for 10 marks. The observation note book / manual with sketches, circuits, programme, reading and calculation written by the students manually depends upon the practical subject during practical classes should be evaluated properly during the practical class hours with date.
- The Record work for every completed exercise should be submitted in the subsequent practical classes and marks should be awarded for 10 marks for each exercise as per the above allocation.
- At the end of the Semester, the average marks of all the exercises should be calculated for 20 marks (including Observation and Record writing) and the marks awarded for attendance is to be added to arrive at the internal assessment mark for Practical. (20+5=25 marks)
- Only regular students, appearing first time have to submit the duly signed bonafide record note book/file during the Practical Board Examinations.

All the marks awarded for Assignments, Tests, Seminar presentation and Attendance should be entered periodically in the Personal Theory Log Book of the staff, who is handling the theory subject.

The marks awarded for Observation, Record work and Attendance should be entered periodically in the Personal Practical Log Book of the staff, who is handling the practical subject.

10. Communication Skill Practical, Computer Application Practical and Physical

Education:

The Communication Skill Practical and Computer Application Practical with more emphasis are being introduced in First Year. Much Stress is given to increase the Communication skill and ICT skill of students.

As per the recommendation of MHRD and under Fit India scheme, the Physical education is introduced to encourage students to remain healthy and fit by including physical activities and sports.

11. Project Work and Internship:

The students of all the Diploma Courses have to do a Project Work as part of the Curriculum and in partial fulfillment for the award of Diploma by the State Board of Technical Education and Training, Tamil Nadu. In order to encourage students to do worthwhile and innovative projects, every year prizes are awarded for the best three projects i.e. institution wise, region wise and state wise. **The Project work must be reviewed twice in the same semester. The project work is approved during the V semester by the properly constituted committee with guidelines.**

a) Internal assessment mark for Project Work & Internship:

Project Review I	...	10 marks
Project Review II	...	10 marks
Attendance	...	05 marks (Award of marks same as theory subject pattern)
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Total	...	25 marks
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Proper record should be maintained for the two Project Reviews and preserved for one semester after the publication of Board Exams results. It should be produced to the flying squad and the inspection team at the time of inspection/verification.

b) Allocation of Marks for Project Work & Internship in Board Examinations:

Demonstration/Presentation	25 marks
Report	25 marks
Viva Voce	30 marks
Internship Report	20 marks
Total	100* marks

*Examination will be conducted for 100 marks and will be converted to 75 marks.

c) Internship Report:

The internship training for a period of two weeks shall be undergone by every candidate at the end of IV / V semester during vacation. The certificate shall be produced along with the internship report for evaluation. The evaluation of internship training shall be done along with final year "Project Work & Internship" for 20 marks. The internship shall be undertaken in any industry / Government or Private certified agencies which are in social sector / Govt. Skill Centres / Institutions / Schemes.

A neatly prepared PROJECT REPORT as per the format has to be submitted by individual student during the Project Work & Internship Board examination.

12. Scheme of Examinations:

The Scheme of examinations for subjects is given in Annexure - II.

13. Criteria for Pass:

1. No candidate shall be eligible for the award of Diploma unless he/she has undergone the prescribed course of study successfully in an institution approved by AICTE and affiliated to the State Board of Technical Education & Training, Tamil Nadu and pass all the subjects prescribed in the curriculum.

2. A candidate shall be declared to have passed the examination in a subject if he/she secures not less than *40% in theory subjects* and *50% in practical subjects* out of the total prescribed maximum marks including both the Internal Assessment and the Board Examinations marks put together, subject to the condition that he/she secures at least a minimum of *40 marks out of 100 marks in the Board Theory Examinations* and a minimum of *50 marks out of 100 marks in the Board Practical Examinations*.

14. **Classification of successful candidates:**

Classification of candidates who will pass out the final examinations from April 2023 onwards (Joined first year in 2020 -2021) will be done as specified below.

First Class with Superlative Distinction:

A candidate will be declared to have passed in **First Class with Superlative Distinction** if he/she secures not less than 75% of the marks in all the subjects and passes all the semesters in the first appearance itself and passes all subjects within the stipulated period of study 2 / 3 / 3½ / 4 years [Full time(lateral entry)/Full Time/Sandwich/Part Time] without any break in study.

First Class with Distinction:

A candidate will be declared to have passed in **First Class with Distinction** if he/she secures not less than 75% of the aggregate marks in all the semesters put together and passes all the semesters except the I and II semester in the first appearance itself and passes all subjects within the stipulated period of study 2 / 3 / 3½ / 4 years [Full time(lateral entry)/Full Time/Sandwich/Part Time] without any break in study.

First Class:

A candidate will be declared to have passed in **First Class** if he/she secures not less than 60% of the aggregate marks in all the semesters put together and passes all the subjects within the stipulated period of study 2 / 3 / 3½ / 4 years [Full time(lateral entry)/Full Time/Sandwich/Part Time] without any break in study.

Second Class:

All other successful candidates will be declared to have passed in **Second Class.**

The above classifications are also applicable for the Sandwich / Part-Time students who pass out Final Examination from October 2023 /April 2024 onwards (both joined First Year in 2020 -2021)

15. Duration of a period in the Class Time Table:

The duration of each period of instruction is 1 hour and the total period of instruction hours excluding interval and lunch break in a day should be uniformly maintained as 7 hours corresponding to 7 periods of instruction (Theory & Practical).

ANNEXURE I

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU

BRANCH CODE: 1076

DIPLOMA IN CHEMICAL ENGINEERING (FULL TIME) SYLLABUS

N-SCHEME

(To be implemented for the students admitted from the year 2020-21 onwards)

CURRICULUM OUTLINE

THIRD SEMESTER

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory Hours	Tutorial / Drawing	Practical hours	Total Hours
4076310	Basic Chemical Engineering	5	-	-	5
4076320	General Engineering	5	-	-	5
4076330	Momentum Transfer	5	-	-	5
4076340	Industrial Chemistry	5	-	-	5
4076350	Technical Analysis practical	-	-	4	4
4076360	General engineering practical	-	-	4	4
4076370	Momentum Transfer Practical	-	-	4	4
Extra-curricular activities	Physical Education	-	-	2	2
	Library	1	-	-	1
TOTAL		21	-	14	35

FOURTH SEMESTER

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory Hours	Tutorial / Drawing	Practical hours	Total Hours
4076410	Mechanical Operations	5	-	-	5
4076420	Heat Transfer	5	-	-	5
4076430	Chemical Process Calculations	5	-	-	5
4076440	Chemical Engineering Thermodynamics & Reaction Engineering	5	-	-	5
4076450	Mechanical Operations Practical	-	-	4	4
4076460	Heat Transfer Practical	-	-	4	4
4076470	Chemical Technology Practical	-	-	4	4
Extra-curricular activities	Physical Education	-	-	2	2
	Library	1	-	-	1
TOTAL		21	-	14	35

FIFTH SEMESTER

Subject Code	SUBJECT	HOURS PER WEEK			
		Theory Hours	Tutorial / Drawing	Practical hours	Total Hours
4076510	Mass Transfer - I	6	-	-	6
4076520	Process Instrumentation & Control	5	-	-	5
4076531	Elective Theory - I	5	-	-	5
	1. Chemical Technology.				
	2. Electrochemical Engineering.				
4076532	3. Natural Gas Engineering				
4076540	Entrepreneurship and Startups	-	-	4	4
4076550	Chemical Process Simulation Practical	-	-	4	4
4076560	Process Instrumentation & Control Practical	-	-	4	4
4076570	Petroleum Testing Practical	-	-	4	4
Extra-curricular activities	Physical Education	-	-	2	2
	Library	1	-	-	1
Total		17	-	18	35

SIXTH SEMESTER

Subject Code	Subject	Hours Per Week			
		Theory Hours	Tutorial / Drawing	Practical Hours	Total Hours
4076610	Mass Transfer - II	6	-	-	6
4076620	Industrial Safety and Pollution Control	5	-	-	5
4076631	Elective Theory- II 1. Petroleum and Energy Engineering	5	-	-	5
4076632	2. Renewable Energy Technology				
4076633	3. Environmental Engineering and solid waste management				
4076640	Mass Transfer Practical	-	-	4	4
4076650	Chemical CAD Practical	-	-	6	6
4076660	Project Work	-	-	6	6
Extra-curricular activities	Physical Education	-	-	2	2
	Library	1	-	-	1
Total		17		18	35

ANNEXURE II**STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU****BRANCH CODE: 2079****DIPLOMA IN CHEMICAL ENGINEERING (SANDWICH) SYLLABUS****N-SCHEME****(To be implemented for the students admitted from the year 2020-21 onwards)****SCHEME OF EXAMINATION****THIRD SEMESTER**

Subject Code	SUBJECT	Examination Marks			Minimum for pass	Duration of Exam Hours
		Internal assessment Marks	Board Exam Marks*	Total Mark		
4076310	Basic Chemical Engineering	25	100	100	40	3
4076320	General Engineering	25	100	100	40	3
4076330	Momentum Transfer	25	100	100	40	3
4076340	Industrial Chemistry	25	100	100	40	3
4076350	Technical Analysis practical	25	100	100	50	3
4076360	General engineering practical	25	100	100	50	3
4076370	Momentum Transfer Practical	25	100	100	50	3
TOTAL		175	700	700		

FOURTH SEMESTER

Subject Code	SUBJECT	Examination Marks			Minimum for pass	Duration of Exam Hours
		Internal assessment Marks	Board Exam Marks*	Total Mark		
4076410	Mechanical Operations	25	100	100	40	3
4076420	Heat Transfer	25	100	100	40	3
4076430	Chemical Process Calculations	25	100	100	40	3
4076440	Chemical Engineering Thermodynamics & Reaction Engineering	25	100	100	40	3
4076450	Mechanical Operations Practical	25	100	100	50	3
4076460	Heat Transfer Practical	25	100	100	50	3
4076470	Chemical Technology Practical	25	100	100	50	3
TOTAL		175	700	700		

*Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

FIFTH SEMESTER

Subject Code	SUBJECT	Examination Marks			Minimum for pass	Duration of Exam Hours
		Internal Assessment Marks	Board Exam. Marks*	Total Mark		
4076510	Mass Transfer-I	25	100	100	40	3
4076520	Process Instrumentation & Control	25	100	100	40	3
4076531	Elective-1 1. Chemical Technology	25	100	100	40	3
4076532	2. Electrochemical Engineering					
4076533	3. Natural Gas Engineering					
4076540	Entrepreneurship And Startups	25	100	100	50	3
4076550	Chemical Process Simulation Practical	25	100	100	50	3
4076560	Process Instrumentation & Control Practical	25	100	100	50	3
4076570	Petroleum Testing Practical	25	100	100	50	3
TOTAL		175	700	700		

*Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

SIXTH SEMESTER

Subject Code	SUBJECT	Examination Marks			Minimum for pass	Duration of Exam Hours
		Internal assessment Marks	Board Exam Marks *	Total Mark		
4076610	Mass Transfer-II	25	100	100	40	3
4076620	Industrial Safety and Pollution Control	25	100	100	40	3
4076631	Elective II 1. Petroleum and Energy Engineering	25	100	100	40	3
4076632	2. Renewable Energy Technology					
4076633	3. Environmental Engineering and solid waste management					
4076640	Mass Transfer Practical	25	100	100	50	3
4076650	Chemical CAD Practical	25	100	100	50	3
4076660	Project Work	25	100	100	50	3
TOTAL		150	600	600		

*Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

List of Equivalent Subjects for M - Scheme to N – Scheme

Semester	Subject Code	M- Scheme(Implementing academic year 2015 – 2016)	Subject Code	N- Scheme(Implementing academic year 2020– 2021)
III semester				
III	37031	Industrial Chemistry	4076310	Industrial Chemistry
III	37032	Mechanical Engineering	-	No Equivalent
III	37033	Electrical and Electronics Engineering	-	No Equivalent
III	37034	Mechanical Engineering Practical	-	No Equivalent
III	37035	Electrical and Electronics Engineering Practical	-	No Equivalent
III	37036	Workshop Practice - II	-	No Equivalent
III	30001	Computer application practical	-	No Equivalent
IV semester				
IV	37041	Mechanical operations	4076410	Mechanical operations
IV	37042	Momentum transfer	4076330	Momentum transfer
IV	37043	Inorganic Chemical Technology	4076531	Chemical Technology
IV	37044	Engineering Drawing	-	No Equivalent
IV	37045	Mechanical Operations Practical	4076450	Mechanical Operations Practical
IV	37046	Momentum transfer Practical	4076370	Momentum transfer Practical
IV	37047	Technical Analysis Practical	4076350	Technical Analysis Practical
V semester				
V	37051	Heat Transfer	4076420	Heat Transfer
V	37052	Chemical process calculations	4076430	Chemical process calculations
V	37053	Process Instrumentation and Control	4076520	Process Instrumentation and Control
V	37071	<u>Elective - I</u> 1. Organic Chemical Technology	-	<u>Elective - I</u> No Equivalent
	37072	2.Industrial Safety and Pollution Control	4076620	2.Industrial Safety and Pollution Control
V	37055	Process Instrumentation and Control Practical	4076560	Process Instrumentation and Control Practical
V	37056	Heat Transfer Practical	4076460	Heat Transfer Practical
V	30002	Life and employability Skill	-	No Equivalent
VI semester				
VI	37061	Mass Transfer-I	4076510	Mass Transfer-I
VI	37062	Mass Transfer-II	4076610	Mass Transfer-II
VI	37081	<u>Elective - II</u> 1. Specific process Technologies	-	<u>Elective - II</u> 1. No Equivalent
	37082	2.Process Plant Operations	-	2.No Equivalent
VI	37064	Mass Transfer Practical	4076640	Mass Transfer Practical
VI	37065	Petroleum Testing Practical	4076570	Petroleum Testing Practical
VI	37066	Chemical CAD and ProcessSimulation Practical	4076650	Chemical CAD Practical
VI	37067	Project Work	4076660	Project Work

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076310

Semester : III Semester

Subject Title : BASIC CHEMICAL ENGINEERING

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
BASIC CHEMICAL ENGINEERING	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Role of Chemical Engineers	14
II	Chemical Process	14
III	Tanks and Vessels	15
IV	Documentation, SOP and GMP	15
V	Quality Control	15
Test & Model Exam		7
Total		80

RATIONALE:

The subject allows the students to gain knowledge in understanding the types and nature of industries, gain basic knowledge of Unit operations and unit process in chemical plants, and know his role and responsibilities as a process Technician in chemical Industry.

OBJECTIVES:

On completion of this subject, the students can able to understand the following concepts:

1. Able to understand the importance of chemical industry and his role and responsibility as a process technician
2. Various job opportunities and achievements in chemical engineering.
3. Understand the chemical process and various types of chemical process.
4. Understand the various types of unit operations and unit process.
5. Understand the fundamental concepts in chemical engineering
6. Understand the basic laws in chemical engineering
7. Understand the concept of SOP and GMP
8. Importance of housekeeping and sanitization in chemical plants.
9. Importance of Laboratory for chemical engineers.
10. Importance of sampling and sampling procedures.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">ROLE OF CHEMICAL ENGINEERS</p> <p>Definition of Chemical Engineering and Chemical Industry - Importance of Chemical Industry- List of Ten major chemical industries in India- Raw materials, Products and their end uses. List of Ten major chemical industries in Tamilnadu - Raw materials, Products and their end uses.</p> <p>Compare the duties and responsibilities of a Chemist and Chemical Engineer – List the duties and tasks of a process technician in chemical industry- various job opportunities of chemical engineering-Greatest achievements of Chemical engineering.</p>	14
II	<p style="text-align: center;">CHEMICAL PROCESS</p> <p>Chemical Process – Definition – Different types of chemical process- Batch, Semi batch and Continuous process- steady state and unsteady state process- comparison between them.</p> <p>Brief description about PFD Diagram and P&ID Diagram and their importance.</p> <p>Difference between Unit operations and unit process-Unit operations- Fluid flow, Heat transfer, Evaporation, Distillation, Absorption, Extraction, Drying and Filtration. (Brief descriptions only).</p> <p>Unit Process- Sulphonation, Polymerization, Oxidation, Reduction, Hydrogenation, Alkylation, Nitration and Chlorination. (Brief descriptions only).</p>	14

<p>III</p>	<p style="text-align: center;">TANKS AND VESSELS</p> <p>Tanks- Types of Tanks- Fixed roof tanks and Floating roof tanks. (Brief descriptions only and its uses)</p> <p>Vessels- Types of vessels- Spherical vessel, Bullet vessel and Hemispheroid vessel.(Brief descriptions only and its uses)</p> <p>Common components of vessel ant its functions- Agitator, Baffle, Foam chamber, Gauge hatch, Level indicator, Lining, Manway and Mist eliminator.</p> <p>Function of Tank breather vent in storage tanks- purpose of blanketing in a tank.</p> <p>Potential problems with tanks and vessels- Corrosion, scale build up, over and under pressurization.</p>	<p>15</p>
<p>IV</p>	<p style="text-align: center;">DOCUMENTATION, SOP & GMP</p> <p>Reporting- Concept of Reporting- Kinds of reports in Chemical Industries & its importance: Log books, Batch Tickets, Technical Reports and MIS (Management Information System).</p> <p>Documentation- Definition- SOP (Standard Operating Procedure) - Importance of SOP with one specific example. (Operation of Distillation Column). Importance of Housekeeping and Sanitization in Chemical Plants.</p> <p>GMP (Good Manufacturing Practice) and its importance.</p>	<p>15</p>

V	<p style="text-align: center;">QUALITY CONTROL</p> <p>Quality- importance of Quality in process industries- Laboratory and its importance- job responsibilities of Laboratory personnel- importance of sampling and sampling procedures- Quality control- Cost Of Quality (COQ) - SPC charts and its importance.</p> <p>Common scientific terms: P^H value & its importance, Total Dissolved solids, Alkalinity, Acidity, Turbidity, Conductivity, BOD and COD.</p> <p>Method of analysis of liquid samples using HPLC - Method of analysis of gas samples using Gas Chromatography.</p>	15
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Reference Books

1. Learning Chemical Engineering for Process Industries by Nikhlesh Mathur, Authors press.
2. Introduction to Chemical Engineering by Kenneth A. Solen, Wiley Publications.
3. Introduction to Chemical Engineering by Pushpavanam.S, PHI Learning Pvt Ltd, New Delhi.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076320

Semester : III Semester

Subject Title : GENERAL ENGINEERING

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
GENERAL ENGINEERING	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Strength of materials	12
II	Steam Generation systems and Boilers	15
III	Steam Turbine and Refrigeration Systems	16
IV	Electricity and Electrical Distribution System	15
V	Electrical Transmissions	15
Test & Model Exam		7
Total		80

RATIONALE:

The subject allows the students to gain knowledge in understanding the various mechanical properties of materials, steam generation systems, Boiler function and the important components of a boiler, steam turbines, refrigeration systems, Electrical Distribution systems and Electrical Transmissions.

OBJECTIVES:

On completion of this subject, the students can able to understand the following concepts:

1. Various Mechanical properties of the materials and types of stresses.
2. Comparison of Thin and Thick cylindrical shell.
3. Understand the properties of steam and the function of Boiler.
4. Function of Boiler accessories and Boiler mountings.
5. Understand the importance of steam turbines.
6. Understand the importance of Refrigeration systems.
7. Importance of Electrical Distribution system.
8. Importance of Electrical Emergency systems.
9. Importance of Electric motor and it's working principle.
10. Importance of D.C Generator and it's working principle.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">STRENGTH OF MATERILAS</p> <p>Mechanical properties of materials – Elasticity, Plasticity, Ductility, Malleability, Wear resistance, Toughness, Brittleness, Hardness, Fatigue and Creep. Simple stresses and strains- types of stress- tensile, Compressive and shear stress.</p> <p>Stress -Strain diagram – Hooke’s law – Young’s modulus – Lateral strain – Poisson’s ratio – Volumetric Strain – Bulk modulus- Temperature stress and strains. Cylindrical shells – Definition – Thin and thick cylindrical shell Comparison.</p>	12
II	<p style="text-align: center;">STEAM GENERATION SYSTEM AND BOILERS</p> <p>Steam- Distinguish the wet steam, dry steam, saturated steam and supersaturated steam. Properties of steam- sensible heat, latent heat, total heat of steam, superheat and dryness fraction.</p> <p>Boiler- function of boiler- Distinguish between fire tube boiler and water tube boiler- Distinguish between low pressure boiler and high pressure boiler- Definition of low pressure steam, medium pressure steam and high pressure steam- Describe with line diagram the construction and working of a Simple Vertical Boiler.</p> <p>Function of boiler mountings such as safety valve, water level indicator, pressure gauge, feed check valve, and fusible plug. (Brief descriptions only)</p> <p>Function of Boiler accessories such as Economizer, feed pump, super heater and air pre-heater. (Brief descriptions only)</p>	15

<p>III</p>	<p style="text-align: center;">STEAM TURBINE AND REFIGERATION SYSTEM</p> <p>Steam turbine- purpose of steam turbine in process industries- common types of steam turbines: Reactive steam turbine, impulse turbine, condensing turbine and non- condensing turbine (Brief description only). Construction and working principle of steam turbine with simple sketch- Turbine efficiency- effect of lowering the exhaust pressure of steam on turbine efficiency.</p> <p>Importance of Refrigeration system in process industries- Vapour compression refrigeration system– Capacity of refrigeration unit– Co-efficient of performance – Ton of Refrigeration- Refrigerants– Desirable properties – List the common types of refrigerants – Claude’s Liquefaction process.</p>	<p>16</p>
<p>IV</p>	<p style="text-align: center;">ELECTRICITY AND ELECTRICAL DISTRIBUTION SYSTEM.</p> <p>Definition the following terms: Electricity- Voltage- Voltmeter- Ampere- Ammeter-watts- wattmeter- Ohms. Statement of Ohm’s Law- simple problems in Ohm’s Law.</p> <p>Grounding and the purpose of grounding the motors and equipments.</p> <p>Types of current- AC Current & DC current- comparison of AC & DC current.</p> <p>Electrical Distribution systems: Transformers- Motor Control Centers (MCC) - Fuses- Circuit breakers- Switch. (Functions of the above with brief description).</p> <p>Electrical power failure and effect of power failure in process units- Electrical Emergency system- Uninterrupted power source (UPS).</p>	<p>15</p>

V	<p style="text-align: center;">ELECTRICAL TRANSMISSIONS</p> <p>Electric motor- purpose of electric motor- D.C motor- principle and characteristics of D.C Motor- Synchronous motor and Induction motor- construction and working principle of D.C electric motor.</p> <p>Electric motors and maintenance: Starting the motor, motor vibration, temperature and lubrication, cleaning and ventilation & overload motors.</p> <p>D.C Generator- Principle, construction and working of D.C Generator.</p>	15
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Reference Books

1. Theory of Mechanics by R.S Khurmi- Eurasia Publishing House.
2. A text book of power plant engineering by R.K. Rajput, Laxmi Publishers.
3. A text book of refrigeration and air conditioning by R.S. Khurmi, Chand Publishers.
4. Practical boiler operation engineering and power by Mallick Ranjan, PHI Publishers.
5. A text book of Electrical technology Vol.1 and Vol.2 by B.L. Theraja, S.Chand publishers.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076330

Semester : III Semester

Subject Title : MOMENTUM TRANSFER

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
MOMENTUM TRANSFER	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Fluid Statics	14
II	Fluid Flow Phenomena	14
III	Flow of incompressible Fluids	15
IV	Pipes, Fittings and Valves	15
V	Transportation of Fluids	15
Test & Model Exam		7
Total		80

RATIONALE:

The knowledge of fluid flow is very essential because all chemical plants involved fluid flow. The examples are flow of steam and gases in pipes, flow of liquid in pipes and open Channels etc. This subject aims at the basic concepts of fluid flow, measurement Techniques involved for the same and equipments used for the transportation of fluids. With this background, students will be able to quantitatively find out material and power Requirement for a process.

OBJECTIVES:

On completion of this subject, the students can able to understand the following concepts:

- 1.1 Importance of Fluid Mechanics.
- 1.2 Basic principles and properties of fluids.
- 1.3 Manometers.
- 1.4 Boundary layer concept

- 2.1 Behavior of fluids, Newtonian and non- Newtonian fluids.
- 2.2 Reynolds number and its use.
- 2.3 Continuity equation and its application. Bernoulli's equation and its application.

- 3.2 Flow of fluids through circular pipes in steady state.
- 3.3 Haugen – Poiseuille's equation, Friction factor chart.

- 4.1 Different types of valves used in controlling flow and their specific applications.
- 4.2 Different types of fittings and gaskets.

- 5.1 Performance characteristics of centrifugal and reciprocating pumps.
- 5.2 Blowers and compressors and their types.
- 5.3 Their method of construction and working principles.
- 5.4 Method of generating vacuum.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">FLUID STATICS</p> <p>Fluids – definition, Properties of Fluids – Density, Specific Gravity, Viscosity - Dynamic Viscosity & Kinematic Viscosity, Variation of Viscosity of Gases and Liquids with temperature.</p> <p>Classification of Fluids: Ideal Fluid, Compressible, Incompressible Fluids. Newton’s Law of Viscosity, Newtonian Fluids and Non-Newtonian Fluids with examples. Time dependent fluids – Thixotropic and Rheopectic fluids.</p> <p>Pressure – Types of Pressure – Atmospheric, Gauge & Absolute Pressure. List of Pressure measuring devices. U-Tube Manometer – computation of Pressure difference using U-Tube manometer - Inclined Manometer – Simple Problems in U-Tube manometer.</p> <p>Boundary layer- Concept of Boundary layer- Boundary layer separation and wake formation.</p>	14
II	<p style="text-align: center;">FLUID FLOW PHENOMENA</p> <p>Types of Flow – Laminar & Turbulent Flow, Potential Flow. Reynolds’s Experiment – Critical velocity, Reynolds’s Number and Its Significance, Velocity Profile for Laminar Flow & Turbulent Flow, Simple problems using Reynolds’s Number.</p> <p>Energies of fluids - Potential energy, pressure energy and kinetic energy (Statement only) - Statement of Bernoulli’s Equation (derivation excluded) - Significance of Bernoulli’s Equation, Practical applications of Bernoulli’s Equation.</p> <p>Mass flow rate & Volumetric flow rate, Average velocity, Mass Velocity, Relation between maximum velocity & Average velocity (derivation excluded). Continuity equation & its Significance, Simple problems in Continuity equation.</p>	14

III	<p style="text-align: center;">FLOW OF INCOMPRESSIBLE FLUIDS</p> <p>Pressure drop – Skin Friction & Form Friction – Fanning Friction factor – Relation between Skin friction & Friction Factor (derivation excluded) -Friction factor Chart & its use- Application of Hagen Poiseuille’s equation & Fanning Equation in calculating energy loss- Simple problems.</p> <p>Energy Loss due to sudden expansion, sudden contraction & Pipe fittings (derivation excluded) – Equivalent length concept – Hydraulics radius & Equivalent diameter.</p> <p>Drag – Drag Co-efficient – Stokes’ Law. Fluidization – Minimum fluidized velocity- Advantages & disadvantages of Fluidization- Applications of Fluidization- Simple problems.</p>	15
IV	<p style="text-align: center;">PIPES, FITTINGS AND VALVES</p> <p>Difference between Pipes & Tubes- Sizes of Pipes and Tubes - Schedule Number and BWG Number. Methods of Joining Pipes. Gaskets – List of commonly used Gasket materials in Chemical Industry & its Characteristics.</p> <p>Valves – Functions of Valves, Types of Valves – Gate Valve, Globe Valve, Ball Valve, Diaphragm Valve, Butterfly Valve & Check valve (NRV Valve) (Brief description of the above valves with line diagram)- Water Hammer & its Prevention.</p> <p>Allowances for thermal expansion - Recommended practice in installing piping system.</p>	15

V	<p style="text-align: center;">TRANSPORTATION OF FLUIDS</p> <p>Pumps – Classification of Pumps – Centrifugal Pump -Principle of operation and Working, Salient features of Centrifugal pumps, Types of Impellers and its uses – Priming – Cavitation -Symptoms and Causes of Cavitation & It's Prevention - NPSH - Characteristics curves of Centrifugal pump - Symptoms & possible Causes for Centrifugal pump problems & it's remedies.</p> <p>Positive displacement pump – Reciprocating pump (Single acting & Double acting). Gear Pump – External Gear Pump & Internal Gear Pump. Vacuum Pump - Steam jet ejector - Comparison of devices for moving fluids.</p> <p>Difference between Fans, Blowers & Compressors. Principle of Operation and Working of Axial flow Compressor & Centrifugal Compressor- Concept of Multistage compression.</p>	15
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Reference Books

1. Unit Operations of Chemical Engineering. By W.L.McCabe and J.C.Smith – Sixth edition – McGraw Hill Book Co. Singapore – 2001.
2. Introduction to chemical Engineering. By W.L.Badger and J.T.Banchero – Tata McGraw Hill Publishing Co.Ltd. New Delhi – 1997.
3. Unit Operations –I, K A Gavhane, Nirali Publications.
4. Introduction to chemical Engineering by Ghoshal, Sanyal and Dutta- Tata McGraw Hill Publishing Co.Ltd. New Delhi.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076340

Semester : III Semester

Subject Title : INDUSTRIAL CHEMISTRY

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
INDUSTRIAL CHEMISTRY	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	NOMENCLATURE AND REACTION INTERMEDIATES OF ORGANIC COMPOUNDS	16
II	METHODS OF PREPERATION OF HYDROCARBONS	16
III	PHASE EQUILIBRIUM	13
IV	MATERIALS OF CONSTRUCTION	14
V	CORROSION AND ITS PREVENTION	14
Test & Model Exam		7
Total		80

RATIONALE:

The subject gives the student the knowledge of chemistry that is applied in most of the process industries. These basic information is applied in the subjects of Chemical Engineering during the forthcoming semester.

OBJECTIVES:

On completion of this subject, the students can able to understand the following concepts:

- 1.1 Able to classify the different organic compounds.
- 1.2 Able to understand the different organic chemical reactions.

- 2.1 Understand the various methods of preparation of Hydrocarbons.
- 2.2 Understand the chemical properties of Hydrocarbons.

- 3.1 Understand the application of physical chemistry in chemical industry.
- 3.2 Understand the significance of Distribution Law.

- 4.1 Understand the various metallic materials and its composition.
- 4.2 Properties and application of materials in Process industries.

- 5.1 Understand the corrosion and its types.
- 5.2 Understand how combat against corrosion.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p>NOMENCLATURE AND REACTION INTERMEDIATES OF ORGANIC COMPOUNDS</p> <p>Introduction to organic chemistry – Functional group– Classification of organic compounds on the basis of functional groups – Homologous series – examples of homologous series.</p> <p>IUPAC names of first five members of alkane, alkene and alkyne series (straight & branched chain). Isomerism – types of isomerism.</p> <p>Types of organic reactions – Fission of covalent bond – Homolytic fission – Heterolytic fission - Reaction intermediates – Carbonium ion, Carbanion & Free radical.</p> <p>Electrophile & Nucleophile – examples – substitution reactions – Aromatic and aliphatic nucleophilic substitution (Mechanism not included) – Aromatic and Aliphatic Electrophilic substitution (mechanism not included).</p>	16
II	<p>METHODS OF PREPERATION OF HYDROCARBONS</p> <p>Preparation of Hydrocarbons: methane by decarboxylation of carboxylic acid- ethane by Wurtz reaction of chloromethane- Benzene by cyclic polymerization of Ethyne.</p> <p>Chemical properties of hydrocarbons-Chlorination of methane, ethylene and benzene- substitution & addition reaction of chlorine under different conditions- Friedel craft's alkylation of benzene – any three uses of methane, ethane, ethylene, acetylene and benzene.</p> <p>Method of preparation of formaldehyde (from methanol), acetaldehyde (from ethanol) acetone (from isopropyl alcohol) and aniline (by reduction of nitrobenzene).</p> <p>Method of preparation phenol by Dow's process (from chlorobenzene) and by Cumene process (from benzene).</p>	16

III	<p style="text-align: center;">PHASE EQUILIBRIUM</p> <p>Chemical equilibrium- definition- Law of mass action – Equilibrium constants- Equilibrium constants in terms of molar concentration (K_c) and partial pressure (K_p) - relation between K_c and K_p.</p> <p>Le- Chatlier principle- Conditions for maximum yield by applying Le- Chatlier principle in the manufacture of ammonia by Haber process and in the manufacture of sulphuric acid by Contact process.</p> <p>Distribution law- Nernst's Distribution law- Henry's law- simple problems using Henry's Law- application of Distribution law in solvent extraction process. Gibb's phase rule – Degrees of freedom- Comparison between Rate and Equilibrium.</p>	13
IV	<p style="text-align: center;">MATERIALS OF CONSTRUCTION</p> <p>Properties, composition and applications of the following metallic materials in chemical industries- Cast iron, Mild steel, Low carbon steel , Nickel steel and chrome steel.</p> <p>Stainless steel- composition of stainless steel- various grades of stainless steel and their applications in chemical process industry.</p> <p>Properties, composition and applications of the following Non- Ferrous alloys in chemical industries- Nickel alloys, Copper alloys and Aluminium alloys.</p> <p>Application of Metallic and non-metallic materials in the Chloro- Alkali and Acid industries.</p>	14

V	<p style="text-align: center;">CORROSION AND ITS PREVENTION</p> <p>Corrosion- Types of corrosion- Pitting corrosion, Inter granular corrosion, Galvanic corrosion, stress corrosion, Hydrogen attack and Biological corrosion- Brief description about Galvanic series – various methods employed in reducing corrosion.</p> <p>Combating corrosion: Protective coatings- Anodizing, Nitriding Phosphatizing, Passivation and Hot Dip Galvanizing.</p> <p>Major causes of corrosion in steam and condensate lines & in Cooling towers and its prevention.</p>	14
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Reference Books

1. Material science by S.K. Kajra Choudhry.
2. Text book of organic Chemistry by B.S. Bahl and ArunBahl.
3. Text book of organic Chemistry by P.L. Soni and H.M. Chawla.
4. Principles of physical chemistry by B.R.Puri, L.R.Sharma and Madan Chand & C New Delhi-7.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076350

Semester : III Semester

Subject Title : TECHNICAL ANALYSIS PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
TECHNICAL ANALYSIS PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

RATIONALE:

Analysis of various chemical commodities are necessary for controlling the quality of product in industry. This can be achieved in handling various analysis in the laboratory. The students can be learned all these by doing experiments in the practical classes.

Objectives:

To train the students on basic principles involved in estimation and Characterization of industrially important materials like Water, Oils and Fat, Soap, Cement, Bleaching powder, Glycerol, and Sucrose. The students can able

To determine the water quality for various applications.

To determine the standard quality of fat and oil for food and cosmetic grades

To determine the quality of soap for pharmaceutical and cosmetic grades.

To determine the quality of cement.

To determine the glycerol quality to meet cosmetics standards.

To determine the purity of sugar to meet the sugar and food industry standards.

LIST OF EXPERIMENTS

1. Estimation of Hardness of water by EDTA method.
2. Estimation of Acid value of an Oil.
3. Estimation of Total Fatty Matter content of soap.
4. Estimation of calcium oxide content of cement.
5. Determination of available chlorine in Bleaching Powder.
6. Estimation of purity of Glycerol by Dichromate method.
7. Determination of purity of Sucrose.
8. Determination of PH using PH meter
9. Estimation of Saponification of Oil.
10. Estimation of Mixed Oxide content of cement.

LIST OF EQUIPMENTS / GLASSWARES

- Burettes 50 ml - 5 No's
- Pipettes 25ml, 20ml, and 10ml - 5 No's
- Conical flask 500 ml, 250 ml, 100 ml – 5 No's
- Burette stand with clamp – 5 No's
- Round bottomed flask 500 ml, 250 ml – 5 No's
- Liebig's condenser- 2 No's
- Distillation set -2 No's
- Funnels & Separating funnels - 5 No's
- Watch Glass 6",3",3"- 5 No's
- Wash bottles plastics - 5 No's
- Tripod stand & Wire gauge -5 No's
- Hot plate & Muffle Furnace – 1 No
- Silica Crucible with lid – 1 No
- Buchner funnel – 2 No's
- Refractometer – 1 No
- Suction pump- 1No
- Aspirator bottles – 4 No's

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076360

Semester : III Semester

Subject Title : GENERAL ENGINEERING PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
GENERAL ENGINEERING PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

RATIONALE:

In Diploma level engineering education skill development plays a vital role. These can be achieved by experience in handling various equipments, which are used to identify the strength of material, identify the parts of valves, and in handling electrical machineries and instruments. These will help to handle various equipments in process industries for a chemical engineer.

OBJECTIVES:

The students can able to

Identifying the various parts of valves and centrifugal pump and understand how dismantle and assemble the valves and centrifugal pump.

Find out the COP of refrigeration Test Rig and Hardness of a given sample.

Determination of Unknown Resistance by Ohm's law.

Energy measurement in a single phase circuit using Lamp load.

Load test on a single phase transformer.

Verification of Series and parallel circuit.

LIST OF EXPERIMENTS

1. Identify the parts of Gate valve, dismantle and assemble the parts of Gate valve.
2. Identify the parts of Globe valve, dismantle and assemble the parts of Globe valve.
3. Identify the parts of centrifugal pump, dismantle and assemble the parts of Centrifugal pump.
4. Refrigeration Test Rig – COP Determination
5. Determine the Hardness Test value of given material (mild steel or plastic material) using hardness testing machine.
6. Compressor Test Rig
7. Determination of Unknown Resistance by Ohm's law.
8. Energy measurement in a single phase circuit using Lamp load.
9. Load test on a single phase transformer.
10. Verification of Series and parallel circuit.

LIST OF EQUIPMENTS

1. Gate Valve - 1 No
2. Globe Valve- 1 No
3. Centrifugal pump- 1 No
4. Refrigeration test rig- 1 No
5. Hardness Testing machine- 1 No
6. Compressor Test Rig -1 No
7. Rheostat of various range – 2 No'S
8. RPS (0-12v, 0-30v) - 2 No'S
9. Ammeters (MC and MI) of various ranges – 2 No'S
10. Voltmeters (MC and MI) of various ranges- 2 No'S
11. Wattmeter – 300v/5A-2.5A/UPF - 2 No'S

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076370

Semester : III Semester

Subject Title : MOMENTUM TRANSFER PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
MOMENTUM TRANSFER PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education to skill development especially working with instruments and Equipment's play a vital role. These can be achieved by experience in handling various equipment's. This is accomplished by doing engineering related equipment's in practical classes.

LIST OF EXPERIMENTS

1. Determination of flow rate using Orifice meter
2. Determination of flow rate using Venturi meter.
3. Flow through a straight pipe
4. Flow through a helical coil
5. Rota Meter Calibration
6. Flow through packed column
7. Flow through fluidization column
8. Centrifugal pump characteristics
9. Flow through a Weir
10. Reciprocating pump characteristics

LIST OF EQUIPMENTS

- Orifice Meter – 1 No
- Venturi Meter- 1 No
- Straight pipe - 1 No
- V notch experimental set up -1 No
- Rota Meter - 1 No
- Packed column -1 No
- Fluidization column- 1 No
- Centrifugal Pump - 1 No
- Reciprocating Pump - 1 No
- Helical coil / spiral coil -1 No

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076410

Semester : IV Semester

Subject Title : MECHANICAL OPERATIONS

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
MECHANICAL OPERATIONS	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Size Reduction	14
II	Properties of solids, screening and conveying	15
III	Sedimentation, Centrifugation and Filtration	16
IV	Classification of solid particles	14
V	Mixing and Agitation	14
Test & Model Exam		7
Total		80

Rationale:

It gives the student the knowledge of various mechanical operations and their significance in chemical industries. With this information student can control the operation of equipment in order to separate solid-solid, solid-liquid & gas-solid systems.

Objectives:

On completion of the following exercise, the student must be able

- 1.1 To know the principles of various size Reduction machines
- 1.2 To define the different Laws of size Reduction
- 1.3 To understand the operation of various types of conveyors
- 2.1 To analyze the solid particles in the set of sieves
- 2.2 To understand the working of various Industrial screens.
- 2.3 To know the principles of gas- solid separation
- 3.1 To understand the principles of settling
- 3.2 To distinguish between filtration & settling
- 3.3 To describe the working of various Filtration equipments
- 4.1 To discuss various special methods of separation
- 4.2 To know the application of various separators
- 5.1 To distinguish between Mixing & Agitation
- 5.2 To list out various types of Impellers
- 5.3 To design the mixing tank
- 5.4 To understand the principles of various industrial mixer

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">SIZE REDUCTION</p> <p>Objectives of Size Reduction – Methods of Size Reduction – Crushing Efficiency. Laws of Crushing - Rittinger's Law, Kick's Law & Bond's Law – Work Index – Simple problems in Laws of Crushing.</p> <p>Size Reduction Equipments – Classification of size reduction reductions- Construction , Principle of Working & application of the following Equipments – Blake Jaw Crusher, Smooth Double Roll Crusher – Angle of Nip (Simple Problems) – Ball Mill – Critical Speed of Ball mill & simple problems in critical Speed - Working principle of Fluid Energy Mill.</p>	14
II	<p style="text-align: center;">PROPERTIES OF SOLIDS, SCREENING & CONVEYING</p> <p>Characterization of solid particles - Shape – Sphericity (simple Problem on Sphericity). Definitions of the following terms- Volume shape factor & Surface shape factor, Average particle size, Sauter mean diameter, mass mean diameter and volume mean diameter, specific surface of the mixture & specific surface ratio.</p> <p>Screening – Tyler Standard screen series, Capacity & Effectiveness of screens.-Screen Analysis -Differential Analysis & Cumulative analysis.</p> <p>Screening Equipments - Working Principle of Gyrating Screens & Vibrating Screens. Conveying of Solids - Working Principles & applications of Belt Conveyor, Screw Conveyor & Bucket Elevator.</p>	15

III	<p style="text-align: center;">SEDIMENTATION, CENTRIFUGATION & FILTRATION</p> <p>Settling - Free settling & Hindered Settling – Terminal settling Velocity – Batch sedimentation test.</p> <p>Distinguish between Thickener & Clarifier – Construction and Working Principle of Dorr Thickener.</p> <p>Centrifugation- Principle of Centrifugation - Construction and Working Principle of Top suspended Centrifuge & Disc Type Centrifuge.</p> <p>Filtration - Filter Medium & It's Requirements – Filter aids & It's function – Constant Pressure filtration – Constant rate filtration – Filter Medium Resistance & Filter Cake Resistance (definitions only)-Filtration Equipments - Construction, Principle of Operation & Applications of Filter Press, Leaf Filter & Rotary Drum Filter.</p>	16
IV	<p style="text-align: center;">SEPERATION OF SOLID PARTICLES</p> <p>Construction, Principle of Operation & Applications of the following Equipments:</p> <p>Mechanical Classifier - Dorr Classifier</p> <p>Gravity Concentration – Heavy Medium Separator (Sink & Float Method).</p> <p>Special Separation Techniques- Elutriation and Jigging.</p> <p>Froth Flotation- Functions of Frothers and Collectors – Working principle of Floatation cell.</p> <p>Gas - Solid Separation- Cyclone Separator, Bag Filter & Electrostatic Precipitator.</p>	14

V	<p style="text-align: center;">MIXING AND AGITATION</p> <p>Difference between Mixing and Agitation – Purpose of Agitation – Working Principle of Agitation Vessel – Function of Baffles.</p> <p>Impellers, Types of Impellers & Their applications - Propeller, Paddles & Turbines.</p> <p>Swirling & Vortex Formation in Mixing tanks and their prevention.</p> <p>Concept of Mixing Index – Power Number.</p> <p>Industrial Mixers - Principle of Operation & Applications of Change Can Mixer, Muller Mixer, Banbury Mixer & Ribbon Blender.</p>	14
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Reference Books:

1. Unit operations of chemical Engineering by W.L.Mc cabe & J.C.Smith - Seventh Edition – McGraw Hill Book Co. –Singapore- 2001.
2. Introduction to Chemical Engineering by W.L. Badger & J.T. Banchero - Tata McGraw Hill Publishing Co. Ltd., New Delhi – 1997.
3. Unit Operations –I by Gavahne, Nirali Publications.
4. Mechanical Operations, by Anup K Swain, G.K Roy, Hemlata Patra, Tata McGraw Hill Pvt Ltd, New Delhi.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076420

Semester : IV Semester

Subject Title : HEAT TRANSFER

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
HEAT TRANSFER	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Conduction	12
II	Convection and Radiation	16
III	Heat flow in fluids and heat exchanger	17
IV	Evaporation	14
V	Multiple Effect Evaporation and Thermal Insulation	14
Test & Model Exam		7
Total		80

Rationale:

Most of the chemical engineering operations will involve either heat addition or heat removal in one way or the other. It is, therefore, extremely necessary to have good understanding about the heat transfer mechanisms such as conduction, convection and radiation. This subject enables the students to apply the understanding of heat transfer mechanisms such as conduction, convection and radiation for understanding the performances of various heat transfer equipment such as heat exchangers, condensers, boilers, evaporators etc. used in almost all chemical and related industries. The knowledge of this subject helps in design and fabricate different heat exchange equipment.

Objectives:

On completion of the units of syllabus the students must be able to know about

- 1.1 Mechanism of Heat Transfer, and Heat Transfer by conduction;
- 1.2 Conduction through Composite walls and Hollow cylinders
- 1.3 Variation of Thermal conductivity with temperature.
- 1.4 To calculate the amount of heat loss through flat wall and cylinder.
- 2.1 To study the concept of convection heat transfer
- 2.2 Significance of Dimensionless numbers
- 2.3 To calculate the heat flow rate by Radiation.
- 3.1 Principles of Heat Transfer in Fluids, Log Mean Temperature Difference
- 3.2 Heat Exchange Equipment (Double Pipe, Shell and Tube, Plate Type, Fin).
- 3.3 To study the construction, working and application of various types of heat transfer Equipments.
- 4.1 Principle of Evaporation, Performance of Evaporators, Types of Evaporators and Their operational methods
- 4.2 Evaporator accessories
- 5.1 Multiple effect evaporators and methods of feeding
- 5.2 To study some of the evaporator accessories.
- 5.3 Insulating materials, need for insulation, properties and their applications.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">CONDUCTION</p> <p>Heat Transfer – Modes of Heat Transfer – importance of heat transfer in process units- Fourier's Law of Conduction – Steady State & unsteady state heat conduction.</p> <p>Heat conduction through Composite Wall, Hollow Cylinder & Composite cylinders. Simple problems in conduction</p> <p>Thermal Conductivity, Thermal diffusivity & its significance. Variation of thermal conductivity with temperature.</p> <p>Analogy between heat conduction & Electrical Current flow.</p>	12
II	<p style="text-align: center;">CONVECTION & RADIATION</p> <p>Convection - Types of Convection – Free Convection & Forced Convection.</p> <p>Individual heat transfer coefficient (h) & It's Significance – Film concept in convection - Application of Sieder - Date Equation & Dittus Boelter Equation.</p> <p>Different modes of condensation – Drop wise Condensation & Film wise Condensation – Effect of non-condensable gases in condensable vapours - Condensation of superheated vapours.</p> <p>Boiling Mechanism in Heat Transfer – Nucleate boiling & Film boiling (principles only) – Leidenfrost Phenomenon.</p> <p>Dimensionless Numbers & their Significance in Heat Transfer- Graetz Number, Prandlt Number, Nusselt Number, Rayleigh Number & Grashoff Number. (Brief description only).</p> <p>Radiation Heat transfer - Reflectivity, Absorptivity & Transmissivity – Emissive Power & Emissivity - Concept of Black body – Stephen Boltzmann Law & Kirchhoff's Law - Simple Problems in Radiation.</p>	16

<p>III</p>	<p style="text-align: center;">HEAT FLOW IN FLUIDS & HEAT EXCHANGERS</p> <p>Heat Exchangers - Counter current flow & Parallel flow in heat exchangers – Energy balance in heat exchangers – Heat Flux – Overall heat transfer coefficient – derivation of overall heat transfer coefficient from hot fluid to cold fluid through a metal wall – Fouling factors & it's significance – Logarithmic mean temperature difference (LMTD) (derivation excluded). Simple problems in LMTD.</p> <p>Heat Exchangers: Types of Heat exchangers – Construction & Working Principle of Double pipe Heat Exchanger and Shell & Tube Heat exchanger - Functions of Baffles - Applications of Floating Head and U- Tube Heat Exchangers. Pitch -Triangular & Square Pitch – its advantages & disadvantages.</p> <p>Construction & Working Principle of Plate type heat exchanger- concept of Extended surface heat exchanger (Principle only) - Heat Exchanger efficiency and common problems –Scale formation in Heat Exchangers and its cleaning.</p>	<p>17</p>
<p>IV</p>	<p style="text-align: center;">EVAPORATION</p> <p>Evaporation – Principles of Evaporation – Factors affecting rate of evaporation – Capacity & Economy – Boiling point elevation & Duhring's rule – Energy balance in single effect evaporator- Simple problems in single effect evaporator.</p> <p>Evaporators:- Types of evaporator – Calendria evaporator, Long tube vertical evaporator(Climbing Film) – Falling Film evaporator & Forced circulation evaporator – Construction , operation & applications of all types of evaporators – Important factors to be considered in efficient operation of an Evaporator.</p>	<p>14</p>

V	<p style="text-align: center;">MULTIPLE EFFECT EVAPORATION AND INSULATION</p> <p>Principle of Multiple effect Evaporation – Methods of feeding of multiple effect evaporator – Forward feed, backward feed, mixed feed & parallel feed – Merits & Limitations.</p> <p>Evaporator Accessories - Steam traps- purpose of steam trap-list the four types of steam traps- brief description about any one steam trap. Brief description about Barometric condenser & Entrainment separators.</p> <p>Thermal Insulation – importance of avoiding heat loss in process units -Properties of Insulating materials – Need for thermal insulation – Critical thickness of insulation – important types of insulating materials & their applications.</p>	14
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Reference Books

1. Unit operations of chemical Engineering by W.L.Mc cobe & J.C.Smith - Seventh Edition – McGraw Hill Book Co. –Singapore- 2001.
2. Introduction to Chemical Engineering by W.L. Badger & J.T. Banchero - Tata McGraw Hill Publishing Co. Ltd., New Delhi – 1997.
3. Heat transfer Principles and Applications by Dutta, PHI Publications.
4. Unit Operations-II, by Gavanhe, Nirali Publications.
5. Elementary Chemical Engineering by Max Peters- Tata McGraw Hill Publishing Co. Ltd., New Delhi.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076430

Semester : IV Semester

Subject Title : CHEMICAL PROCESS CALCULATIONS

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
CHEMICAL PROCESS CALCULATIONS	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	BASIC CHEMICAL CALCULATIONS	14
II	BEHAVIOUR OF IDEAL GASES	14
III	MATERIAL BALANCE WITHOUT CHEMICAL REACTION	15
IV	MATERIAL BALANCE WITH CHEMICAL REACTION	15
V	ENERGY BALANCE	15
Test & Model Exam		7
Total		80

Rationale:

This subject prepares the students to formulate and solve material and energy balances on chemical process systems. In process industries raw materials are processed to get different products. The components present in the raw material combine in a definite proportion and the percentage of product formed depend on various parameters like temperature and pressure etc. It is highly essential to know the stoichiometry ratio and proportions and the process conditions to achieve maximum product formation and recycle of the unused materials for better economy. Therefore, knowledge of stoichiometry is the first and foremost requirement for the success of a chemical engineer.

OBJECTIVES

On Completion of the units of syllabus contents the students must be able to understand the following:

1.1 Uses of different units

1.2 Basic concepts of chemical calculation

2.1 Law of conservation of mass

2.2 Material balance in unit operations.

3.1 Exact quantities of materials are to be used to achieve good percentage of conversion.

3.2 Concept of flue gas Analysis

4.1 Law of conservation of energy

4.2 Energy saving possibilities in chemical processes.

5.1 Different type of reactors used in chemical industries.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">BASIC CHEMICAL CALCULATIONS</p> <p>Dimensions - Measurement- Use of different units- Fundamental quantities and Derived quantities - FPS,CGS,MKS and SI systems- Conversion factors.</p> <p>Basis of calculation - Mole concept - Atomic weight, Molecular weight Methods of expressing the composition of solids and solutions- Weight percent & Volume percent- Mole percent and mole fraction- Concept of PPM (Parts Per Million)- Equivalent weight- Molarity, Molality and Normality. Density and Specific gravity.</p>	14
II	<p style="text-align: center;">BEHAVIOUR OF IDEAL GASES</p> <p>Behaviour of Ideal gases- Ideal gas law- absolute pressure and gauge pressure- absolute temperature and relative temperature-temperature scales- unit conversion of temperature and pressure.</p> <p>Gaseous mixtures-Dalton's law of partial pressure for gas mixtures- Amagot's law of partial volume - Average molecular weight and density of gaseous mixtures.</p> <p>Vapour pressure-Effect of temperature on vapour pressure- Hausbrand chart and its use- Effect of pressure and vapour pressure on boiling point. Calculating vapour pressure using Clausius – Clapeyron equation.</p>	14

III	<p style="text-align: center;">MATERIAL BALANCE WITHOUT CHEMICAL REACTION</p> <p>Material balance- definition of steady state and unsteady state material balance equations.</p> <p>Methods of solving the three basic types of material balance problems- definitions of terms Tie substance, Inert material, simultaneous equation - Calculating quantities of acids required in mixed acid blending process.</p> <p>Material balance problems involving unit operation such as distillation, Evaporation, Leaching and drying.</p> <p>Bypass operation- Recycle operation- Purging operation (Brief descriptions only).</p>	15
IV	<p style="text-align: center;">MATERIAL BALANCE WITH CHEMICAL REACTIONS</p> <p>Definition of the following terms- Stoichiometric coefficient- Stoichiometric ratio- Limiting reactant - Excess reactant – Percentage of excess reactant – Percentage conversion – Percentage yield – Selectivity – Simple problems.</p> <p>Combustion – Gross calorific value and Net calorific value-Theoretical air requirement –percentage excess air—Orsat analysis of Flue gases - simple problems.</p>	15
V	<p style="text-align: center;">ENERGY BALANCE</p> <p>Energy balance - definition of terms Heat capacity, Molal heat capacity, specific heat, sensible heat and Latent heat of pure liquid. Heat capacity of pure gas and gaseous mixtures at constant pressure-amount of heat required to raise the temperature of process fluid using heat capacity data.</p> <p>Enthalpy changes accompanying chemical reaction – standard heat of formation-standard heat of combustion-heat of reaction.</p>	15

Reference Books:

1. Stoichiometry - 5 th edition, B.I Bhatt & S.B Thakore, TATA McGrew Hill education Pvt Ltd, New Delhi.
2. Chemical Process Calculations by D.C.Sikdar, PHI Learning pvt Ltd, Delhi.
3. Process Calculations by V. Venkataramani, N.Anantharaman, and K.M.Sheriffa Begum.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076440

Semester : IV Semester

Subject Title : CHEMICAL ENGINEERING THERMODYNAMICS AND REACTION
ENGINEERING

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
CHEMICAL ENGINEERING THERMODYNAMICS AND REACTION ENGINEERING	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Properties of system and first law of thermodynamics	15
II	Second law of thermodynamics and thermodynamic properties	16
III	Chemical Kinetics	14
IV	Chemical Reactors	14
V	Solid Catalyst	14
Test & Model Exam		7
Total		80

Rationale:

This subject prepares the students in strong understanding of the various thermodynamic systems and application of First law and Second law of thermodynamics in various process. In process industries raw materials are processed to get different products. The components present in the raw material combine in a definite proportion. It is highly essential to know the chemical kinetics of the chemical reaction and the working principle of Industrial reactors. Therefore, knowledge of Reaction engineering and thermodynamics is the first and foremost requirement for the success of a chemical engineer.

OBJECTIVES

On Completion of the units of syllabus contents the students must be able to understand the following:

1. Understand the various thermodynamic process and systems.
2. Understand the First law of thermodynamics.
3. Understand the Second law of thermodynamics
4. Understand the various thermodynamic properties.
5. Understands the chemical kinetics of reaction, and importance of catalyst.
6. The different type of reactors used in chemical industries.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p>PROPERTIES OF SYSTEM AND FIRST LAW OF THERMODYNAMICS</p> <p>Terminologies in Thermodynamics- System and surroundings- open system, closed system, and isolated system- Homogenous system and heterogeneous system- Thermodynamic equilibrium. Thermodynamic process- Isothermal process, Isobaric process, Isochoric process, adiabatic process and cyclic process (definitions only).</p> <p>Properties of a system-Extensive properties and Intensive properties with examples-state function and path function- comparison between reversible process and irreversible process- Internal energy and Enthalpy First law of Thermodynamics and its applications.</p> <p>Ideal gas equation of state- Equation of state for real gases and its uses- Compressibility factor-Law of Corresponding states.</p>	15
II	<p>SECOND LAW OF THERMODYNAMICS & THERMODYNAMIC PROPERTIES</p> <p>Limitations of First law of Thermodynamics-Heat engine & Thermal efficiency- Heat pump & Thermal efficiency- Statement of Second Law of Thermodynamics- Carnot cycle and steps involved in Carnot cycle- Efficiency of Carnot cycle- simple problems on Carnot cycle efficiency - concept of Entropy.</p> <p>Third law of Thermodynamics-Clausius inequality- Irreversibility and Lost work- Helmholtz Free energy (A), Gibb's Free energy and its significance.</p> <p>Joule- Thomson effect and significance of Joule- Thomson co-efficient. Fugacity & Fugacity co-efficient- Activity and Activity co-efficient- Chemical potential and its significance.</p>	16

<p>III</p>	<p style="text-align: center;">CHEMICAL KINETICS</p> <p>Chemical reaction- classification of chemical reactions- Definitions of reaction rate- elementary and non-elementary reactions- Molecularity and order of a reaction - Rate law, rate constant and units of rate constant – Fractional conversion.</p> <p>Effect of temperature on reaction rate- Activation energy- Arrhenius equation- simple problem in Arrhenius equation – Determination of the rate equation – Integral method analysis for irreversible unimolecular First order reaction and Second order reaction.</p> <p>Chemical equilibrium and equilibrium constant- importance of thermodynamics in chemical reactions- Feasibility of a chemical reaction – Factors influencing the rate of reactions- ratio of reactants, presence of inert gas, pressure and temperature.</p>	<p>14</p>
<p>IV</p>	<p style="text-align: center;">CHEMICAL REACTORS</p> <p>Importance of chemical reactors in chemical industry- classification of chemical reactors- construction, operation and application of Continuous Stirred Tank Reactor (CSTR) and Plug Flow Tubular Reactor (PFTR)</p> <p>Construction, operation and application of Fixed Bed reactor and Fluidized bed reactors.</p> <p>Concept of Space time and space velocity- simple problems- comparison of batch reactor, CSTR and PFTR.</p>	<p>14</p>

V	<p style="text-align: center;">SOLID CATALYST</p> <p>Catalyst- Homogenous and heterogeneous catalyst – Role of catalyst in chemical reactions- List the important catalysts used in various industrial process. Brief description about inhibitors, poisons and promoters.</p> <p>Preparation of Solid Catalyst- Specific characteristics of solid catalysts- Activity, Kindling point, Solid density, specificity, Surface area and Porosity.</p> <p>Catalyst deactivation- Deactivation by thermal degradation and sintering- Deactivation by poisoning- methods of catalyst regeneration.</p>	14
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Reference Books:

1. Chemical Engineering Thermodynamics by Gopinath Halder, PHI Learning, Delhi.
2. Chemical Engineering Thermodynamics by Pradeep Ahuja, PHI Learning, Delhi
3. Chemical Engineering Thermodynamics by D.C. Sikdar, Khanna Publishers, Delhi

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076450

Semester : IV Semester

Subject Title : MECHANICAL OPERATIONS PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
MECHANICAL OPERATIONS PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education skill development plays a vital role. These can be achieved by experience in handling various equipments. This is accomplished by doing engineering related experiments in practical classes.

OBJECTIVES:

- 1.1 To determine the absolute viscosity of given liquid.
- 2.1 To study the settling characteristics of given slurry using Batch settling
- 3.1 To determine the power consumption, power number, Froude number & Reynolds number of given Impellor in the Mixing tank and compare the above Parameters using the liquids of different viscosity.
- 4.1 To determine specific cake resistance and filter medium resistance of given slurry using Leaf filter and compare the above parameters with other types of filters.
- 5.1 To determine the sieve efficiency using the set of sieves and compare the efficiency for different nature of feed particles.
- 6.1 To determine the Reduction ratio and specific surface area of newly generated solid particles using the Jaw crusher
- 7.1 To determine the Reduction ratio and specific surface area of newly generated solid particles using the Roller crusher.
- 8.1 To find out the parameters such as Grinding efficiency, optimum size of ball, critical speed, optimum speed and power requirement for grinding in a cylindrical ball mill
- 9.1 To determine specific cake resistance and filter medium resistance of given slurry using Plate & Frame Filter press and compare the above parameter with other types of filters
- 10.1 To separate the given size range of solid particle from air stream and determine the settling velocity of solid particle in different regions of settling particle using a Cyclone Separator.

LIST OF EXPERIMENTS:

1. Stoke's Law of Settling
2. Batch Settling
3. Industrial Mixer
4. Leaf filter
5. Sieve Analysis
6. Jaw Crusher
7. Roller crusher
8. Ball mill
9. Filter press(Plate and Frame)
10. Cyclone Separator

LIST OF EQUIPMENTS:

- Long, wide glass tube – 2 No's
- Measuring Jar – 1Litre - 2 No's
- Mixing Tank with accessories- 1 No's
- Leaf Filter with accessories such as Vacuum pump, manometer etc. - 1 No's.
- Set of sieves and sieve shaker machine - 1 No's
- Jaw Crusher - 1 No's
- Double Roller Crusher - 1 No's
- Ball mill with different size of balls - 1 No's
- Plate and Frame filter press with accessories -1 No's
- Cyclone separator -1 No's

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076460

Semester : IV Semester

Subject Title : HEAT TRANSFER PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
HEAT TRANSFER PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education skill development plays a vital role. These can be achieved by experience in handling various equipments. This is accomplished by doing engineering related experiments in practical classes.

Objectives:

After completing all the experiments of the laboratory the student will be able to

- Determine the Thermal conductivity of the metal, Insulating Material and Glass wool.
- Determine the overall heat transfer coefficient of a double pipe heat exchanger by co-current flow & counter current flow.
- Determine the quantity of heat transferred and overall heat transfer coefficient of a condenser.
- Determine the heat transfer characteristics under forced convection.
- Determine the heat transfer characteristics under free convection.
- Determine the emissivity of the given metal.
- Determine the Stefan Boltzmann Constant.

LIST OF EXPERIMENTS

1. Thermal Conductivity of Metal Bar
2. Heat loss in pipe
3. Double Pipe Heat Exchanger by co-current Flow
4. Double Pipe Heat Exchanger by Counter-current flow
5. Natural Convection Heat Transfer
6. Forced Convection Heat Transfer
7. Determination of Heat Transfer co-efficient in Vertical Condenser
8. Determination of Heat Transfer co-efficient in Horizontal Condenser
9. Determination of Emissivity of a grey Body
10. Verification of Stefan Boltzmann constant

LIST OF EQUIPMENTS

Modules for the determination of the following:-

1. Thermal Conductivity of Metal Bar- 1No's
2. Heat loss in pipes -1 No's
3. Double Pipe Heat Exchanger by co-current Flow -1 No's
4. Double Pipe Heat Exchanger by Counter-current flow- 1 No's
5. Natural Convection Heat Transfer -1 No's
6. Forced Convection Heat Transfer- 1 No's
7. Horizontal Condenser and vertical condenser-1 No's
8. Emissivity apparatus- 1 No's
9. Stefan Boltzmann apparatus- 1 No's

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076470

Semester : IV Semester

Subject Title : CHEMICAL TECHNOLOGY PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
CHEMICAL TECHNOLOGY PRACTICAL	4	64	25	100*	100	3 Hrs.

RATIONALE:

Analysis of various chemical commodities are necessary for controlling the quality of product in industry. This can be achieved in handling various analysis in the laboratory. The students can be learned all these by doing experiments in the practical classes.

Objectives:

To train the students on basic principles involved in estimation and Characterization of industrially important materials like Water, Oils and Fat, Soap, Cement, Bleaching powder, Glycerol, and Sucrose. The students can able

To determine the water quality for various applications.

To determine the standard quality of fat and oil for food and cosmetic grades

To determine the quality of soap for pharmaceutical and cosmetic grades.

To determine the quality of cement.

To determine the glycerol quality to meet cosmetics standards.

To determine the purity of sugar to meet the sugar and food industry standards.

LIST OF THE EXPERIMENTS

1. Viscosity Determination using REDWOOD Viscometer
2. Viscosity Determination using SAYBOLT Viscometer
3. Determination of Flash and Fire point of the given oils by open cup method
4. Determination of Flash and Fire point of the given oils by closed cup method
5. Determination of Cloud point and pour point of a given sample
6. Determination of specific gravity of given sample by using hydrometer
7. Determination of melting point of given sample
8. Determination of softening point of given sample by using ring and ball apparatus
9. Proximate analysis of a given coal sample.
10. Determination of distribution co-efficient of given sample using paper Chromatography.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076510

Semester : V Semester

Subject Title : MASS TRANSFER-I

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
MASS TRANSFER-I	6	96	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Principles of mass transfer	15
II	Absorption	20
III	Humidification	20
IV	Fundamentals of distillation	16
V	Design and techniques of Distillation column	18
Test & Model Exam		7
Total		96

Rationale:

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment's like distillation columns, absorption columns, which are used in industries for purification of products. This course explains the fundamentals of mass transfer and techniques involved in mass transfer operations of distillation, extraction and absorption. This subject intends to equip the students with the concept and principles of mass transfer operation, which are of prime importance in any chemical industry. Mass transfer equipment's are an integral part of any chemical plant. This subject will help the student's to operate and design various mass transfer equipments.

OBJECTIVES

On completion of the units of the syllabus, the student will be able to understand the following:

1. The basic principle of mass transfer operation, diffusion & Eddy diffusion
2. The importance of mass transfer coefficients and different methods of conducting mass transfer operations
3. Raoult's law and its application in distillation.
4. Basic principles of distillation and, the types of distillation such as batch, flash And fractionation.
5. Use of tray and packed tower in distillation and their operational problems.
6. Methods of determining theoretical trays for a tray tower used in rectification by McCabe - Thiele method.
7. Special methods of distillation such as extractive, azeotropic and steam distillation.
8. Basics of absorption and desorption
9. Use of packings and a packed tower in absorption.
10. The basics of Humidification process.
11. Operation of cooling towers.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">PRINCIPLES OF MASS TRANSFER</p> <p>Diffusion and mass transfer operation- molecular diffusion and eddy diffusion - Fick's law of diffusion-.Equimolar counter diffusion-special case Diffusion of A through stagnant non-diffusing B-.Mass transfer coefficients – units of mass transfer coefficient-relation between mass transfer coefficients -inter phase mass transfer- Overall mass transfer coefficient.</p> <p>Classification of mass transfer operations - methods of conducting mass transfer operations - unsteady state and steady state operations-stage wise and differential contact operation</p>	15
II	<p style="text-align: center;">ABSORPTION</p> <p>Principles of Gas absorption - equilibrium solubility of gases - ideal and non-ideal liquid solutions - Henry's Law - choice of solvent for absorption-absorption factor - Tray towers and packed towers for absorption – equilibrium curve and operating line for absorption-concepts of minimum Gas-Liquid ratio.</p> <p>Construction and principle of operation of packed bed absorption column-packing materials- random packing and regular packing-Operating problems like loading, flooding, entrainment, priming, weeping and coning – HTU, NTU and HETP concepts.</p>	20

<p>III</p>	<p style="text-align: center;">HUMIDIFICATION</p> <p>Humidification operation-Terminology used in humidification operation such as Absolute humidity , Molal humidity , Dry bulb temperature , Wet bulb temperature , Relative humidity ,Percentage saturation ,Dew point, Adiabatic saturation temperature ,Humid heat and Humid volume -Lewis relation- simple problems in Humidification</p> <p>Equipment for Humidification operations-construction and working principle of cooling towers - arrangements of cooling towers- natural draft, forced draft and induced draft –Cooling tower efficiency – common problems in cooling tower and solutions.</p>	<p>20</p>
<p>IV</p>	<p style="text-align: center;">FUNDAMETALS OF DISTILLATION</p> <p>Distillation- relative volatility- boiling point diagram and equilibrium diagram– construction of boiling point and equilibrium diagram for a binary system using vapour pressure data - Raoult's law –azeotropic mixture- maximum and minimum boiling azeotropes – simple or differential distillation- Rayleigh's equation- flash distillation –vacuum distillation- continuous multistage rectification.</p> <p>Dimensionless numbers in mass transfer and its significance- Schmidt number, Lewis number, and Sherwood number (Brief description only).</p>	<p>16</p>

V	DESIGN AND TECHNIQUES OF DISTILLATION COLUMN	18
	<p>Tray towers - calculation of number of trays - McCabe Thiele method - Assumptions in McCabe-Thiele method -Graphical procedure to determine the number of theoretical trays -total reflux - minimum reflux - optimum reflux- q line –values of q based on five different feed conditions- operating lines – feed tray location.- Types of distillation column trays- Types of plate efficiencies- Overall efficiency and Murphree plate efficiency.</p> <p>Azeotropic distillation - Extractive distillation - Steam distillation.</p>	

Reference Books:

1. Unit operations of Chemical Engineering by W.L.McCabe & J.C.Smith - Sixth edition
-
McGraw Hill Book Co. Singapore – 2001.
2. Mass Transfer Operations by R.E.Treybal - McGraw Hill Book Co.1986.
3. Mass Transfer Principles and Operations by A.P.Sinha and Parameswar De,
PHI Publications, India.
4. Mass Transfer by KV Narayanan and B.Lakshmikutty, CBS Publishers.
5. Text Book of Mass Transfer operations-I, by KiranD.Patil-Nirali Prakashan, Pune.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076520

Semester : V Semester

Subject Title : PROCESS INSTRUMENTATION AND CONTROL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
PROCESS INSTRUMENTATION AND CONTROL	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	BASIC CONCEPTS OF MEASUREMENT AND MEASUREMENT OF TEMPERATURE	13
II	MEASUREMENT OF PRESSURE	13
III	MEASUREMENT OF FLOW, LIQUID LEVEL AND HUMIDITY.	13
IV	PROCESS CONTROL	19
V	COMPUTERIZED PROCESS CONTROL	17
Test & Model Exam		7
Total		80

Rationale:

This subject gives the knowledge of various instruments used to measure various processes parameters. This course will impart knowledge on working principle, construction, repair, and use of these instruments. This course will make the students knowledgeable in various types of measuring instruments used in chemical process industries.

The diploma holder in chemical engineering has to deal with all kinds of equipment's in the chemical industry. This subject provides him/her thorough knowledge using all type of measuring & control instruments along with heat transfer, mass transfer equipment's along with pumps, blowers, compressors, crushers and screens and size reduction machines.

OBJECTIVE

- 1.1 To understand the application of various Industrial instruments & control
- 1.2 System to measure the process variables
- 1.3 To know the necessity of studying Instrumentation
- 1.4 To list out various Temperature measuring Instruments
- 2.1 To list out various pressure measuring Instruments
- 2.2 To understand the working of various temperature measuring Instruments
- 2.3 To understand the working of various pressure measuring Instruments
- 3.1 To list out various Flow measuring Instruments
- 3.2 To list out various Liquid level measuring Instruments
- 3.3 To measure the Flow rate using different flow measuring Instruments
- 3.4 To handle various level measuring Instruments
- 3.5 To understand the operation of different Humidity measuring Instruments
- 4.1 To understand the significance of automatic control system.
- 4.2 To distinguish the various modes of control actions
- 4.3 To understand the principle of various controllers
- 5.1 To understand about transmission of both analog and digital signals
- 5.2 To understand the concept about Distributed Controlled System and its applications.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p>BASIC CONCEPT OF MEASUREMENT AND MEASUREMENT OF TEMPERATURE</p> <p>Purpose of Instrumentation – Measurement and its aim- Functional elements of Instruments – Static and Dynamic characteristics of Instruments - Signalling and Recording Instruments – Instrumentation diagram.</p> <p>Temperature measuring Instruments- Methods of temperature measurement- - Bimetallic Thermometer- RTD- Thermocouples – Thermistor – Radiation Pyrometer- optical pyrometer- Temperature Transmitter.</p>	13
II	<p>MEASUREMENT OF PRESSURE</p> <p>Pressure- Units of Pressure- Different types of pressure- Methods of pressure measurement - Bourdon gauge - Bellow and Diaphragm pressure sensors.</p> <p>Vacuum measurement - Pirani gauge - Ionization gauge. Electrical pressure Transducers - Strain gauge pressure Transducers – Differential pressure Transmitter- Piezoelectric Pressure Transducer.</p>	13
III	<p>MEASUREMENT OF FLOW ,LIQUID LEVEL AND HUMIDITY</p> <p>Flow measurement: Introduction- Methods of flow measurement- Orifice meter–Venturimeter- Rotameter- Pitot tube-Electromagnetic Flow meter- Turbine flow meter- Nutating Disc type.</p> <p>Liquid level measurement: Introduction- Methods of level measurement- Sight glass- Float-tape level indicator- Air purge system- Capacitive and Conductivity type level sensor- Radiation level detector.</p> <p>Humidity measurement: Hair Hygrometer – Sling Psychrometer.</p>	13

IV	<p style="text-align: center;">PROCESS CONTROL</p> <p>Automatic control system –significance –Terminology used in control system: controlled variable, manipulated variable, set point, etc.,-General process control system: open loop system ,closed loop system ,Feedback control system, Feed forward control system and Ratio control system (Principles and Purposes only)- Block diagram-elements of process dynamics –static and dynamic behaviour of process-process lag-dead time-process degree of freedom.</p> <p>Automatic controllers: controllers- classification; based on control action such as P,I,PI,PD,PID – based on actuating medium such as Pneumatic, Hydraulic and Electronic(concept and application only in Pneumatic system) - Final control element: control valves, variable speed drives.</p> <p>Control application in (a) liquid level system (b) Heat Exchanger-control of temperature and flow rate. (c) Batch Reactor- control of temperature and pressure.</p>	19
V	<p style="text-align: center;">COMPUTERIZED PROCESS CONTROL</p> <p>Modes of signal- Transmission of analog signal-electronic and pneumatic methods- Transmission of Digital signal - Data logging and transmission using computer-conversion of analog signal into digital vice-versa.</p> <p>Process control computers: Analog computer system, Digital computer system-Features of both types- application of Distributed Controlled System(DCS) in unit operation ,unit process and plant control-schematic diagrams for the control of simple unit process-computer supervisory control-simple control flow sheets using computer for Batch reactor and CSTR.</p>	17

Reference Books:

1. Industrial Instrumentation by Donald P Eckman , Allied Publishers, 1982
 2. Industrial Instrumentation and control by S.K Singh , Twelfth edition, Tata McGraw Hill Publishing Company Ltd ., New Delhi.
 3. Automatic Process Control by Donald P.Eckman, Sixth edition, Wiley Eastern Limited.
- Computer Control of Processes by Chidambaram, Narosa Publishing House.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076531

Semester : V Semester

Subject Title : CHEMICAL TECHNOLOGY

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
CHEMICAL TECHNOLOGY	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	PROCESS WATER TREATMENT	14
II	INORGANIC CHEMICALS AND ALLIED INDUSTRIES	16
III	FERTILIZER AND ACID INDUSTRIES	15
IV	OIL, SOAP AND PAPER INDUSTRY	14
V	POLYMER INDUSTRY	14
Test & Model Exam		7
Total		80

Rationale:

It is necessary to provide information to Chemical Engineering students about new materials, chemicals involved and manufacturing process of some important and frequently used chemical products. Due to these basic knowledge, the students can develop their skill further in process industries.

Objectives:

After completion of the syllabus in this subject, students are able to

- 1.1 To understand the knowledge of hardness of water and its causes.
- 1.2 To understand various methods of water treatment methods.
- 1.3 To acquire the knowledge of municipal and industrial waste water treatment.
- 1.4 To bring about the knowledge of membrane separation processes.
- 1.1 To understand the process involved in manufacture of Soda ash and Caustic Soda.
- 2.2 To understand the process involved in manufacture of carbon dioxide, Oxygen and its uses.
- 3.1 To understand the process involved in manufacture of Ammonia and its uses.
- 3.2 To understand the process involved in manufacture of Urea, NPK & Super Phosphate.
- 4.1 To acquire the knowledge of commercial glasses and its methods of Manufacture.
- 4.2 To understand the process involved in the manufacture of Cement.
- 4.3 To acquire the knowledge of constituents of paint and its manufacturing Processes.
- 5.1 To understand the manufacturing process of sulfuric acid and hydrochloric Acid.
- 5.2 To understand the manufacturing process of Phosphoric and Nitric acid and its uses.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">PROCESS WATER TREATMENT</p> <p>Sources of water- characteristics of water- Hardness- Temporary hardness and Permanent hardness- disadvantages of hard water- scale formation in boilers & its disadvantages- caustic embrittlement.</p> <p>Water softening methods- Lime soda process, Zeolite process, Ion – Exchange process- Demineralisation of water and its importance- difference between cooled water and chilled water and its applications- preparation of Boiler feed water- need for deaeration- working principle of Deaerator.</p>	14
II	<p style="text-align: center;">INORGANIC CHEMICALS AND ALLIED INDUSTRIES</p> <p>Raw materials, reactions involved, Process description and applications for the following process: Manufacture of Soda ash by Solvay process- manufacture of chlorine- chlorine compression and liquefaction- manufacture of caustic soda by membrane cell process- caustic soda flakes production.</p> <p>Manufacture of Oxygen from air by Liquefaction- Manufacture of Portland cement- phenomena of setting of cement- Manufacture of paint- Manufacture of glass- various grades of glass.</p>	16

III	<p style="text-align: center;">FERTILIZER AND ACID INDUSTRIES</p> <p>Manufacture of Ammonia- Desulphurisation- primary and secondary Reforming- shift conversion- Co₂ removal – final rectification- Ammonia synthesis and recovery- uses of Ammonia.</p> <p>Raw materials, reactions involved, Process description and applications for the following process: Manufacture of Urea- Manufacture of Triple Superphosphate- Manufacture of Phosphoric acid – Manufacture of Sulphuric acid by DCDA process- Manufacture of Nitric acid.</p>	15
IV	<p style="text-align: center;">OIL, SOAP AND PAPER INDUSTRY</p> <p>Chemistry of oils and fats- classification of oils- Distinguish between oils and fats- Production of oil from plant seeds- Hydrogenation of vegetable oils- Manufacture of soap by full boiled process- recovery and purification of Glycerine.</p> <p>Manufacture of pulp by Kraft process- classification of pulping process- Black liquor and brown liquor- Manufacture of paper from pulp.</p>	14
V	<p style="text-align: center;">POLYMER INDUSTRY</p> <p>Polymers- classification of polymers- methods of polymerisation- addition polymerisation and condensation polymerisation with examples- Types of polymerisation- Bulk polymerisation, Solution polymerisation, and Emulsion polymerisation.</p> <p>Manufacture of polyethylene by high pressure process- Manufacture of Polypropylene by Gas-phase process- Manufacture of Nylon 6-6 from Caprolactum- Rubber- classification of rubber with examples- Manufacture of Styrene- Butadiene Rubber (SBR).</p>	14

Reference Books:

1. Shreve's Chemical Process Industries - George T.Austin - Fifth Edition
McGraw Hill Book Co. Singapore – 1984.
2. Dryden's Outlines of Chemical Technology for the 21st Century – Gopal Rao, 3rd
Edition - Affiliated East West Press Pvt. Ltd., New Delhi – 2001.
3. Chemical technology I and II - Chemical engineering education development
Centre, I.I.T. Chennai .
4. Industrial Chemicals by Faith - John Wiley and Sons.
5. .Encyclopedia of Chemical Technology - 4th Edition Kirk Othmer.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076532

Semester : V Semester

Subject Title : ELECTROCHEMICAL ENGINEERING

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
ELECTROCHEMICAL ENGINEERING	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	POLARISATION AND OVER POTENTIAL	14
II	COLLOIDAL ELECTROCHEMISTRY	15
III	ELECTROACTIVE LAYERS AND MODIFIED ELECTRODES	15
IV	ELECTROCHEMICAL TECHNIQUES	15
V	ELECTROLYTIC PRODUCTION OF IN-ORGANIC CHEMICALS	14
Test & Model Exam		7
Total		80

RATIONALE:

1. To produce employable students with the knowledge and competency in Chemical and electrochemical engineering complemented by the appropriate skills and attributes.
2. To produce creative and innovative students with design and soft skills to carry out various problem solving tasks.
3. To enable the students to work as teams on multidisciplinary projects with effective communication skills, individual, supportive and leadership qualities with the right attitudes and ethics.
4. To produce students who possess interest in research and lifelong learning, as well as continuously striving for the forefront of technology.
5. To enable the students to set up models for an electrochemical system, based on continuity equations and transport equations for relevant variables, and with necessary boundary conditions.

OBJECTIVES:

The students of this program would have

1. Ability to implement equations for production and transport of heat in electrochemical systems, and explain the temperature dependence of electrode potentials, electrode kinetics and mass transport properties.
2. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
3. Ability implement models for current distribution in porous electrodes.
4. Understanding of professional and ethical responsibility.
5. Recognition of the need and ability to engage in life-long learning.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	POLARISATION AND OVER POTENTIAL Electrolytic polarization, Dissolution and Decomposition potential, Overvoltage – hydrogen and oxygen overvoltage, applications, Polarography – principles, diffusion layer, limiting current density, polarographic circuit, dropping mercury electrode, merits & demerits, supporting electrolyte, current maxima, polarograms, half wave potential, diffusion current, applications	14
II	COLLOIDAL ELECTROCHEMISTRY Electrochemical properties of colloids – Charge on colloidal particles, Electrical Double Layer, Coagulation of colloidal sols, Electro kinetic phenomena - Electro-Osmosis – Determination of zeta potential, Electrophoresis – sedimentation potential (Dorn effect), Determination of colloidal particle size, Surfactant, Emulsion, Emulsifiers, gels - Applications	15
III	ELECTROACTIVE LAYERS AND MODIFIED ELECTRODES Chemically modified electrodes, Types and methods of modification – chemisorption, covalent bond formation, polymer film coatings, inorganic materials, Langmuir-Blodgett (LB) methods, properties of the modified electrodes, electrochemistry at monolayer and multilayer modified electrodes, characterisation of modified electrodes.	15

IV	<p style="text-align: center;">ELECTROCHEMICAL TECHNIQUES</p> <p>Ion selective electrodes – Principles of potentiometry and amperometry- determination of dissolved oxygen. Linear sweep voltammetry and cyclic voltammetry derivation of Randles- Sevciks equation – effect of sweep rate-analysis of cyclic voltammograms.</p> <p>Potential step method (chronoamperometry) under diffusion control derivation of Cottrell equation for a planar and spherical electrode- significance of spherical diffusion – derivation of Ilkovic equation.- Chronopotentiometry and analysis of chronopotentiograms-derivation of sands equation for constant current input under linear diffusion- concepts of Faradaic impedance –derivation of kinetic parameters from impedance measurements – Nyquist and bode plots for simple redox reactions-principles of scanning probe techniques-STM-AFM and SECM – working principles of electrochemistry.</p>	15
V	<p style="text-align: center;">ELECTROLYTIC PRODUCTION OF IN-ORGANIC CHEMICALS</p> <p>Electrolytic production of sodium hypochlorite, sodium and potassium chlorates, bromates and iodates. Sodium, potassium and ammonium perchlorates, perchloric acid. Potassium, and ammonium persulphates, hydrogen peroxide, potassium permanganate, cuprous oxide and manganese dioxide – Basic principles, reaction mechanisms, effect of operating variables, cell design and operating characteristics of industrial cells.</p>	14

Reference Books:

1. Electrochemical methods- Fundamentals and applications by Bard and Faulkner John Wiley son's publications.
2. Electrochemical reaction engineering by Scott, Academic Press.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS

N-SCHEME

(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)
 Subject Code : 4076533
 Semester : VI
 Subject Title : Natural Gas Engineering

TEACHING AND SCHEME OF EXAMINATION:

No. of Weeks per Semester: 16 Weeks

Subject	Instructions		Examination			
	Hours/ week	Hours/ Semester	Marks			Duration
			Internal Assessment	Board Examination	Total	
NATURAL GAS ENGINEERING	5	80	25	100*	100	3 Hrs

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

TOPICS AND ALLOCATION OF HOURS

Unit	Topic	Hours
1	Properties And Composition Of Natural Gas	15
2	Estimation And Production Of Natural Gas	14
3	Gas From Condensate Oil Fields	14
4	Acid Gas Treating Of Natural Gas	15
5	Dehydration Of Natural Gas And NGL Recovery	15
6	Test & Revision	7
Total		80

RATIONALE:

The process of making the oil and gas available in the huge quantities needed to sustain our industrial economy and maintain our standard of living is quite challenging. Petroleum engineers are trained to face these challenges. Oil and gas must be discovered: its quantity and production potential must be assessed: optimal extraction methods must be established to maximize recovery; and it must be transported from the point of production to the refinery and then stored. All these processes need to be carried out in an environmentally benign manner. Petroleum engineers must be multi-faceted in order to cover all these various aspects.

OBJECTIVES:

On Completion of the units of syllabus contents the students must be able to understand the following:

- Understand the basic concept and application of natural gas engineering.
- Formulating, communicating and implementing solutions to engineering problems in a variety of professional environment.
- Understand the Importance, properties and composition of natural gas.
- Estimate and production of natural gas.
- *Understand Principles and production of acid gas treating of natural gas.*
- *Understand Processing of condensate well fluids.*
- Know about different types of dehydration of natural gas and NGL recovery.
- Learn the Natural gas processing, gas compression, Gas gathering, operation and trouble shooting of natural gas pipelines.

DETAILED SYLLABUS

Contents : Theory

UNIT	NAME OF TOPICS	Hours
I	<p style="text-align: center;">PROPERTIES AND COMPOSITION OF NATURAL GAS</p> <p>Natural gas origin - Composition of natural gas - Sources of Natural gas - Thermodynamics Properties, Specific gravity, Pseudo critical Properties, viscosity - Compressibility factor and chart for natural gas - Heating value and flammability limit of natural gas - Source of information for natural gas engineering and its applications.</p>	15 Hrs
II	<p style="text-align: center;">ESTIMATION AND PRODUCTION OF NATURAL GAS</p> <p>Estimation of gas reserves by volumetric method: Isopach, isowall map, material balance method, model studies method – Production of natural gas - LPG treatment process - Pressure decline method -Problems in the production of natural gas - Field separation – Vertical separations, Horizontal separations.</p>	14 Hrs
III	<p style="text-align: center;">GAS FROM CONDENSATE OIL FIELDS</p> <p>Processing of condensate well fluids - High pressure gas and gas sales system, Reabsorption in condensate system, distillation in stabilization - Cycling of gas condensate reservoirs - Sweep patterns -Katy cycling pla - Gathering and transmission, and natural gas liquefaction.</p>	14 Hrs
IV	<p style="text-align: center;">ACID GAS TREATING OF NATURAL GAS</p> <p>Acid gas removal: Metal oxide process- Iron oxide process , Zinc oxide process - Slurry process - Chem Sweet process, sulfa check process - Amine process, girbotol process - Carbonate washing process - Methanol based process - rectisol process, ifp process, potassium phosphate process, alkazid process, hotpotassiumcarbonate process, giamarco vetrocoke process, molecular sieve and membrane waste process - Sulphur recovery process - Claus process, sulphur production by redox process.</p>	15 Hrs

V	DEHYDRATION OF NATURAL GAS AND NGL RECOVERY	15 Hrs
	<p>Dehydration: Glycol dehydration - Solid desiccant dehydration, refrigeration cooling of gas desiccant dehydration, membrane – vortex dehydration process, supersonic dehydration process.</p> <p>NGL Recovery: shrinking process- Refrigeration process - mechanical cascade refrigeration process, mixed refrigeration process, self refrigeration process, cryogenic refrigeration process - ortloff gas sub cooled process, ortloff residue split vapour pressure - Lean oil absorption process-Solid bed adsorption and membrane separation process - NGL fractionation.</p>	

REFERENCE BOOKS:

1. "Katz and Lee" "Hand Book of Natural Gas Engineering", Tata McGraw Hill.
2. "Lyons, W.C" "Standard Handbook of Petroleum and Natural Gas Engineering", Vol. 2, Gulf Professional Publishing, Elsevier Inc.
3. "Katz D.L. and Lee, R.L" "Natural Gas Industry-A Review of World Resources and Industrial Applications", Butterworth.
4. "During, M.M" "The Natural Gas Industry-A Review of World Resources and Industrial Applications", Butterworth.
5. "Saied Mokhatab, William A. Poe, and James G. Speight" "Hand book of Natural Gas Transmission and Processing", Gulf Professional Publishing, Elsevier Inc.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076540

Semester : V Semester

Subject Title : ENTREPRENEURSHIP AND STARTUPS

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examination	Total	
ENTREPRENEURSHIP AND STARTUPS	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Entrepreneurship – Introduction and Process	12
II	Business Idea and Banking	12
III	Start ups, E-cell and Success Stories	12
IV	Pricing and Cost Analysis	12
V	Business Plan Preparation	12
Revision		4
Total		64

RATIONALE:

Development of a diploma curriculum is a dynamic process responsive to the society and reflecting the needs and aspiration of its learners. Fast changing society deserves changes in educational curriculum particularly to establish relevance to emerging socio-economic environments; to ensure equity of opportunity and participation and finally promoting concern for excellence. In this context the course on entrepreneurship and start ups aims at instilling and stimulating human urge for excellence by realizing individual potential for generating and putting to use the inputs, relevant to social prosperity and thereby ensure good means of living for every individual, provides jobs and develop Indian economy.

OBJECTIVES

At the end of the study of 5th semester the students will be able to

- To excite the students about entrepreneurship
- Acquiring Entrepreneurial spirit and resourcefulness
- Understanding the concept and process of entrepreneurship
- Acquiring entrepreneurial quality, competency and motivation
- Learning the process and skills of creation and management of entrepreneurial venture
- Familiarization with various uses of human resource for earning dignified means of living
- Know its contribution in and role in the growth and development of individual and the nation
- Understand the formation of E-cell
- Survey and analyze the market to understand customer needs
- Understand the importance of generation of ideas and product selection
- Learn the preparation of project feasibility report
- Understand the importance of sales and turnover
- Familiarization of various financial and non-financial schemes
- Aware the concept of incubation and starts ups

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p data-bbox="256 344 948 376">Entrepreneurship – Introduction and Process</p> <ul data-bbox="304 405 1174 1211" style="list-style-type: none"><li data-bbox="304 405 863 436">● Concept, Functions and Importance<li data-bbox="304 461 783 492">● Myths about Entrepreneurship<li data-bbox="304 517 858 548">● Pros and Cons of Entrepreneurship<li data-bbox="304 573 762 604">● Process of Entrepreneurship<li data-bbox="304 629 703 660">● Benefits of Entrepreneur<li data-bbox="304 685 852 716">● Competencies and characteristics<li data-bbox="304 741 703 772">● Ethical Entrepreneurship<li data-bbox="304 797 884 828">● Entrepreneurial Values and Attitudes<li data-bbox="304 853 501 884">● Motivation<li data-bbox="304 909 488 940">● Creativity<li data-bbox="304 965 501 996">● Innovation<li data-bbox="304 1021 852 1052">● Entrepreneurs - as problem solvers<li data-bbox="304 1077 1174 1108">● Mindset of an employee and an entrepreneur<li data-bbox="304 1133 932 1164">● Business Failure – causes and remedies<li data-bbox="304 1189 911 1220">● Role of Networking in entrepreneurship	
II	<p data-bbox="256 1312 675 1344">Business Idea and Banking</p> <ul data-bbox="304 1373 1259 2011" style="list-style-type: none"><li data-bbox="304 1373 1166 1404">● Types of Business: Manufacturing, Trading and Services.<li data-bbox="304 1429 1075 1514">● Stakeholders: sellers, vendors and consumers and Competitors<li data-bbox="304 1538 799 1570">● E- commerce Business Models<li data-bbox="304 1594 1259 1680">● Types of Resources - Human, Capital and Entrepreneurial tools and resources<li data-bbox="304 1704 1254 1789">● Selection and utilization of human resources and professionals, etc.<li data-bbox="304 1814 807 1845">● Goals of Business; Goal Setting<li data-bbox="304 1870 1035 1901">● Patent, copyright and Intellectual property rights<li data-bbox="304 1926 916 1957">● Negotiations - Importance and methods<li data-bbox="304 1982 1007 2013">● Customer Relations and Vendor Management	

	<ul style="list-style-type: none"> ● Size and capital based classification of business enterprises ● Various sources of Information ● Role of financial institutions ● Role of Government policy ● Entrepreneurial support systems ● Incentive schemes for state government ● Incentive schemes for Central Governments 	
III	<p>Start ups, E-cell and Success Stories</p> <ul style="list-style-type: none"> ● Concept of Incubation centre's ● Visit and report of DIC , financial institutions and other relevance institutions ● Success stories of Indian and global business legends ● Field Visit to MSME's ● Study visit to Incubation centres and start ups ● Learn to earn ● Startup and its stages ● Role of Technology – E-commerce and Social Media ● Role of E-Cell ● E-Cell to Entrepreneurship 	
IV	<p>Pricing and Cost Analysis</p> <ul style="list-style-type: none"> ● Unit of Sale, Unit Price and Unit Cost - for single product or service ● Types of Costs - Start up, Variable and Fixed ● Income Statement ● Cash flow Projections ● Break Even Analysis - for single product or service ● Taxes ● Financial Business Case Study ● Understand the meaning and concept of the term Cash Inflow and Cash Outflow ● Price ● Calculate Per Unit Cost of a single product 	

	<ul style="list-style-type: none"> ● Operational Costs ● Understand the importance and preparation of Income Statement ● Prepare a Cash Flow Projection ● Projections ● Pricing and Factors affecting pricing. ● Launch strategies after pricing and proof of concept 	
V	<p>Business Plan Preparation</p> <ul style="list-style-type: none"> ● Generation of Ideas. ● Business Ideas vs. Business Opportunities ● Opportunity Assessment – Factors, Micro and Macro Market Environment ● Selecting the Right Opportunity ● Product selection ● New product development and analysis ● Feasibility Study Report – Technical analysis, financial analysis and commercial analysis ● Market Research - Concept, Importance and Process ● Market Sensing and Testing ● Marketing and Sales strategy ● Digital marketing ● Branding - Business name, logo, tag line ● Promotion strategy ● Business Plan Preparation ● Social Entrepreneurship as Problem ● Solving - Concept and Importance ● Risk Taking-Concept ● Types of business risks ● Execution of Business Plan 	

Note: (i) Unit 1, 2 & 3 contents are common for all diploma programs

(ii) Unit 4 & Unit 5 contents are optional; Conveners/HoDs are requested framing with their branch specific contents.

REFERNCE BOOKS:

1. Dr. G.K. Varshney, Fundamentals of Entrepreneurship, Sahitya Bhawan Publications, Agra - 282002
2. Dr. G.K. Varshney, Business Regulatory Framework , Sahitya Bhawan Publications, Agra - 282002
3. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Entrepreneurship , McGraw Hill (India) Private Limited, Noida - 201301
4. M.Scarborough, R.Cornwell, Essentials of Entrepreneurship and small business management, Pearson Education India, Noida - 201301
5. Charantimath Poornima M. Entrepreneurship Development and Small Business Enterprises, Pearson Education, Noida - 201301
6. Trott, Innovation Management and New Product Development, Pearson Education, Noida - 201301
7. M N Arora, A Textbook of Cost and Management Accounting, Vikas Publishing House Pvt. Ltd., New Delhi-110044
8. Prasanna Chandra, Financial Management, Tata McGraw Hill education private limited, New Delhi
9. I. V. Trivedi, Renu Jatana, Indian Banking System, RBSA Publishers, Rajasthan
10. Simon Daniel, HOW TO START A BUSINESS IN INDIA, BUUKS, Chennai - 600018
11. Ramani Sarada, The Business Plan Write-Up Simplified - A practitioners guide to writing the Business Plan, Notion Press Media Pvt. Ltd., Chennai 600095.

Board Examination – Evaluation Pattern

Internal Mark Allocation

Assignment (Theory portion)*	- 1
	0
Seminar Presentation	- 1
	0
Attendance	- 5
Total	- 2
	5

Note: * Two assignments should be submitted. The same must be evaluated and converted to 10 marks.

Guidelines for assignment:

First assignment – Unit I

Second assignment – Unit

II

Guidelines for Seminar Presentation-

Unit III

Each assignment should have five three marks questions and two five marks questions.

BOARD EXAMINATION

Note

1. The students should be taught all units and proper exposure and field visit also arranged. All the portions should be completed before examinations.
2. The students should maintain theory assignment and seminar presentation. The assignment and seminar presentation should be submitted during the Board Practical Examinations.
3. The question paper consists of theory and practical portions. All students should write the answers for theory questions (45 Marks) and practical portions (55 Marks) should be completed for board examinations.
4. All exercises should be given in the question paper and students are allowed to select by lot. If required the dimensions of the exercises may be varied for

every batch. No fixed time allotted for each portion and students have liberty to do the examination for 3Hrs.

5. For Written Examination: theory question and answer: 45 Marks

Ten questions will be asked for 3 marks each. Five questions from each unit 1 & 2. (10 X 3 = 30).

Three questions will be asked for 5 marks each. One question from each unit 1, 2 & 3. (3 X 5 = 15)

6. For Practical Examination: The business plan/Feasibility report or Report on Unit 4 & 5 should be submitted during the board practical examinations. The same have to be evaluated for the report submission (40 marks).

DETAILED ALLOCATION OF MARKS

Sl. No	Description	Marks
Part A	Written Examination - Theory Question and answer (10 questions x 3 marks:30 marks & (3 questions x 5 marks: 15 marks)	45
Part B	Practical Examination – Submission on Business Plan/Feasibility Report or Report on Unit 4 & 5	40
Part C	Viva voce	15
	Total	100

MODEL QUESTION PAPER
ENTREPRENEURSHIP AND START UPS

Part A

Time: 1 hour

Marks: 45

- I. Answer ten questions in brief (10x3=30)
1. Define entrepreneurship.
 2. State the process of entrepreneurship
 3. What are the benefits of being an entrepreneur?
 4. How do entrepreneurs act as problem solvers?
 5. Outline the role of networking in entrepreneurship.
 6. List the various types of business
 7. Outline the business model.
 8. Suggest the various goals of business.
 9. How selection of human resources is carried out?
 10. Specify the role of government policy on entrepreneurship.

- II. Answer three questions in details (3x5=15)

11. Describe the importance of innovation on entrepreneurship.
12. Enumerate the various incentive schemes for the central government.
13. How technology will play a major role in E- commerce?

Part B

Practical Examination – Submission on Business Plan / Feasibility Report or Report on Unit 4 & 5

Marks:40

PART C

Viva Voce

Marks:15

TATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076550

Semester : V Semester

Subject Title : CHEMICAL PROCESS SIMULATION PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
CHEMICAL PROCESS SIMULATION PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education skill development plays a vital role. These can be achieved by experience in handling various equipments. This is accomplished by doing engineering related experiments in practical classes.

Objectives:

- Able to handle various unit operation and plant at different condition of process variable using simulator.
- Need of simulator- Application of simulators distributed controlled system-Dynamic Graphic (mimic), Bar graph- Trend and Alarm

Guidelines:

- All the Ten experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking reading in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.
- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitted a batch of 30 students during Board Examinations

LIST OF EXPERIMENTS

Practice the following using process simulator. The simulator can be used from Virtual Lab simulators created by Ministry of Education under National Mission on Education through ICT.

Change the P,I,D values and process parameters and observe the change in trend, bar graph and mimics

Attend the malfunction occurring in the plant then restoring to its design conditions.

Perform the experiments using the simulator by varying the process variables and tabulate the results.

Practice the above exercise on the following modules given below using process simulator.

1. Fractionation column for the distillation of binary mixture
2. Batch Reactor / Reaction kinetic studies in Batch Reactor
3. Double pipe Heat exchanger
4. Size reduction using Ball mill / Drying characteristics of solids using Rotary Drier.
5. Level and flow control in different sizes of vessel
6. Continuous Stirred Tank Reactor
7. Centrifugal pump
8. Fluidized bed column
9. Packed bed column
10. Flow through pipes.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076560

Semester : V Semester

Subject Title : PROCESS INSTRUMENTATION AND CONTROL PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
PROCESS INSTRUMENTATION AND CONTROL PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education skill development plays a vital role. These can be achieved by experience in handling various equipments. This is accomplished by doing engineering related experiments in practical classes.

Guidelines:

- All the Ten experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking reading in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.
- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitted a batch of 30 students during Board Examinations.

LIST OF EXPERIMENTS

1. Study of characteristics of Thermocouple module.
2. Study of characteristics of RTD module.
3. Study of characteristics of Thermistor module.
4. Measurement of Pressure using Bourdon Pressure Transducer
5. Study the linearity of P/I and I/P converter.
6. Level measurement by using Differential Pressure (DP) Transmitter.
7. Study of valve flow coefficients and inherent characteristics of Linear, Equal% and Quick opening.
8. Study of ON- OFF controller using Temperature controller Trainer kit by monitoring the process in SCADA mode or Analog.
9. Study of P, PI and PID controller using Liquid Level controller Trainer kit by monitoring the process in SCADA mode or Analog.
10. Study of P, PI and PID controller using Pressure controller Trainer kit by monitoring the process in SCADA mode or Analog.

LIST OF EQUIPMENTS

1. Thermocouple, RTD – 1 No
2. Thermistor- 1 No
3. Bourdon Pressure Transducer- 1No
4. P/I and I/P converter -1 No
5. Differential Pressure Transmitter – 1 No
6. Pneumatic control valve (Linear, Equal % and Quick opening) set up -1 No
7. Temperature control Trainer Kit with SCADA or Analog- 1
8. Liquid Level control Trainer Kit with SCADA or Analog -1No
9. Pressure Control Trainer Kit with SCADA or Analog -1 No

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076570

Semester : V Semester

Subject Title : PETROLEUM TESTING PRACTICAL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
PETROLEUM TESTING PRACTICAL	4	64	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education skill development plays a vital role. These can be achieved by experience in handling various equipments. This is accomplished by doing engineering related experiments in practical classes.

Guidelines:

- All the experiments given in the list of experiments should be completed and given for the end semester practical examination.
- In order to develop best skills in handling Instruments/Equipment and taking reading in the practical classes, every two students should be provided with a separate experimental setup for doing experiments in the laboratory.
- The external examiners are requested to ensure that a single experimental question should not be given to more than four students while admitted a batch of 30 students during Board Examinations.

LIST OF EXPERIMENTS

1. Reid Vapor pressure determination test.
2. Smoke point determination test.
3. Aniline point determination test.
4. ASTM distillation to find the quality of the petroleum product.
5. Total Acidity test
6. Bromine number test to determine the % of olefin in the Distillate.
7. Carbon residue determination by Conradson method.
8. Carbon residue determination by Rams bottom method
9. Copper corrosion test.
10. Determination of Sediments and water in crude by centrifuging.

Apparatus / Equipment Required:

1. Reid vapor pressure apparatus- 1 No
2. Smoke point apparatus- 1 No
3. Aniline Point apparatus -1 No
4. ASTM Distillation unit -1 No
5. Centrifuge-1 No
6. Electronic Balance -1No
7. Hot Plate-1 No
8. Thermometer- 4 No's

Glass ware & miscellaneous items required:

1. Round Bottom Flask
2. Conical Flask
3. Beaker
4. Burette
5. Pipette
6. Standard Flask
7. Centrifuge Tubes
8. Measuring Cylinder
9. Silica crucible
10. Glass beads

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076610

Semester : VI Semester

Subject Title : MASS TRANSFER-II

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			
	Hours / Week	Hours / Semester	Marks			Duration
			Internal Assessment	Board Examinations	Total	
MASS TRANSFER-II	6	96	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	Drying	15
II	Crystallization	20
III	Solvent extraction	20
IV	Leaching	18
V	Adsorption	16
Test & Model Exam		7
Total		96

Rationale:

In this subject the basic concepts of mass transfer are covered to enable the students to understand working of various mass transfer equipment's like crystallizers and driers which are used in industries for purification of products

This course explains the fundamentals of mass transfer and techniques involved in mass transfer operations of extraction, drying and adsorption.

This subject intends to equip the students with the concept and principles of mass transfer operation, which are of prime importance in any chemical industry. Mass transfer equipment's are an integral part of any chemical plant. This subject will help the students to operate and design various mass transfer equipment's.

Objectives:

On completion of the units of Syllabus, the students must be able to know about the following

- 1.1 The principles of extraction process
- 1.2 Various types of extraction equipments.
- 2.1 Drying characteristics solid material
- 2.2 Diffusion mechanism and capillary mechanism in drying
- 2.3 Different types of dryers used in industries.
- 3.1 Principles of Crystallization
- 3.2 Crystal growth and Crystal characteristics
- 3.3 Type of crystallizers used in industries.
- 4.1 The differences between Physical and Chemical adsorption
- 4.2 Types of adsorbents and their applications
- 4.3 Various absorption Equipments used in industries.
- 5.1 The principles of Leaching and their significance
- 5.2 Different methods of leaching used in industries
- 5.3 Operation of various leaching equipments.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">DRYING</p> <p>Principles of Drying - Dry basis and wet basis- moisture content - Equilibrium moisture - free moisture.- Bound and unbound moisture – mechanism of drying of solids - Constant rate drying ,Falling rate drying and critical moisture content, Time of drying - Equation for time of drying- shrinkage and case hardening .</p> <p>Batch and continuous driers - Tray drier - Rotary drier - Spray drier - Fluidised bed drier – Freeze drier- Description and operation of the above equipments.-simple problems in drying.</p>	15
II	<p style="text-align: center;">CRYSTALLISATION</p> <p>Crystallisation- differentiate between evaporation and crystallisation- Importance of crystal size- origin of crystals in crystallizer- yield and purity of crystals- supersaturation- unit of supersaturation-methods of creating supersaturation- Nucleation- primary and secondary nucleation- Crystal growth- Ostwald ripening- caking and effect of humidity on storage.</p> <p>Crystallisation equipment- Forced circulation evaporator crystallizer- Oslo evaporative crystallizer- Draft tube baffle crystallizer - Description and operation of the above equipments.</p>	20

III	<p style="text-align: center;">SOLVENT EXTRACTION</p> <p>Liquid-liquid extraction – importance of extraction – raffinate and extract- triangular charts and their use – Distribution coefficient and selectivity – choice of solvent for extraction - applications of extraction.</p> <p>Extraction equipments-Mixer settler cascades - Sieve plate columns – Pulsed column extractor – rotating disk contactors- - Description and operation of the above equipments – comparison of extractors.</p>	20
IV	<p style="text-align: center;">LEACHING</p> <p>Principles of Leaching – difference between leaching and extraction– industrial applications of leaching- Factors affecting the rate of leaching- particle size, temperature, solvent and agitation- Shanks extraction battery process for leaching.</p> <p>Equipments for Leaching: Bollman Extractor - Rotocel extractor - Bonotto extractor – Description and operation of these equipments.</p>	18
V	<p style="text-align: center;">ADSORPTION</p> <p>Adsorption- comparison of physical and chemical adsorption- industrial applications of adsorption- Industrial adsorbents and their uses- Activated carbon, Silica Gel, Activated Alumina, Zeolites and Fuller’s Earth.</p> <p>Adsorption equipment- Agitated vessel, Fixed bed adsorber and moving bed adsorber- Description and operation of the above equipments.</p> <p>Adsorption regeneration- Temperature swing adsorption.</p>	16

Reference Books:

1. Unit operations of Chemical Engineering. By W.L.McCabe&J.C.Smith - Sixth edition McGraw Hill Book Co. Singapore - 2001
2. Mass Transfer Operations by R.E.Treybal - McGraw Hill Book Co.1986
3. Mass Transfer Principles and Operations by A.P.Sinha and Parameswar De, PHI Publications, India.
4. Text Book of Mass Transfer operations-I, by Kiran D.Patil-Nirali Prakashan, Pune.
5. Mass Transfer by KV Narayanan and B.Lakshmikutty, CBS Publishers.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076620

Semester : VI Semester

Subject Title : INDUSTRIAL SAFETY AND POLLUTION CONTROL

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
INDUSTRIAL SAFETY AND POLLUTION CONTROL	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	INDUSTRIAL ACCIDENT AND SAFETY	14
II	FIRE AND ITS PREVENTION	15
III	PROCESS PLANT HAZARDS	15
IV	PREVENTIVE AND PROTECTIVE MEASURES	15
V	POLLUTION CONTROL	14
Test & Model Exam		7
Total		80

Rationale:

This subject helps the students to understand the basic principles of plant safety and various safety measures adopted in chemical plants. Also helps to understand various occupational hazards existing in chemical industries. The subject aims at providing students the knowledge of various pollutants with respect to air, water and particularly emissions. The knowledge of students, mode of treatment and analysis techniques for different pollutants will also be imparted. Industrial safety is gaining importance with time and this subject will also cover chemical hazards.

Objectives:

On completion of the syllabus the student must be able

- 1.1 To understand the importance of safety in process industries by taking two case studies.
- 1.2 To understand the evaluation of various toxicants in the working area.
- 2.1 To acquire the knowledge about Fires, causes and their classification.
- 2.2 To know the importance of Flash point, Fire Point, LFL & UFL.
- 2.3 To understand the concepts of Fire balls, Runaway chemical reactions, etc.,
- 3.1 To Know how to carryout HAZOP study regarding temperature and pressure.
- 3.2 To know the working principle of various process protective equipments and their Importance.
- 3.3 To understand the various work permit system and their procedure.
- 3.4 To know the importance of emergency planning and their types.
- 3.5 To gain knowledge about various personnel protective equipments and their uses.
- 4.1 To bring about the important aspects in the environmental act 1986.
- 5.1 To understand the effects of acid rain, Global warming, Ozone depletion and their Control Measures.
- 5.2 To know the various chemical and biological treatment of industrial effluent.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">INDUSTRIAL ACCIDENT AND SAFETY</p> <p>Process Safety – causes of Accidents –unsafe acts and conditions– importance of safety in process industries – Responsibility of supervisor regarding safety – material safety data sheet and its importance- Evaluating workers exposure to volatile toxicants ,dusts and noise.</p> <p>Accident prevention- safety training and role of safety training in industry- Case study of accidents in process industry: Bhopal gas tragedy, India- Fukushima nuclear disaster, Japan.</p>	14
II	<p style="text-align: center;">FIRE AND ITS PREVENTION</p> <p>Elements of fire and Fire triangle - different causes of fire- Distinction between fires and explosion- Flash point and Fire point- causes of initiation of fire- classification of fires - causes of electrical fire- Fire alarms and smoke detectors.</p> <p>Fire extinguish techniques - working of Carbon-dioxide fire extinguisher and Dry chemical fire extinguisher.</p>	15
III	<p style="text-align: center;">PROCESS PLANT HAZARDS</p> <p>Hazard – classification of hazards- causes and prevention of Pressure vessel hazards- Static Electricity hazards and its control- Flammability and Toxicity- Lower Explosive Limit (LEL) and Upper Explosive Limit(UEL)- Threshold Limit Value(TLV)- Hazards of temperature- BLEVE- Runaway chemical reaction.</p> <p>MSDS(Material Safety Data Sheet) for the following chemicals- Ammonia, Benzene, Acetone, Phenol and Toluene.</p>	15
IV	PREVENTIVE AND PROTECTIVE MEASURES	

	<p>Permit to work system- Hot work permit, Confined space vessel work permit, safety precautions while entry into confined spaces and Height work permit- occupational safety and health risks related to maintenance- Lockout/ Tagout procedures.</p> <p>Functions of relief valves and safety valves - Breather vent for storage tanks- Function of Flame Arresters- Flare systems- Planning for Emergencies- Personnel protective Equipments and its importance.</p>	15
V	<p style="text-align: center;">POLLUTION CONTROL</p> <p>Air pollution-sources and types of pollutants-Adverse effects- Air sampling and Monitoring- Ozone depletion – Green house effects- Acid rain and Global warming - Important aspects of Environment Protection Act, 1986.</p> <p>Water pollution- sources and types- constituents of waste water- - Important terms used in water treatment- BOD, COD, DO, TDS, and Biodegradability tests -Primary treatment - Coagulation and Flocculation- Secondary (Biological) treatment - Activated Sludge process - Important aspects of The Water (Prevention and control of Pollution) Act, 1974.</p>	14

Reference books:

1. Hand Book of "Industrial Safety and Health, Trade and Technical Press Ltd. Morden, U.K.1980.
2. William Handley, Industrial Safety Hand Book, McGraw-Hill Book Company 2nd Edition, 1969.
3. Fawatt, H.H.and Wood, W.S. Safety and Accident Prevention in Chemical Operation, Interscience, 1965.
4. S.P.Mahajan, "Pollution Control in Process Industries" Tata McGraw Hill, NewDelhi1985.
5. K.S.N.Raju, "Chemical Process industry safety" Tata McGraw Hill, New Delhi 2006.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076631

Semester : VI Semester

Subject Title : PETROLEUM AND ENERGY ENGINEERING

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
PETROLEUM AND ENERGY ENGINEERING	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	CRUDE PETROLEUM AND LUBE OIL	14
II	CRACKING AND CHEMICAL TREATMENT OF PETROLEUM	14
III	MANUFACTURE OF PETROCHEMICALS-I	14
IV	MANUFACTURE OF PETROCHEMICALS-II	14
V	ENERGY ENGINEERING	17
Test & Model Exam		7
Total		80

RATIONALE:

Every Petrochemical engineering technologist gets acquainted with knowledge of petrochemical technology to operate a plant efficiency, safety and economically. Proper selection of equipment and process improves efficiency of the plant. By learning this subject they can measure performance of various refinery products and select relevant process with safe handling of equipment to obtain desired petrochemicals such as C1 to C4 and also aromatics Compounds. The various chapters of Petrochemical technology like C1, C2, C3, C4 fractions, aromatics and plastic derivatives etc., provide the complete sketch about the processes in all petrochemical complexes also provides the processing of raw materials for various commercial products based on crude petroleum.

OBJECTIVES:

On completion of the units of the syllabus the students must be able to know about

- The manufacturing process, Physical properties and uses from C1 compounds like Methanol, Chloromethane.
- The manufacturing process, Physical properties and uses from C2 compounds like Ethylene, Acetylene.
- The manufacturing process, Physical properties and uses from C3 compounds like Isopropanol, acetone. C4 Compounds - Butadiene manufacturing from various chemicals and its physical properties.
- The manufacturing process, Physical properties and uses of Aromatic Compounds.
- Properties, Classification, manufacturing and industrial applications of Plastics.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">CRUDE PETROLEUM AND LUBE OIL</p> <p>Petroleum- origin of petroleum- classification of crude petroleum- composition of petroleum- Different oil refineries of India and their capacities –Fractional distillation of crude oil – petroleum products from crude oil refining and their boiling ranges.</p> <p>Different tests of crude oil and its significance- Reid vapour pressure, Octane number, Cetane number, Calorific value, and Viscosity Index.</p>	14
II	<p style="text-align: center;">CRACKING AND CHEMICAL TREATMENT OF PETROLEUM</p> <p>Manufacturing process of Lube oil- treatment of lube oil- various additives added to lube oil- Manufacturing process of wax- Grades of wax – uses of wax.</p> <p>Cracking- types of cracking- thermal cracking and catalytic cracking- Fluidised catalytic cracking and their products- sweetening of petroleum- chemical treatment for upgrading liquid fuel- Hydrocracking, Reforming, Alkylation, Visbreaking and isomerisation.</p>	15
III	<p style="text-align: center;">MANUFACTURE OF PETROCHEMICALS-I</p> <p>Process description, flow diagram, reactions involved and uses of for the following process - Ethylene oxide by direct oxidation of ethylene- Butanol production by Oxo process – Nitrobenzene from benzene.</p> <p>Process description, flow diagram, reactions involved and uses for the following process- Phenol and acetone by isopropyl benzene oxidation- Dehydrogenation of ethyl benzene to styrene- production of synthesis gas from Naphtha.</p>	15

IV	<p style="text-align: center;">MANUFACTURE OF PETROCHEMICALS- II</p> <p>Process description, flow diagram and uses for the following process- Butadiene from dehydrogenation of Butane- cyclohexane from Benzene- Pthalic anhydride from O-Xylene- Maleic anhydride from Benzene.</p> <p>Process description, flow diagram and uses for the following process- Propylene oxide- Formaldehyde from methanol- Manufacture of LAB.</p>	15
V	<p style="text-align: center;">ENERGY ENGINEERING</p> <p>Needs of energy Conservation in process Industry – Energy conservation methods- Estimation of energy consumption - Specific Energy consumption (SEC) - simple problem in SEC- Energy optimization- Energy Audit in existing plant- Forecasting energy requirement.</p> <p>Waste heat recovery from stack gas and Boilers - Use of Refractory and insulating materials for energy savings - Energy efficient Motors and pumps-Energy efficiency in thermal utilities - cooling tower, Heat exchangers, Distillation column.</p>	14

Reference Books:

1. "M. Gopala Rao Marshall Sittig" "Dryden's Outlines of Chemical Technology", Edited and Reprinted by, 2nd Edition.
2. "Dr. B.K. BhaskaraRao" "A Text on Petro Chemicals", 1st Edition, Khanna Publishers.
3. "Austin, G.T" "Shreve's Chemical Process Industries", 5th Edition, McGraw Hill.
4. "Kirk-Othmer" "Encyclopedia of Chemical Technology", 4th Edition, 1993, Wiley – InterScience Publication, John Wiley & Sons, New York.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)

Subject Code : 4076632

Semester : VI Semester

Subject Title : RENEWABLE ENERGY TECHNOLOGY

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
RENEWABLE ENERGY TECHNOLOGY	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Topics and Allocation of Hours

UNIT	Topic	Hrs.
I	RENEWABLE ENERGY SOURCES	14
II	SOLAR ENERGY UTILIZATION	14
III	ENERGY STORAGE TECHNOLOGY	15
IV	GEO THERMAL AND OCEAN ENERGY	15
V	HYDROGEN ENERGY & FUEL CELL	15
Test & Model Exam		7
Total		80

Rationale:

This subject helps the students to understand the basic principles of various renewable sources like solar energy, wind energy, geothermal energy and the technology behind them and its various applications.

Objectives:

On completion of the syllabus the student must be able to

1. Understand the basic concepts of various energy sources.
2. Understand the solar energy utilization.
3. Understand about various energy storing technologies.
4. Understand the theories and application of Geothermal and ocean energy.
5. Understand the theories and application of Hydrogen energy and fuel cell.

DETAILED SYLLABUS

Contents: Theory

Unit	Name of the Topics	Hours
I	<p style="text-align: center;">RENEWABLE ENERGY SOURCES</p> <p>Solar energy: radiation measuring instrument, Basics of Flat plate collectors, Concentrators Solar Principle of photovoltaic conversion of solar energy. Application of solar energy. Wind energy: characteristics and measurement, Wind energy conversion principles, Types and classification of WECS. Biomass Energy: Classification of biomass. Physicochemical characteristics of biomass as fuel. Biomass conversion routes. Small Hydropower: Overview of micro, mini and small hydro system, types of hydro turbine; Ocean Energy, Principle of ocean thermal energy conversion system, Principles of Wave and Tidal energy conversion. Geothermal energy: Origin of geothermal resources, type of geothermal energy deposits. Hydrogen as a source of energy. Types of fuel cell, fuel cell system.</p>	14
II	<p style="text-align: center;">SOLAR ENERGY UTILIZATION</p> <p>Solar Radiation: Extra-terrestrial and terrestrial, radiation measuring instrument, radiation measurement and predictions. Solar thermal conversion: Basics, Flat plate collectors-liquid and air type. Theory of flat plate collectors, selective coating, advanced collectors, Concentrators: optical design of concentrators, solar water heater, solar dryers, solar stills Solar ponds, solar cooling and refrigeration, Solar thermal power generation and sterling engine. Solar photovoltaic: Principle of photovoltaic conversion of solar energy. Solar cells, Home lighting systems, Solar lanterns, Solar PV pumps, Solar energy storage options</p>	14

<p>III</p>	<p style="text-align: center;">ENERGY STORAGE TECHNOLOGY</p> <p>Introduction, Need of Energy storage, Different modes of energy storage, Technology Types– Mechanical energy storage: flywheels, compressed air, and pumped hydro; Electrical and Magnetic Energy storage: Batteries, Capacitors, electromagnets, Chemical energy storage.</p> <p>Basics of Sensible heat storage, Stratified storage, Rock bed storage, Thermal storage in buildings, Earth storage, and Aquifers storage. Basics of Latent heat storage, Phase change materials (PCM), Stefan problem. Brief description of the technologies and the differences between them; State-of-the-art – Past demonstrations, existing hurdles and performance targets for commercialization;</p>	<p>15</p>
<p>IV</p>	<p style="text-align: center;">GEO THERMAL AND OCEAN ENERGY</p> <p>Introduction of Geothermal Energy, Geothermal resources; definition and classification, Hydrothermal system, Hot dry rock systems, Geopressured reservoirs, Magma energy, Dry rock and hot aquifer analysis Utilization of geothermal resources, Direct utilization; Swimming bathing & balneology, space conditioning, district heating, Geothermal heat pump; basic concept of heat pump, air conditioner, heating and cooling mode in heat pump, Heat pump with geothermal resources; typical GHP loop configuration Ocean Thermal: Introduction, OTECHistory and technology progress, working principle, resources & site requirement</p>	<p>15</p>

V	<p style="text-align: center;">HYDROGEN ENERGY & FUEL CELL</p> <p>Hydrogen Energy – introduction and application, General introduction to infrastructure requirement for hydrogen production, storage, dispensing & utilization. Electrochemical: Electrolysis, Photo electro chemical. Biological: Photo Biological, Anaerobic Digestion Fermentative Micro- organisms. Physics and chemical properties: General storage methods, compressed storage, Glass micro sphere storage, Zeolites, Metal hydride storage, chemical hydride storage and cryogenic storage. Overview of hydrogen utilization: I.C. Engines, gas turbines, hydrogen burners, power plant, Principles of fuel cells, types of fuel cells, fuels for fuel cells, low, medium and high temperature fuel cells, power generation by fuel cells, applications of fuel cells, future potential of fuel cells.</p>	15
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Reference Books

1. Renewable Energy by Godfrey Boyle
2. Renewable Energy Resources by John Twidell and Tony Weir.
3. Solar Energy, G. N. Tiwari, Narosa Publishing House.
4. Energy Storage Science & Technology by Pendse.
5. Renewable Energy Resources: basic principle & application by Tiwari and Ghosal.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME

(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)
 Subject Code : 4076633
 Semester : V SEMESTER
 Subject Title : ENVIRONMENTAL ENGINEERING AND SOLID WASTE
 MANAGEMENT

TEACHING AND SCHEME OF EXAMINATION

No of weeks per semester: 16 weeks

Subject	Instructions		Examination			Duration
	Hours / Week	Hours / Semester	Marks			
			Internal Assessment	Board Examinations	Total	
ENVIRONMENTAL ENGINEERING AND SOLID WASTE MANAGEMENT	5	80	25	100*	100	3 Hrs.

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

TOPICS AND ALLOCATION OF HOURS

Unit	Topic	Hours
1.	Environmental Legislation	15
2.	Air Pollution & its Control Measures	15
3.	Water Pollution & its Control Measures	15
4.	Solid Waste Management	15
5.	Noise Pollution	13
6.	Test & Revision	7
Total		80

RATIONALE:

The exponential growth of Engineering and Technology has benefited the mankind with extreme sophistication and comfort. India's government has set in place policies and special economic zones to promote investment in its petrochemical sector and several key domestic companies have unveiled ambitious expansion plans for the next few years. The chapters of Environmental Engineering deals with the various factors of environment like Air pollution, Water pollution, Noise pollution, Soil pollution, and Standards of environment, etc, provides the auxiliary operations carried out in preventing the Environment from pollution.

OBJECTIVES:

On completion of the units of the syllabus the students must be able to know about

- Environmental Legislation.
- Knowledge about international treaty.
- Need for renewable energy sources.
- Alternate sources of energy.
- Air pollution & its effects
- Air pollution preventive measures.
- Extraction equipments
- Sources of water pollution
- Preventive measures of water pollution
- Soil pollution & its sources
- Disposal of solid waste
- Standards for noise level
- Measures of noise pollution.

DETAILED SYLLABUS

Contents: Theory

UNIT	NAME OF TOPICS	Hours
I	<p style="text-align: center;">ENVIRONMENTAL LEGISLATION</p> <p>Indian Constitution and Environmental Protection – National Environmental policies – Precautionary Principle and Polluter Pays Principle – Montreal Protocol, Kyoto agreement, Rio declaration. Environmental Protection act , Air & Water Pollution Control Acts & Rules (Salient Features only) – Functions of State / Central Pollution Control Boards – Environmental Management System: ISO 14 000 (Salient Features only)</p> <p style="text-align: center;">CLEAN TECHNOLOGY AND ENERGY</p> <p>Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco - Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in Industry.</p>	15 Hrs
II	<p style="text-align: center;">AIR POLLUTION & ITS CONTROL MEASURES</p> <p>Causes of air pollution – types & sources of air pollutants – Climatic & Meteorological effect on air pollution concentration – formation of smog & fumigation – Green house effect & Global Warming : Concepts of El Nino. Collection of Gaseous Air Pollutants – Collection of Particulate Pollutants – Analysis of Air Pollutants like: Sulphur dioxide – Nitrogen oxide – Carbon monoxide – Oxidants & Ozone – Hydrocarbons – Particulate Matter. Control of Particulate Emission – Control of Gaseous Emission – Flue Gas Treatment Methods: on, Settling Chambers, Cyclones, Filtration, Scrubbers, and Electrostatic Precipitators.</p>	15 Hrs

III	<p style="text-align: center;">WATER POLLUTION & ITS CONTROL MEASURES</p> <p>Origin of wastewater — Type of water pollutants and their effects Biological Pollution (point & non-point sources) – Chemical Pollutants Toxic Organic & Inorganic Chemicals – Oxygen demanding substances – Physical Pollutants Thermal Waste – Radioactive waste – Physiological Pollutants: Taste affecting substances – other forming substances. Adverse effects on Human Health & Environment, Aquatic Life, Animal life, Plant life — Water Pollution Measurement Techniques – Water Pollution Control Equipments & Instruments – Indian Standards for Water Pollution Control.</p>	15 Hrs
IV	<p style="text-align: center;">SOLID WASTE MANAGEMENT</p> <p>Fundamentals of solid waste Management – Classification of solid wastes- Storage, collection and transportation of solid waste – - Biomedical waste and health aspects- Chemical Industries solid waste- classification of chemical industries solid waste- disposal of all types of solid wastes- incineration, landfill and Bio chemical process- its advantages & disadvantages -control measures of industrial waste- - Recycling of industrial waste- E-Waste management –Generation of value added products from solid wastes.</p>	15 Hrs
V	<p style="text-align: center;">NOISE POLLUTION</p> <p>Intensity, Duration – Types of Industrial Noise – effects of Noise – Noise Measuring & Control – Permissible Noise Limits, simple problems.</p>	13 Hrs

REFERENCE BOOKS:

1. "S S Dara" "Environmental Chemistry and Pollution Control", S. Chand & Company Limited.
2. "Jonathan and Amos Turk" "Environmental Science".
3. "Metcalf & Eddy" "Waste water Engineering", Tata McGraw Hill.
4. "H M Dix" "Environmental pollution", Wiley–Blackwell.
5. "Pollution Control Acts, Rules and Notifications Issued There under", 5th Edition, Central Pollution Control Board.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)
 Subject Code : 40766640
 Semester : VI SEMESTER
 Subject Title : MASS TRANSFER PRACTICAL*

TEACHING AND SCHEME OF EXAMINATION:

No. of Weeks per Semester: 16

Weeks

Subject	Instructions		Examination			Duration
	Hours/Week	Hours/Semester	Marks			
MASS TRANSFER PRACTICAL	4	64	Internal Assessment	Board Examination	Total	3 Hrs.
			25	100*	100	

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Rationale:

In Diploma level engineering education to skill development especially working with instruments and Equipment's play a vital role. These can be achieved by experience in handling various equipment's. This is accomplished by doing engineering related equipment's in practical classes.

Objectives:

- After completing all the experiments of the practical the student will be able to understand Verification of Rayleigh equation. Determine vaporization efficiency of steam distillation .Construct equilibrium curve of a tertiary system. Determine drying character tics and crystallization behavior and solubility character tics.

Guidelines:

- All the ten experiments given in the list of experiment should be completed and given for the end semester practical examinations.
- In order to develop but best skills in handling instruct/equipment and taking reading in the practical classes. Every two students should be provide with a separate experimented setup for doing experiments in the laboratory.
- The external examiners are requested to ensure that a single experimented question should not be given to more than four students while admitted a batch of 30 students during board examination.

List of Experiments:

1. Simple Distillation
2. Determination of Vapor- Liquid Equilibrium
3. Steam Distillation
4. Liquid-Liquid Extraction
5. Soxlet Extraction
6. Drying Characteristic solid
7. Crystallization by Cooling
8. Crystallization by Evaporation
9. Decolourization by Adsorption
10. Diffusivity Measurements

List of Equipments:

1. Simple Distillation Apparatus -1 No
2. Vapour Liquid Equilibrium Apparatus -1 No
3. Steam Distillation Apparatus -1 No
4. Liquid-Liquid Extraction Apparatus- 1No
5. Soxhlet Extractor -1 No
6. Drier- 1No
7. Crystallization by Cooling Apparatus- 1No
8. Crystallization by Evaporation Apparatus- 1No
9. Decolourization by Adsorption Equipment- 1 No
10. Diffusivity Measurements Apparatus- 1 No

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)
 Subject Code : 4076650
 Semester : VI SEMESTER
 Subject Title : CHEMICAL CAD PRACTICAL*

TEACHING AND SCHEME OF EXAMINATION:

No. of Weeks per Semester: 16 Weeks

Subject	Instructions		Examination			Duration
	Hours/Week	Hours/Semester	Marks			
CHEMICAL CAD PRACTICAL	6	96	Internal Assessment	Board Examination	Total	3 Hrs
			25	100*	100	

* Examinations will be conducted for 100 marks and it will be reduced to 75 marks.

Objectives:

- In this practical subject, the students are required to learn the basic
- Concepts of AutoCAD like screen inter face, various commands and co-Ordinate system used.
- This practical subject will also impart them requisite knowledge of creating 2D objects using various draw commands.
- The students will also learn to draw the isometric drawings and isometric Projections.

The students will also learn the 3D fundamentals and 2D to 3D conversions.

LIST OF EXPERIMENTS

Using all Auto cad commands for plotting (2D dimensional) chemical Equipments- different views- dimensioning--3D fundamentals -2D to 3D Conversion.

EXERCISES:

A) Practice to draw the following Chemical Engineering Equipment with 2D using AutoCAD commends.

1. Fractionation column
2. Batch Reactor
3. Shell and tube Heat exchanger
4. Long tube Evaporator
5. Rotary Drum Filter
6. Simple piping layout with 2D

B) Practice to draw the following Chemical Engineering Equipment with 3D using AutoCAD commends.

1. Spray Drier
2. Agitated batch crystallizer
3. Simple piping layout in isometric view.
4. Set up Process Instrumentation Diagram (P & ID) of Distillation column.

STATE BOARD OF TECHNICAL EDUCATION & TRAINING, TAMILNADU
DIPLOMA IN ENGINEERING / TECHNOLOGY SYLLABUS
N-SCHEME
(Implemented from the Academic year 2020 - 2021 onwards)

Course Name : 1076: Diploma in Chemical Engineering (Full Time)
 Subject Code : 4076660
 Semester : VI
 Subject Title : PROJECT WORK & INTERNSHIP

TEACHING AND SCHEME OF EXAMINATION:

No. of Weeks per Semester: 16

Weeks

Subject	Instructions		Examination			Duration
	Hours/Week	Hours/Semester	Marks			
PROJECT WORK & INTERNSHIP	6	96	Internal Assessment	Board Examination	Total	3 Hrs
			25	100*	100	

Minimum Marks for Pass is 50 out of which minimum 50 marks should be obtained out of 100 marks in the Board Examination alone.

Objectives:

- To develop the creative talents in the students.
- The project work should involve less cost, easy manufacturing technique and suitable to the real life situations.
- The project work should be useful to the mankind.
- To give the students a taste of real life problem solving and thus simulate industrial environment within the polytechnic.

- To develop those abilities that cannot be developed by normal class room situations such as group work, sharing responsibility, initiate, creativity etc.

INTERNAL ASSESSMENT:

The internal assessment should be calculated based on the review of the progress of the work done by the student periodically as follows.

Detail of assessment	Period of assessment	Max. Marks
First Review	6 th week	10
Second Review	12 th week	10
Attendance	Entire semester	5
Total		25

EVALUATION FOR BOARD EXAMINATION:

Details of Mark allocation	Max Marks
Demonstration/Presentation	25
Report	25
Viva Voce	30
Internship report	20
Total	100

NOTE:

- The topic for project work must be formulation of chemicals, design work, experimental work and material, energy balance or design calculations of a specific unit process / operation.
- The selection of Project work should be carried out in V semester itself.
- The Project committee's approval should be obtained prior to the executing of project.
- Periodical assessment should be carried out from V semester.
- The students' batch size should not exceed 6 Nos.
- The students should maintain a logbook of the work carried out by them.
- The internal assessment marks will be given based on the work carried out by the students as per the logbook.
- The power point presentation must be done during the Board examination Viva-Voce.