

**DEPARTMENT OF TECHNICAL EDUCATION (DIPLOMA SECTOR)
UTTAR PRADESH**

**CURRICULUM FOR DIPLOMA PROGRAMME
IN
CHEMICAL ENGINEERING
(5th to 6th Semester)**

=====

Semester System

=====



(EFFECTIVE FROM YEAR 2026-27)

Prepared By:

INSTITUTE OF RESEARCH, DEVELOPMENT & TRAINING, U.P., KANPUR

CONTENTS

Sr. No.	Particulars	Page No.
1.	Acknowledgement	4
2.	Salient Features of the Diploma Program	5
3.	Employment Opportunities	6
4.	POS and Learning Outcomes of the Program	7-9
5.	Study and Evaluation Scheme	10-16
6.	Detailed Contents of Various Subjects	17-55
	FIFTH SEMESTER	
5.1	MASS TRANSFER OPERATIONS-II	17-19
5.2	MASS TRANSFER OPERATIONS-II (LAB)	20-21
5.3	PROCESS CONTROL AND INSTRUMENTATION	22-24
5.4	PROCESS CONTROL AND INSTRUMENTATION (LAB)	25-26
5.5	PROGRAM ELECTIVE-3	27-31
5.6	PROGRAM ELECTIVE-4	32-37
5.7	OPEN ELECTIVE-2	38-41
5.8	(Q) INDIAN CONSTITUTION	42-44
	SIXTH SEMESTER	
6.1	PROCESS EQUIPMENT DESIGN	45-47
6.2	ENTREPRENEURSHIP AND START-UPS	48-50
6.4	OPEN ELECTIVE-3	51-55
7.	Guidelines for Assessment of Student centered Activities and Internal Assessment (SCA)	56
8.	Resource Requirement	57-60
9.	Evaluation Scheme Guidelines (As per AICTE)	61-65
10.	List Of Experts	66

PREFACE

An important issue generally debated amongst the planners and educator's world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization have created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and opens economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we must develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse the quality aspect through developing human resources in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives are being taken by the State Board of Technical Education, UP to revise the existing curricula as per the needs of the industry and make NSQF compliant.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much-needed dynamism in the system.

F.R. Khan

Director

Institute of Research Development & Training, Kanpur

1. ACKNOWLEDGEMENTS

We gratefully acknowledge the guidance and contribution received from the following people:

1. Sh. Narendra Kumar Bhushan, IAS Additional Chief Secretary, Technical Education Govt. of U.P. for his exemplary vision & approach.
2. Sh. F. R. Khan Director I.R.D.T. Kanpur continually motivating, guiding and taking keen interest in the review of the curriculum.
3. All the participants from Polytechnics and other technical institutions for their professional input during curriculum workshops.
4. CDC Officer and others concerning staff of IRDT for their support and assistance in conducting curriculum workshops.

(Mohd Nadeem)
Research Assistant
Curriculum In-charge
I.R.D.T. Kanpur

(Dr. Kunwer Mrityunjay Singh)
Curriculum Co-Ordinator
I.R.D.T. Kanpur

2. SALIENT FEATURES

- | | |
|---|---|
| 1. Name of the Programme | ➤ Diploma in Chemical Engineering |
| 2. Duration of the Programme | ➤ Three years (Six Semesters) |
| 3. Entry Qualification | ➤ Matriculation or equivalent NEP-
2020/NSQF Level 5 as Prescribed by
State Board of Technical Education,
U.P. |
| 4. Pattern of the Programme | ➤ Semester System |
| 5. Ratio between theory and Practice | ➤ 40% (Theory) / 60% (Practical) |

1) **Industrial Training/Internship:**

Four and six weeks of industrial training is made mandatory after the II and IV semesters during summer vacation. Total marks allotted to industrial training will be respectively 50 & 100.

In the last (6th Semester) we have made the one semester Industrial training/Internship as optional along with usual classroom training.

2) **Audit & Pathways:**

As per AICTE and NEP-2020 directives, Essence of Indian Knowledge & Tradition, Indian Constitution, Entrepreneurship & Startup, subjects on Environmental Studies have been incorporated in the curriculum.

3) **Student Centered Activities:**

A provision of 4-8 hrs. per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise co-curricular activities such as expert lectures, classroom seminars, games, hobby club like photography, painting, singing etc. declamation contests, field visits, NCC, NSS and other cultural activities, etc.

4) **Project work:**

Micro/Mini/Major project work has been included in the curriculum to enable the student to get familiarized with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

3. EMPLOYMENT OPPORTUNITIES

Employment opportunities for diploma holders in Chemical Engineering are visualized in the following industries at various levels/positions:

i) Chemical and Allied Industries like:

- Fertilizer industry
- Petroleum refinery and petrochemical industry
- Oil and Natural Gas Corporation
- Cement plant
- Cosmetic industry
- Sugar industry
- Mineral industry
- Pulp and paper industry
- Polymer industry
- Food industry
- Agro industry
- Pharmaceutical industry
- Distillery
- Paint and dyeing industry
- Rubber industry
- Soap & detergent industry
- Textile industry, etc.
- Pesticide industry
- General processing industries
- Glass industry
- Ceramics industry
- Automobile industry (paint shop and electroplating shop)
- Test equipment: manufacturing and repairing

In various functional areas like erection and commissioning of plant, plant operation, energy conservation, plant utilities, production, water treatment, maintenance and safety, quality control, inspection and testing, marketing and sales, consultancy services, and areas concerning environmental protection.

ii) Research Organizations like:

- CSIR laboratories
- Defense laboratories
- Atomic energy establishments, etc.

iii) Boards and Corporations

iv) Entrepreneurs of small/tiny units, especially in food, agriculture, and chemical industries such as paints, soap, detergents, equipment repairing, etc.

v) Academic Institutions (as technicians/instructors at all levels)

4. (A) PROGRAM OUTCOMES (POS)

PO1: Basics and Discipline specific Knowledge

Assimilate knowledge of basic mathematics, science, engineering fundamentals, and Chemical Engineering.

PO2: Problem's Analysis and solution

Identify analyse and solve problems using standard methods and established techniques.

PO3: Design and Development

Design solutions for technical problems.

Assist in designing components, systems, or processes to meet specific requirements.

PO4: Engineering Tools, Experimentation, and Testing

Use modern engineering tools and appropriate techniques to conduct experiments as per BIS standard.

PO5: Socio/ Economic /Environmental impact assessment/remedy.

Apply relevant technologies while considering societal needs, environmental impact keeping in view sustainable and ethical responsibilities.

PO6: Project Management and Communication

Apply engineering management principles, work effectively as an individual or in a team, and communicate clearly on activities.

PO7: Lifelong Learning

Recognize the importance of continuous learning and actively pursue self-improvement to keep pace with technological developments.

4. (B) LEARNING OUTCOMES OF THE PROGRAM

After undergoing this program, students will be able to:	
1.	Prepare and interpret drawings of engineering components and plants.
2.	Read and interpret drawings related to plant layout, process equipment and components, process flow sheets and product manufacturing.
3.	Apply concepts of mechanics to solve chemical engineering problems.
4.	Apply basic principles of science and engineering to solve chemical engineering problems.
5.	Select various materials used in chemical processes, their properties and specifications.
6.	Understand various unit operations, unit processes and process instrumentation in process industry.
7.	Calculate the quantity of raw materials, energy inputs, manpower requirement and output from the process.
8.	Control the process and quality of the products commiserating with laid specifications.
9.	Recognise the need for and have the ability to engage in lifelong learning
10.	Conduct experiments, analyses, interpret data and synthesis valid conclusion.
11.	Operate conventional machines by changing components as per specifications and ensure their effective functioning in the process industry.
12.	Use electrical and electronic instruments to measure various engineering parameters.
13.	Use various measuring and gauging instruments
14.	Select material as per desired application
15.	Understand the general design of process equipment's and testing
16.	Operate different utility plants
17.	Understand different renewable sources of energy and their applications.
18.	Understand different plants utilities and their generation and maintenance
19.	Use various software tools for automation and process development.
20.	Interpret factory acts, laws and taxes
21.	Develop communication and interpersonal skills for effective functioning in the world of work.
22.	Communicate effectively in English and the local language, both orally and in written form, with others.
23.	Manage resources effectively at workplace.

24.	Plan and execute given task/project as a team member or leader.
25.	Prepare detailed project proposal and report.
26.	Use computer and IT tools for creating documents, making spread sheet and making presentation.
27.	Solve real life problems by application of acquired knowledge and skills.
28.	Use energy conservation methods to manage energy efficiency.
29.	Use appropriate practices for conservation and prevention of environment pollution and safety in process industries.

STUDY AND EVALUATION SCHEME FOR CHEMICAL ENGINEERING (352)

FIFTH SEMESTER

SR. NO.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME PERIODS/WEEK			CREDITS	MARKS IN EVALUATION SCHEME										TOTAL MARKS OF INTERNAL & EXTERNAL
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
			L	T	P		TH	PR	TOT	TH	HRS	PR	HRS	TOT			
5.1	MASS TRANSFER OPERATIONS-II	PROGRAM CORE (THEORY)	3	-	-	3	40	-	40	60	3	-	-	60	100		
5.2	MASS TRANSFER OPERATIONS-II (LAB)	PROGRAM CORE (PRACTICAL)	-	-	4	2	-	60	60	-	-	40	3	40	100		
5.3	PROCESS CONTROL AND INSTRUMENTATION	PROGRAM CORE (THEORY)	2	-	-	2	40	-	40	60	3	-	-	60	100		
5.4	PROCESS CONTROL AND INSTRUMENTATION	PROGRAM CORE (Practical))	-	-	4	2	-	60	60	-	-	40	3	40	100		
5.5	PROGRAM ELECTIVE-3	PROGRAM CORE (THEORY)	2	1	-	3	40	-	40	60	3	-	-	60	100		
5.6	PROGRAM ELECTIVE-4	PROGRAM CORE (PRACTICUM)	2	-	4	4	40	-	40	60	3	-	-	60	100		
5.7	ADVANCE SKILL DEVELOPMENT	(Q) OPEN ELECTIVE-2 (THEORY)	2	-	-	2	50	-	-	-	-	-	-	-	N/A		
		(Q) OPEN ELECTIVE-2 (Certification Course)					-	-	-	-	-	-	-	N//A			
5.8	(Q) INDIAN CONSTITUTION	AUDIT COURSE	2	-	-	-	-	50	50	-	-	-	-	-	N/A		
5.9	SUMMER INTERNSHIP** (6 WEEKS)	SUMMER TRAINING	-	-	-	2	-	60	60	-	-	40	3	40	100		
# STUDENT CENTERED ACTIVITIES			-	-	8	-	-	50	50	-	-	-	-	-	50		
TOTAL			13	1	20	20	160	230	390	240	-	120	-	360	750		

NOTE: -

- (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
- Advance skill development mention at 5.6 in the table provides the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 Hrs (Offline/Online).

Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. Photography etc., Seminars, Declamation Contests, voluntary contribution in physical activities, Educational Field Visits, NCC, NSS, Cultural Activities and Self-Study.

** Students will present a seminar on their summer internship along with certificate, project and report.

STUDY AND EVALUATION SCHEME FOR CHEMICAL ENGINEERING (352)

SIXTH SEMESTER

NORMAL PATHWAY

Sr. No.	SUBJECTS	COURSE TYPE & CATEGORY	STUDY SCHEME PERIODS/WEEK			CREDITS	MARKS IN EVALUATION SCHEME								TOTAL MARKS OF INTERNAL & EXTERNAL
			L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
							Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	PROCESS EQUIPMENT DESIGN	PROGRAM CORE (THEORY)	03	01	-	4	40	-	40	60	3	-	-	60	100
6.2	ENTREPRENEURSHIP AND START-UPS	HUMANITIES & SOCIAL SCIENCE	02	-	-	2	40	-	40	60	3	-	-	60	100
6.3	IN HOUSE PROJECT	PROJECT	04	-	16	12	-	240	240	-	-	160	-	160	400
6.4	ADVANCE SKILL DEVELOPMENT	(Q) OPEN ELECTIVE-3 (THEORY)	02	-	-	2	50	-	-	-	-	-	-	-	N/A
		(Q) OPEN ELECTIVE-3 (Certification Course)					-	-	-	-	-	-	-	-	N/A
#STUDENT CENTERED ACTIVITIES			-	-	6	-	-	50	50	-	-	-	-	-	50
TOTAL			11	01	22	20	80	290	370	120		160		280	650

- (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
- Advance skill development mention at 6.4 in the table provides the scope of selecting the course as per choice from the elective list provided in the syllabus conducted by various agencies of repute of duration not less than 20 Hrs (Offline/Online).
Student Centered Activities will comprise of co-curricular activities like extension lectures, games, hobby clubs e.g. Photography etc., Seminars, Declamation Contests, voluntary contribution in physical activities, Educational Field Visits, NCC, NSS, Cultural Activities and Self-Study.

OR

INDUSTRIAL PATHWAY

Sr. No.	SUBJECTS	CATEGORY & COURSE TYPE	STUDY SCHEME Periods/Week			Credits(C) (L+T)+P=C	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External	ASSESSMENT
							INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT								
			L	T	P		Th	Pr	Tot	Th	Hrs.	Pr	Hrs	Tot				
6.1	ENTREPRENEURSHIP AND START-UPS (ONLINE MODE)	HUMANITIES & SOCIAL SCIENCE (THEORY)	-	-	-	2	-	-	-	100	03	-	-	100	100	THEORY		
6.2	INDUSTRIAL HANDS-ON PRACTICE	INDUSTRIAL TRAINING	-	-	-	12	150*			200**					350			
6.3	INDUSTRIAL PROJECT	INDUSTRIAL TRAINING	-	-	-	4	50*			50**					100			
6.4	SEMINAR	IN HOUSE	-	-	-	2	-	100	100	-	-	-	-	-	100			
Total			-	-	-	20									650			

NOTE

1. The Industrial training tenure should not be less than 14 weeks.
2. Industry must be registered with MSME/Directorate of industries/Limited Organization/State/Central Government establishments.
3. Monthly progress reports of Intern/ Trainee should be attested and forwarded by industrial supervisor (allotted to Intern/Trainee) during industrial Internship/Training.
4. The Industrial unit/organisation must evaluate students using the format provided by polytechnic in the form of marks.
5. The Industrial Hands on Practice, Industrial Project and seminar must be evaluated on the basis of the AICTE Internship Policy: Guidelines and procedures (Chapter -9 Procedures / format for organizing internship)
6. "Entrepreneurship and Start-up" course is also mandatory in Industrial internship/training mode. It will be conducted online mode by his/her polytechnic institute. After completing the online course, students must appear for exam conducted by the Board of Technical Education, Lucknow.
7. ***Evaluation by faculty mentor**
The institute will depute one faculty member for mentoring at least 20-30 students undertaking apprenticeship training. Such mentors will monitor, guide and provide counselling to the students as and when required. Faculty mentor of the institute(s) may make a surprise visit to the internship/apprenticeship site to check the student's presence physically. (The Proforma of the evaluation is attached as the Annexure -1)
8. **** Evaluation by industry** : The industry shall assess the candidates based on the following parameters attendance, discipline and punctuality, familiarity of tools and material, engineering skills, application of knowledge and problem-solving skills, comprehension and observation, professional ethics, safety and environmental consciousness, communication skills, supervisory skills and general conduct during the period (The Proforma of the evaluation is attached as the Annexure -2)
9. **# Evaluation through seminar presentation/Viva-Voce at the institute** : The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

PROGRAM ELECTIVE-3

SR. NO.	SUBJECT NAME
1.	FERTILIZER ENGINEERING
2.	PETROLEUM REFINING TECHNOLOGY

PROGRAM ELECTIVE-4

SR. NO.	SUBJECT NAME
1.	POLLUTION CONTROL AND INDUSTRIAL SAFETY
2.	SAFETY IN CHEMICAL PROCESS INDUSTRY

OPEN ELECTIVE-2

SR.NO.	(Q) THEORY COURSES NAME
1.	DISASTER MANAGMENT
2.	ARTIFICIAL INTELLIGENCE

SR.NO.	CERTIFICATE COURSES
1.	COURSES CONDUCTED BY CENTRE OF EXCELLENCE (ESTABLISHED BY THIRD PARTY AS: - TATA TECHNOLOGIES. etc) (Annexure-1)
2.	COURSES CONDUCTED BY INFOSYS PRINGBOARD
3.	COURSES CONDUCTED BY TCS ION
4.	COURSES CONDUCTED BY OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL ORGANIZATION OR PLATFORMS OF REPUTE
5.	COURSES CONDUCTED BY AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
6.	COURSES CONDUCTED BY C-DAC
7.	COURSES CONDUCTED BY NEILIT

OPEN ELECTIVE -3

SR.NO.	(Q) THEORY COURSES NAME
•	ECONOMIC POLICIES IN INDIA
•	PROJECT MANAGEMENT

SR.NO.	CERTIFICATE COURSES
1.	COURSES CONDUCTED BY CENTRE OF EXCELLENCE (ESTABLISHED BY THIRD PARTY AS: - TATA TECHNOLOGIES. etc) (Annexure-1)
2.	COURSES CONDUCTED BY INFOSYS PRINGBOARD
3.	COURSES CONDUCTED BY TCS ION
4.	COURSES CONDUCTED BY OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL ORGANIZATION OR PLATFORMS OF REPUTE
5.	COURSES CONDUCTED BY AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
6.	COURSES CONDUCTED BY C-DAC
7.	COURSES CONDUCTED BY NEILIT

LIST OF COURSES CONDUCTED BY TATA TECHNOLOGIES

1. Fundamentals of Innovation and Design Thinking
2. Product Design and Development
3. Product Verification and Analysis
4. Advanced Automobile
5. Electric Vehicle
6. Internet of Things
7. Advanced Manufacturing
8. Advanced Welding & Painting using Simulator
9. Industrial Automation and MES
10. Industrial Robotics
11. Inspection and Quality Control
12. Advanced Plumbing
13. AI and ML

6. DETAILED CONTENT OF VARIOUS SUBJECT

THEORY	5.1 MASS TRANSFER OPERATIONS– II	L	T	P
		3	-	-

COURSE OBJECTIVE

The objectives of this course are to:

- Provide in-depth knowledge of **advanced mass transfer operations** used in chemical industries.
- Enable students to understand **principles and design concepts of distillation columns**.
- Develop the ability to **analyze separation processes** such as extraction, adsorption, crystallization, and membrane separation.
- Familiarize students with **industrial mass transfer equipment and operational limitations**.
- Strengthen problem-solving skills related to **stage-wise and equilibrium-based separations**.

COURSE OUTCOMES (CO):

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

CO1: Explain principles of distillation, vapor–liquid equilibrium, and working of plate and packed distillation columns.

CO2: Analyze extraction and leaching operations and explain the working of industrial extraction equipment.

CO3: Explain principles, types, and industrial applications of adsorption processes and adsorption isotherms.

CO4: Explain membrane separation processes and classify membrane-based separation techniques used in industries.

CO5: Describe principles, mechanisms, and industrial equipment used in crystallization processes..

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcome s (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	3	1	1	1	1	1	1	*	*
CO2	2	3	2	2	1	2	1	*	*
CO3	2	2	1	1	1	1	1	*	*
CO4	2	2	1	1	1	1	1	*	*
CO5	2	2	1	1	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1: Distillation

(16 periods)

1. Concept of Distillation, Vapour Liquid Equilibria, Raoult's and Dalton's Law, Relative Volatility, Methods of Distillation: Differential/Simple and batch Distillation, Rayleigh's equation. Flash or Equilibrium Distillation. Material Balance over stripping and enriching section, Mc Cabe Theile Method (only procedure) Feed plate, feed line/q-line equation, feed conditions, reflux ratio: total, minimum & optimum.
2. Batch Distillation, Azeotropic Distillation, Extractive Distillation, steam Distillation (Concept only).
3. Plate & Packed column- Construction, working & differentiation.
4. Concept of flooding, foaming, dumping, Weeping, Entrainment in distillation columns.

Unit-2: Extraction

(07 periods)

Definition, Types of extraction and Applications (final expression/Material Balance and physical meaning of terms therein, No derivation)

Equipment: mixer settler, spray and packed extraction towers, perforated plate extraction tower, agitated tower extractor.

Definition and application of leaching, equipment: leaching through stationary solid beds, moving beds.

Unit-3: Adsorption

(05 periods)

Concept of Adsorption operation, types of adsorption and nature of adsorbent, effect of temperature on adsorption and industrial application, adsorption isotherms, Langmuir and Freundlich adsorption isotherm

Unit-4: Membrane Separation and Crystallization

(05 periods)

Introduction to Membrane Separation, Types of Membrane, Membrane Separation Processes, Brief Introduction: reverse osmosis, microfiltration, ultra-filtration, nano filtration, dialysis.

Unit-5: Crystallization

(09 periods)

Concept of crystallization, saturation and super saturation and solubility curve, mechanism of crystallization/crystal formation, method of super saturation – Miers super saturation theory.

Classification of crystallizers – construction and working of agitated tank crystallizer, draft tube baffle crystallizer, Swenson walker crystallizer, vacuum crystallizer.

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed/tray), different types of packing used in the column, different types of extractors and membrane separation techniques. This will also make the students aware of auxiliary equipment/model/ supports for different equipment. Emphasis should also be given to problem solving and practices especially for distillation column and extraction.

LIST OF RECOMMENDED BOOKS

1. Mass Transfer Operations by Treybal, Kogakusha Publication
2. Introduction to Chemical Engineering by Badger and Banchero; McGraw Hill Publication
3. Unit Operations of Chemical Engineering by Mc Cabe and Smith; McGraw Hill Publication
4. Mass Transfer by Sherwood Pigford and Wilke; McGraw Hill Publication
5. Chemical Engineering Handbook by Perry and Chilton; McGraw Hill Publication
6. Mass Transfer by K.A Gavhane, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	43
2	07	14
3	05	11
4	05	11
5	09	21
Total	42	100

PRACTICAL	5.2 MASS TRANSFER OPERATIONS-II	L	T	P
		-	-	4

COURSE OBJECTIVES

The objectives of this course are to:

- Provide hands-on understanding of **mass transfer operations** used in chemical industries.
- Enable students to **study and operate mass transfer equipment** such as distillation columns, extractors, adsorbers, membranes, and crystallizers.
- Develop practical skills to **analyze separation performance** using experimental observations.
- Reinforce theoretical concepts of **distillation, extraction, adsorption, membrane separation, and crystallization** through laboratory experiments.

COURSE OUTCOMES (CO)

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

CO1: Perform separation of binary mixtures using batch and continuous distillation experiments.

CO2: Carry out liquid–liquid and solid–liquid extraction operations using laboratory-scale equipment.

CO3: Conduct adsorption experiments and analyze adsorption behavior using suitable adsorbents.

CO4: Perform membrane separation experiments and study the effects of membrane fouling on performance.

CO5: Study crystallization mechanisms and identify batch and continuous crystallizers through experiments and sketches..

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	2	3	1	3	–	1	1	*	*
CO2	2	3	1	3	1	1	1	*	*
CO3	2	2	1	3	1	1	1	*	*
CO4	2	2	1	3	1	–	–	*	*
CO5	2	1	1	2	–	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

LIST OF PRACTICALS

Unit-1: Distillation

- Ex 1. To study the separation of a Binary Mixture by Batch Distillation with Simple Material Balance.
- Ex 2. To study the separation of a Binary Mixture by Continuous Distillation.

Unit-2: Extraction

- Ex1. To study the Liquid - Liquid Extraction of a solute from one phase to another phase.
- Ex 2. To study the Solid - Liquid Extraction of a solute from one phase to another phase.

Unit-3: Adsorption

- Ex1. To study adsorption of Dye using Charcoal.
- Ex2. To study the adsorption of water vapor on silica gel.

Unit-4: Membrane Separation

- Ex1. To study the separation of Particles or solutes using Microfiltration.
- Ex2. To study the effects of Membrane fouling on Membrane performance.

Unit-5: Crystallization

- Ex1. To study the Mechanism of Crystallization/ Crystal formation.
- Ex2. Study sketch of Batch Crystallizers.
- Ex3. Study sketch of Continuous Crystallization

INSTRUCTIONAL STRATEGY

Field visit will make the students familiar with different types of column (packed/tray), different types of packing used in the column, different types of extractors and membrane separation techniques. This will also make the students aware of auxiliary equipment/model/ supports for different equipment. Emphasis should also be given to problem solving and practices especially for distillation column and extraction.

RECOMMENDED BOOKS

7. Mass Transfer Operations by Treybal, Kogakusha Publication
8. Introduction to Chemical Engineering by Badger and Banchero; McGraw Hill Publication
9. Unit Operations of Chemical Engineering by McCabe and Smith; McGraw Hill Publication
10. Mass Transfer by Sherwood Pigford and Wilke; McGraw Hill Publication
11. Chemical Engineering Handbook by Perry and Chilton; McGraw Hill Publication
12. Mass Transfer by K.A Gavhane, Nirali Publication

THEORY	5.3 PROCESS CONTROL AND INSTRUMENTATION	L	T	P
		2	-	-

COURSE OBJECTIVES

- To provide knowledge of industrial instrumentation for measurement of process variables.
- To develop understanding of automatic control systems used in chemical industries.
- To study dynamic behavior of first and second order processes.
- To familiarize students with controllers, control valves, PLC and DCS systems.
- To enable students to analyze and implement closed loop control systems.

COURSE OUTCOMES (CO)

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

CO1: Measure temperature, pressure, level, and flow using appropriate industrial instrumentation.

CO2: Explain the components and significance of automatic control systems and process dynamics.

CO3: Analyze the dynamic behavior of first-order and second-order process systems.

CO4: Apply different modes of control action and develop block diagrams for closed-loop control systems.

CO5: Explain the basic concepts and applications of PLC and DCS in process control systems.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PS O 1	PS O 2
CO1	3	1	1	3	1	—	3	*	*
CO2	3	2	1	2	1	1	2	*	*
CO3	2	3	—	2	—	1	1	*	*
CO4	2	2	2	3	1	1	1	*	*
CO5	2	1	—	2	1	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1: Instrumentation

(06 Periods)

1. Temperature : Types of Temperature measuring instruments, Bimetallic Thermometer , Thermocouples, RTD , Temperature Transmitter.
2. Pressure: Types of Pressure measuring instruments, Bourdon Tube gauge, U Tube Manometer, Diaphragm pressure sensor, Pressure Transmitter.
3. Level measurement: Types of Level measuring instruments, Float type Level measuring instrument, Ultrasonic Level measuring instrument, Differential Pressure Type Level measuring instrument, level transmitter.
4. Flow rate: Types of Flow rate measuring instruments, Mass flow meter.

Unit-2: Introduction: Process Dynamics

(06 Periods)

Automatic control system and its significance; Manual v/s Automatic control, Physical and block diagrams of stirred tank heater system.

Elements of control System: Controller, Measuring instrument, Final control elements, Transmitter, Transducers.

Process Characteristics: Process variables, Laplace transformation, Forcing functions: step, ramp, impulse and sinusoidal function.

Unit-3: Elements of Process Dynamics

(08 Periods)

1. 1st order system - Examples of 1st order system: Naked bulb thermometer and its derivation; Stirred tank heater; Mixing process; Liquid levels (derivation excluded).
2. 2nd order system- Examples of 2nd order system: Non-Interacting and Interacting system (concept only). Transfer function of 2nd order system (derivation excluded); Terms used in Underdamped system: Decay ratio, Overshoot, Response time and Rise time.

Unit-4: Controller Characteristic or Modes of Control Action

(06 Periods)

(06 Periods)

Standard block diagram symbol, overall transfer function for a single loop system, Negative and positive feedback system, servo and regulatory problem, Final control elements: control valve mechanism, Elements of controller, Type of controllers: proportional control, Two positions/ON-OFF control, integral control, proportional-integral control, proportional derivative control, proportional-integral-derivative control their comparison.

Unit-5: Introduction to Programmable Logic Controller (PLC) and Distributed Control System (DCS)

(02 Periods)

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Sessional Test
- Practical work

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern Publications.
2. Process System Analysis and Control by Coughanowr and Steven LeBlanc, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publications.
4. Principles of Industrial Instrumentation by D. Patranabis; Tata McGraw Hill Company
5. Chemical Process Control: An Introduction to Theory BY George Stephanopoulos

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted(%)
1	6	25
2	6	25
3	8	25
4	6	20
5	2	5
Total	28	100

PRACTICAL	5.4 PROCESS CONTROL AND INSTRUMENTATION	L	T	P
		-	-	4

COURSE OBJECTIVE

The objective of this course is to develop practical skills in the measurement, calibration and control of process variables using industrial instruments and control systems. The course also enables students to study process dynamics and controller performance used in process industries.

COURSE OUTCOMES (COs)

CO1: Measure temperature and calibrate process instruments using standard industrial methods.

CO2: Measure and interpret pressure and level parameters using industrial measuring instruments.

CO3: Analyze the performance characteristics of control valves and signal converters used in process control systems.

CO4: Evaluate the dynamic behavior of interacting and non-interacting process systems.

CO5: Operate and compare different controller modes for effective process control.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcome s (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PS O 1	PS O2
CO1	3	2	-	2	2	-	-	*	*
CO2	3	3	-	2	2	-	-	*	*
CO3	3	3	2	2	3	-	-	*	*
CO4	3	3	2	3	2	-	-	*	*
CO5	3	3	3	2	3	-	-	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

LIST OF PRACTICALS

UNIT-1: Temperature Measurement and Calibration

Experiments

1. Measurement of Temperature by Thermocouple Module.
2. Measurement of Temperature by RTD Module.
3. Calibration of Pressure Gauge with the Help of Dead Weight Pressure Gauge.

UNIT-2: Pressure and Level Measurement

Experiments

1. Level Measurement by using Differential Pressure (DP) Transmitter.
2. Measurement of Pressure by Bourdon Pressure Transducer.

UNIT-3: Control Valves and Signal Converters

Experiments

1. Study of Characteristics of Control Valve (Linear, Equal Percentage and Quick Opening).
2. Study the Linearity of P/I and I/P Converter.

UNIT-4: Process Dynamics

Experiments

1. To Study the Response of Two Tank Non-Interacting Liquid Level System.
2. To Study the Response of Two Tank Interacting Liquid Level System.

UNIT–5: Process Controllers

Experiments

1. To Study On-Off Controller for Temperature Control.
2. To Study P, PI, PD and PID Controller using Pressure Controller Trainer Kit by Monitoring the Process in SCADA Mode or Analog Mode.

INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

MEANS OF ASSESSMENT

- Practical work

RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley Eastern Publications.
2. Process System Analysis and Control by Coughanowr and Steven LeBlanc, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publications.
4. Principles of Industrial Instrumentation by D. Patranabis; Tata McGraw Hill Company
5. Chemical Process Control: An Introduction to Theory BY George Stephanopoulos

THEORY	5.5 FERTILIZER ENGINEERING (P.O.E-3)	L	T	P
		2	1	-

COURSE OBJECTIVES

The objectives of this course are to:

- Provide knowledge of **fertilizer industry and its importance** in increasing agricultural productivity.
- Enable understanding of **types, applications, advantages, and limitations of fertilizers**.
- Familiarize students with **manufacturing processes of nitrogenous, phosphatic, and potassic fertilizers**.
- Develop understanding of **catalysts and raw materials** used in fertilizer manufacturing.
- Introduce concepts of **mixed fertilizers and bio-fertilizers** along with their advantages and applications.

COURSE OUTCOMES (CO)

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

CO1: Explain the role of fertilizers in agriculture along with their applications, advantages, and limitations.

CO2: Describe types, raw materials, catalysts, and manufacturing processes of nitrogenous fertilizers.

CO3: Explain raw materials and manufacturing processes of phosphatic fertilizers and evaluate their nutrient content.

CO4: Explain manufacturing processes, advantages, and limitations of potassic, mixed, and compound fertilizers (NPK).

CO5: Explain the concept, advantages, applications, and manufacturing of bio-fertilizers

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	3	1	—	—	2	—	1	*	*
CO2	3	2	—	1	1	1	1	*	*
CO3	2	2	1	1	1	1	1	*	*
CO4	2	2	1	1	1	1	1	*	*
CO5	2	1	1	1	3	1	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

1. Introduction

(09 Periods)

Origin and development of commercial fertilizers under Indian conditions, Role of fertilizers in plant growth and their application to soil, Advantages and disadvantages of fertilizers.

2. Nitrogenous Fertilizers

(09 Periods)

Types of nitrogenous fertilizers, Feed stock for production of ammonia: natural gas, associated gas, coke oven gas, naphtha, fuel oil, coal etc., methods of production: Ammonium sulphate, ammonium nitrate, calcium ammonium nitrate and urea, Operation problems of the urea plants.

3. Phosphoric Fertilizers

(09 Periods)

Raw materials- phosphoric rock, sulphur, manufacturing of super phosphates of all grades by different processes.

4. Potassic Fertilizer, Mixed/Compound Fertilizers

(09 Periods)

Manufacture of Potassium chloride and Potassium sulphate Advantages and disadvantages of mixed and compound fertilizers. Materials used in manufacturing of mixed fertilizers. Manufacture of various grades of NPK fertilizers.

5. Bio- Fertilizer

(06 Periods)

Introduction to Bio-fertilizer, Advantages of bio-fertilizers over conventional fertilizers. Manufacturing of bio-fertilizers.

INSTRUCTIONAL STRATEGY

Industrial visit to any fertilizer industry can be organized. Audio-visual should be used in teaching.

MEANS OF ASSESSMENT

- Assignment and quiz/class tests
- Mid semester and end semester written tests
- Practical work

RECOMMENDED BOOKS

1. Shreve's Chemical Process Industries by R. Norris Shreve and George T. Austin; McGraw Hill, New York
2. Outline of Chemical Technology by Charles E. Dryden, M. Gopala Rao, Marshall Sitting; Affiliated East West Publisher, Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	9	22
2.	9	22
3.	9	22
4.	9	22
5.	6	12
Total	42	100

PRACTICUM	5.5 PETROLEUM REFINING TECHNOLOGY (POE-3)	L	T	P
		2	1	-

COURSE OBJECTIVES

The objectives of this course are to:

- Provide detailed knowledge of **petroleum industry and its significance** as a core chemical industry.
- Enable understanding of **petroleum exploration, refining processes, and conversion techniques**.
- Familiarize students with **properties, specifications, and applications of petroleum products**.
- Develop the ability to **test petroleum products** using standard laboratory methods.
- Introduce basic concepts of **petrochemicals and lube oil manufacturing processes**.

COURSE OUTCOMES (CO):

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

CO1: Explain the formation, composition of crude oil, petroleum exploration practices, and standard testing methods of petroleum products.

CO2: Describe the composition, properties, specifications, and applications of major petroleum products.

CO3: Explain crude oil distillation processes and thermal conversion techniques used in petroleum refining.

CO4: Explain catalytic conversion and finishing processes employed in modern petroleum refineries.

CO5: Describe lube oil manufacturing processes and major petrochemicals derived from petroleum

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio- Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	3	1	–	2	1	1	1	*	*
CO2	3	2	–	1	1	1	1	*	*
CO3	2	2	–	1	2	1	–	*	*
CO4	2	2	1	–	1	1	–	*	*
CO5	2	1	–	–	1	–	–	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1: Petroleum Exploration

(09 Periods)

Theories of formation of crude oil, chemistry and composition of crude oil. Petroleum industry in India. Test methods of petroleum products-flash and fire point, octane number, cetane number, aniline point, viscosity index, cloud point and pour point, density and specific gravity, ASTM distillation.

Unit-2: Petroleum Products

(09 Periods)

Composition, properties, specification and uses of LPG, Naphtha, Motor spirit (Gasoline), Kerosene, Aviation turbine fuel, Diesel fuel, Fuel oil, lubricating oils (Automotive engine oils, industrial lubricating oils), petroleum wax, bitumen.

Unit-3: Crude Oil Distillation

(09 Periods)

1. Impurities in crude oils, desalting of crude oils, atmospheric distillation of crude oil, vacuum distillation of atmospheric residue.
2. Thermal Conversion Process- Thermal cracking visbreaking (Conventional Vis breaking and soaker visbreaking), Coking (delayed coking, fluid coking, Flexi coking)

Unit-4: Catalytic Conversion Process

(09 Periods)

1. Fluid catalytic cracking, catalytic reforming, hydro cracking, catalytic alkylation, catalytic isomerization, catalytic polymerization
2. Finishing process- Hydrogen sulphide removal process, sweetening processes (caustic treatment, doctor treating process), merox process, solvent extraction process (Edeleanu process)

Unit-5: Lube Oil Manufacturing Process

(06 Periods)

1. Evaluation of crude oils for lube oil base stocks, vacuum distillation, solvent Deasphalting, solvent extraction of lube oil fractions, solvent dew axing, hydro finishing
2. Introduction to major petrochemicals like Synthesis gas, Acetaldehyde, Ethylene oxide, styrene, Acrylonitrile, Butadiene.

INSTRUCTIONAL STRATEGIES

Theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with assignments. Expert lectures by professionals from petroleum industry can enrich the students with better inputs regarding the various processes involved for improving the quality of petroleum products. Also, a visit of the students to a refinery plant will further help them to understand the different processes and equipment involved in the petroleum and petrochemical industry.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Sessional Test
- Practical work

RECOMMENDED BOOKS

1. Petroleum Refining Technology by Ram Prasad; Khanna Publishers, Delhi
2. Petroleum Refining Engineering by W.L. Nelson; McGraw-Hill
3. Modern Petroleum Refining Processes by B. K. Rao; Oxford and IBH Publishing Co.
4. Petrochemical Process Technology by I. D. Mall; McMillan India
5. Introduction to petrochemicals by S. Maiti; Oxford and IBH Publishing Co.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	09	22
2.	09	22
3.	09	22
4.	09	22
5.	06	12
Total	42	100

PRACTICUM	5.6 POLLUTION CONTROL AND INDUSTRIAL SAFETY (POE-4)	L	T	P
		2	-	4

COURSE OBJECTIVES

The objectives of this course are to:

- Provide knowledge of **various types of pollution** caused by industrial activities.
- Enable students to understand **pollution control mechanisms and equipment** used in industries.
- Develop awareness about **environmental protection laws and regulations**.
- Train students in **solid waste management practices** for pollution reduction.
- Familiarize students with **industrial safety practices and accident prevention** in chemical plants.

COURSE OUTCOMES (CO)

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

CO1: Identify types of industrial pollution and explain air pollution sources, impacts, and control mechanisms.

CO2: Explain water pollution parameters and apply suitable industrial wastewater treatment methods.

CO3: Explain environmental protection laws, hazardous chemical regulations, and safety codes related to pollution control.

CO4: Apply solid waste and radioactive waste management techniques for environmental protection.

CO5: Identify industrial hazards in chemical plants and apply appropriate safety measures to prevent accidents.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcome s (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysi s	PO3 Design & Developmen t	PO4 Tools, Experimentati on & Testing	PO5 Socio- Economic/ Environme ntal	PO6 Project Mgmt & Communic ation	PO7 Lifelon g Learnin g	P S O 1	PS O2
CO1	3	1	–	2	3	–	1	*	*
CO2	2	2	1	3	2	1	1	*	*
CO3	2	1	–	–	3	–	1	*	*
CO4	2	2	1	2	3	1	1	*	*
CO5	2	2	2	2	3	2	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1: Introduction & Air Pollution and Control Mechanism

(06 Periods)

Environment and Pollution, Classification of pollution e.g. Land, Water, Air, Noise Environment Impact assessment Studies, Character and origin of industrial wastes.

1. Definition of air pollution, Types of Air pollutants and their sources like SPM, SO_x, NO_x, NH₃, F, Cl, CFC, CO₂ etc.
2. Air Pollution control equipment in industries
3. Settling chamber
4. Cyclone
5. Electrostatic precipitator
6. Bag Filter
7. Ambient air quality measurement & their standards

Experiment:

1. Removal of suspended impurities from air using fabric filter.
2. Demonstration of Cyclone Separator for removal of suspended particles from air.

Unit-2: Water Pollution

(06 Periods)

1. Water pollution, standards for drinking water, domestic waste water and industrial waste water. Methods of measurement of various parameter like BOD, SS, pH, COD, TDS etc.
2. Methods of treatment of industrial waste water like chemical treatment, physio-chemical treatment, bio-chemical treatment

Experiment:

1. Determination of pH value
2. Determination of turbidity
3. Determination of total solids, suspended solids, and total dissolved solids
4. Determination of dissolved oxygen (DO)/BOD/COD.
3. Determination of sulphate in water
4. Determination of chloride in water
5. Removal of suspended solids from water by coagulation.

Unit-3: Environment Protection & Pollution Acts

(06 Periods)

1. Environmental protection from hazardous chemicals waste:
2. Terminology relating to chemical hazards and air pollution, classification of chemical hazards and hazardous chemicals, codes of safety for operational hazards in laboratories, industries etc. (Reference should be made of I.S. Codes)
3. A water pollution prevention control Act 1974, Air Pollution Act 1981, Environment protection Act 1986, Hazardous chemical manufacturing, storage and impact rules 1989 and
4. hazardous waste and management and handling rules 1989, Regulation and control Rules 2000.

Unit-4: Radio Active Pollution & Solid Waste Management

(04 Periods)

Sources and effect on human, animal, plant and material; measurement; means to control and preventive measures

1. Municipal solid waste, biomedical waste, Plastic waste and its management, solid waste disposal methods such as open dumping, sanitary landfilling composting, incineration.
2. Importance of development of green area.

Experiment:

1. Prepare chart for treatments of different solid waste

Unit-5: Safety in Chemical Industry

(06 Periods)

Receiving and storing chemicals- transporting and moving chemicals- Safety in chemical reactions, pipelines with color coding in chemical factories. Precautions in the case of processes in operations involving explosive or inflammable dusts, gases, vapours etc. Maintenance of chemical plants-corrosion health hazards in common

chemical processes, Fire hazards and their prevention. Codes of practice and specification for safety equipment (Reference should be made from I.S. Codes), case study of major chemical process industries disasters/accidents.

INSTRUCTIONAL STRATEGY

- Case Study of any disaster should be undertaken. Study should be data based. Field visit to the industries should be planned.
- Student should encourage to undertake project work related to environmental problems.

MEANS OF ASSESSMENT

- Class Test
- Home Assignment
- Attendance
- Sessional Test

RECOMMENDED BOOKS

1. Safety in Process Plant Design by Wells
2. Safety and Accident Prevention in Chemical Operation by H. H, Tanacatte and W. S. Wood
3. Engineering Chemistry by P.C. Ja

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	6	20
2.	6	20
3.	6	20
4.	4	18
5.	6	22
Total	28	100

OR

PRACTICUM	5.6 SAFETY IN CHEMICAL PROCESS INDUSTRY (POE -4)	L	T	P
		2	-	4

COURSE OBJECTIVES

The objectives of this course are to:

- Provide knowledge of **industrial safety principles and practices** used in chemical process industries.
- Enable students to **identify hazards and assess risks** associated with chemical processes and workplaces.
- Develop skills for applying **hazard identification and risk assessment methodologies**.
- Familiarize students with **safe handling, storage, and disposal of hazardous chemicals**.
- Create awareness about **safety management systems, legal aspects, and safety audits**.

CO1: Apply hazard identification and risk assessment methodologies such as PHA, HAZOP, MCA, ETA, and FTA for chemical processes.

CO2: Identify workplace hazards and implement preventive measures including proper housekeeping and fire safety practices.

CO3: Apply safe handling, storage, exposure control, and confined space entry procedures for hazardous chemicals.

CO4: Identify industry-specific hazards and recommend safety and pollution control measures for different process industries.

CO5: Explain safety management principles, legal aspects of industrial safety, and prepare basic safety training modules and safety audit reports.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcome s (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentati on & Testing	PO5 Socio- Economic/ Environme ntal	PO6 Project Mgmt & Communic ation	PO7 Lifelong Learnin g	PSO 1	PSO 2
CO1	2	3	1	3	2	1	1	*	*
CO2	2	2	–	3	2	1	1	*	*
CO3	2	2	1	3	2	1	1	*	*
CO4	2	2	–	2	3	1	1	*	*
CO5	2	1	–	–	1	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

UNIT-I: Hazard identification methodologies, risk assessment methods-PHA, HAZOP, MCA, ETA, FTA, consequence analysis (06 periods)

Practical:

1. Conducting a hazard identification exercise using PHA, HAZOP, MCA, ETA, FTA methodologies
2. Simulating risk assessment scenarios in a mock worldwide.

UNIT-II: Hazards in work places - nature and type of work places, types of hazards, hazards due to improper house-keeping, hazards due to fire in multi-floor industries and buildings, guidelines and safe methods in the above situations. (06 periods)

Practicals:

1. Demonstrating proper housekeeping techniques to mitigate hazards

UNIT-III: Workers' exposures to hazardous chemicals, TLVs of chemicals, physical and chemical properties of chemicals leading to accidents like fire explosions, ingestion and inhalation, pollution in work places due to dangerous dusts, fumes and vapours, guidelines and safe methods in chemicals handling, storage and entry into confined spaces. (06 periods)

Practical:

1. Performing safe handling, storage and disposal of hazardous chemicals
2. Conducting a confined space entry simulation with safety protocols.

UNIT-IV: Hazards peculiar to industries like fertilizer, heavy chemicals, petroleum, pulp and paper, tanneries, dyes, paints, pesticides, glass and ceramics, dairy and sugar industries, guidelines for safe- guarding personnel and safeguarding against water, land and air pollution in the above industries. (06 periods)

Practical:

1. Assessing and mitigating hazards in mock fertilizer, petroleum, or dairy industry setups.

UNIT-V: Safety education and training- safety management, fundamentals of safety tenets, measuring safety performance, motivating safety performance, legal aspects of industrial safety, safety audit. (04 periods)

Practical:

1. Designing and presenting a safety training module or audit report

RECOMMENDED BOOKS

1. Dr B.K. Bhaskara Rao, Er. R.K. Jain, and Vineet Kumar, "Safety in Chemical Plants/Industry and Its Management" Khanna Publishers.
2. S.C. Sharma, "Industrial Safety and Maintenance Management", Khanna Book Publishing Co. Private Limited, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	6	20
2	6	20
3	6	20
4	6	12
5	4	16
Total	28	100

THEORY	5.7 DISASTER MANAGEMENT (O.E-2)	L	T	P
		2	-	-

COURSE OBJECTIVES:

Following are the objectives of this course:

- To learn about various types of natural and man-made disasters.
- To know pre- and post-disaster management for some of the disasters.
- To know about various information and organisations in disaster management in India.
- To get exposed to technological tools and their role in disaster management.

COURSE OUTCOMES:

After competing this course, student will be:

CO1: Acquainted with fundamental concepts of disaster, hazard, vulnerability, risk, and capacity, and explain their inter-relationships.

CO2 : Classify various types of disasters (Geological, Hydro-meteorological, Biological, Man-made) and analyze their causes, trends, and consequences.

CO3 : Apply the Disaster Management Cycle (Pre, During, Post) and global frameworks (Hyogo, IDNDR) to plan for risk assessment and mitigation.

CO4 : Familiarised with institutional and legal mechanism of Disaster Management in India, including the DM Act 2005 and the role of various agencies.

CO5: Able to select scientific tools (GIS, RS, GPS) and engineering practices (structural/non-structural mitigation) for disaster preparedness and safe construction.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PS O 1	PSO 2
CO1	2	-	-	-	3	-	1	*	*
CO2	3	2	-	-	3	-	2	*	*
CO3	1	2	1	-	3	2	2	*	*
CO4	2	-	-	-	3	1	2	*	*
CO5	3	2	1	2	3	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit – I: Understanding Disaster

(02 Periods)

Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management.

Unit – II: Types, Trends, Causes, Consequences and Control of Disasters

(05 Periods)

Geological Disasters (earthquakes, landslides, tsunami, mining); Hydro-Meteorological Disasters (floods, cyclones, lightning, thunder-storms, hail storms, avalanches, droughts, cold and heat waves) Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Manmade Disasters (building collapse, rural and urban fire, road and rail accidents, nuclear, radiological, chemicals and biological disasters) Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters.

Unit - III: Disaster Management Cycle and Framework

(08 Periods)

Disaster Management Cycle – Paradigm Shift in Disaster Management. Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness. During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief and Rehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action.

Unit – IV: Disaster Management in India

(05 Periods)

Disaster Profile of India – Mega Disasters of India and Lessons Learnt. Disaster Management Act 2005 – Institutional and Financial Mechanism, National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter Governmental Agencies 457 Open Elective Courses

Unit – V: Applications of Science and Technology for Disaster Management

(08 Periods)

Geo-informatics in Disaster Management (RS, GIS, GPS and RS). Disaster Communication System (Early Warning and Its Dissemination). Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India

RECOMMENDED BOOKS:

1. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management.
2. Bhandani, R. K., An overview on natural & man-made disasters and their reduction, CSIR, New Delhi.
3. Srivastava, H. N., and Gupta G. D., Management of Natural Disasters in developing countries, Daya Publishers, Delhi.
4. Alexander, David, Natural Disasters, Kluwer Academic London.
5. Ghosh, G. K., Disaster Management, A P H Publishing Corporation.
6. Murthy, D. B. N., Disaster Management: Text & Case Studies, Deep & Deep Pvt. Ltd.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	02	10
II	05	19
III	08	28
IV	05	19
V	08	24
Total	28	100

THEORY	5.7 ARTIFICIAL INTELLIGENCE (O.E-2)	L	T	P
		2	-	-

COURSE OBJECTIVES

The objectives of this course are to:

- Introduce students to the fundamental concepts, goals, and applications of Artificial Intelligence.
- Enable understanding of intelligent agents and their interaction with different environments.
- Develop basic knowledge of search algorithms and problem-solving techniques used in AI.
- Familiarize students with fuzzy logic systems and their role in decision-making.
- Introduce neural network concepts and their applications in intelligent systems.

COURSE OUTCOMES (CO):

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

CO1: Explain the concept, goals, history, and applications of Artificial Intelligence.

CO2: Describe intelligent agents, their types, and properties of environments.

CO3: Apply basic search algorithms and heuristic techniques for problem solving.

CO4: Explain principles and components of fuzzy logic systems.

CO5: Describe the structure and working of neural networks including perceptron and back-propagation.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcomes (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	3	1	–	–	–	–	1	*	*
CO2	2	2	–	–	–	–	1	*	*
CO3	2	3	–	–	–	–	1	*	*
CO4	2	2	–	–	–	–	1	*	*
CO5	2	2	1	–	–	–	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT:

Unit 1 – Introduction to Artificial Intelligence

(06 Periods)

- Artificial Intelligence (AI) definition
- Goals of AI
- History of AI
- Applications of AI

Unit 2 – Agents and Environments

(06 Periods)

- Agent Terminology, Types of Agents – Simple Reflex Agents, Model Based Reflex Agents, Goal Based Agents
- Nature of Environments, Properties of Environments

Unit 3 – Search Algorithms Terminology

(06 Periods)

- Brute Force Search Strategies – Breadth First Search, Depth First Search.
- Heuristic Search Strategies, Local Search Algorithms.

Unit 4 – Fuzzy Logic Systems

(05 Periods)

Introduction to Fuzzy Logic and Fuzzy systems,

- Membership functions,
- Fuzzification/Defuzzification

Unit 5 – Neural Networks

(05 Periods)

Basic structure of Neural Networks

- Perceptron
- Back-propagation

RECOMMENDED BOOKS

Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial Intelligence use cases Denis Rothman Packt Publishing ISBN – 978-1788990547

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	06	15
2	06	25
3	06	20
4	05	20
5	05	20
Total	28	100

AUDIT COURSE	5.8 INDIAN CONSTITUTION	L	T	P
		2	-	-

COURSE OBJECTIVES:

To provide a comprehensive understanding of the Indian Constitution's history and philosophy, and to familiarize them with the administrative structure, powers, and functions of the Union, State, and Local governments, along with the Judiciary and Election Commission.

COURSE OUTCOMES:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

CO1: Explain the making of the Indian Constitution, interpret the Preamble, and discuss the significance of Fundamental Rights and Duties.

CO2: Describe the structure of the Union Executive, detailing the powers and roles of the President, Prime Minister, and Council of Ministers.

CO3: Distinguish between the functions of the Lok Sabha and Rajya Sabha and explain the jurisdiction and structure of the Supreme Court.

CO4: Discuss the administrative framework of State Governments, focusing on the roles of the Governor, Chief Minister, and State Secretariat.

CO5: Outline the hierarchy and functions of Local Administration, including District Administration, Municipal Corporations, and Zila Panchayats.

CO6: Examine the structure of the Election Commission of India and its critical role in conducting free and fair elections.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2	Legend : High (3), Medium (2), Low (1) and No mapping (-) * PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.
CO1	-	-	-	-	3	1	3	*	*	
CO2	-	-	-	-	2	2	2	*	*	
CO3	-	-	-	-	3	1	2	*	*	
CO4	-	-	-	-	2	2	2	*	*	
CO5	-	-	-	-	3	2	2	*	*	
CO6	-	-	-	-	3	1	2	*	*	

ator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

Unit – I: The Constitution – Introduction

(06 Periods)

The History of the Making of the Indian Constitution
Preamble and the Basic Structure, and its interpretation
Fundamental Rights and Duties and their interpretation

Unit – II: Union Government

Periods)

(06

Structure of the Indian Union Government
President – Election, Role and Power
Prime Minister and Council of Ministers

Unit – III: Indian Legislature & Judiciary

(06 Periods)

Composition of Lok Sabha and Rajya Sabha
Powers & Functions of Lok Sabha and Rajya Sabha
Structure of Supreme Court including Appointment of Judges
Powers & Functions of Supreme Court

Unit – IV: State Government

(03 Periods)

Governor – Role and Power
Chief Minister and Council of Ministers
State Secretariat

Unit – V: Local Administration

(04 Periods)

District Administration
Municipal Corporation
Zila Panchayat

Unit – VI: Election Commission

(03 Periods)

Structure of Election Commission of India
Role and Function of Election Commission

INSTRUCTIONAL STRATEGY

Teach the Indian Constitution through interactive methods like case studies, debates, and role-plays to engage students. Use visuals and simplified texts to explain key features like fundamental rights and duties. Encourage discussions on amendments and landmark judgments. Incorporate quizzes and group projects to foster critical thinking and civic awareness

MEANS OF ASSESSMENT

- Class test/quizzes
- Home assignments
- Attendance
- Sessional Test

RECOMMENDED BOOKS:

1. Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2. The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3. Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Third 2018 edition
4. Our Constitution Subhash Chand Kashyap NBT New Delhi.

SUGGESTED SOFTWARE/LEARNING WEBSITES:

- 1.1. <https://www.constitution.org/cons/india/const.html>
- 1.2. <http://www.legislative.gov.in/constitution-of-india>

1.3. <https://www.sci.gov.in/constitution>

1.4. <https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/>

1.5. <https://ncert.nic.in/textbook.php>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	6	20
2	6	20
3	6	20
4	3	12
5	4	16
6	3	12
Total	28	100

THEORY	6.1 PROCESS EQUIPMENT DESIGN	L	T	P
		3	1	-

COURSE OBJECTIVES

The objectives of this course are to:

- Provide fundamental knowledge of **process equipment design philosophy** used in chemical industries.
- Enable students to understand **design procedures and codes** applicable to pressure vessels, heat exchangers, and distillation columns.
- Develop the ability to **design critical components** such as shells, heads, and supports of process equipment.
- Familiarize students with **fabrication techniques and testing methods** used for process equipment.
- Strengthen understanding of **stress analysis and mechanical considerations** in equipment design.

COURSE OUTCOMES (CO)

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

CO1: Explain general design philosophy, fabrication aspects, and stress analysis used in process equipment design.

CO2: Design pressure vessels considering operating conditions, applicable codes, safety factors, and corrosion allowances.

CO3: Design shell-and-tube heat exchangers using standard design procedures and codes.

CO4: Design and select suitable supports and mechanical components for pressure vessels.

CO5: Design distillation columns and analyze tray selection and operating limitations such as flooding and weeping.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

Course Outcome s (COs)	PO1 Basics & Discipline Knowledge	PO2 Problem Analysis	PO3 Design & Development	PO4 Tools, Experimentation & Testing	PO5 Socio-Economic/ Environmental	PO6 Project Mgmt & Communication	PO7 Lifelong Learning	PSO 1	PSO 2
CO1	3	2	—	—	—	—	—	*	*
CO2	2	3	3	—	1	—	1	*	*
CO3	2	3	3	2	1	2	1	*	*
CO4	2	2	3	—	1	—	—	*	*
CO5	2	3	3	1	—	2	—	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1: Basic Considerations in Process Equipment Design, Stress and Stress Analysis (10 Periods)

1. Introduction
2. The general design procedures
3. Fabrication Techniques
4. Equipment classification
5. Definition & types of stresses
6. Thermal stresses
7. Stresses caused by bending
8. Stresses in cylinders and spheres

Unit-2: Pressure Vessels (10 Periods)

2. Introduction
3. Operating conditions -Normal conditions, Transient conditions
4. Pressure vessel code
5. Design stress and design criteria
6. Corrosion allowance
7. Joint efficiency
8. Shell thickness for spherical and cylindrical vessels
9. Head or covers- crown and knuckle radius

Unit-3: Heat Exchanger (10 Periods)

1. Introduction
2. Codes and standards for heat exchangers
3. Overall heat transfer co efficient
4. Shell and tube heat exchangers: Tubes, Shell, Tube sheet layout. (Tube count), Shell types (Passes), Baffles, tie rods, tube joining methods
5. Flow patterns
6. Kern's method for heat exchanger design

Unit-4: Supports for Vessels (10 Periods)

1. Introduction
2. Bracket or lug supports
3. Leg supports
4. Skirt supports
5. Saddle supports
6. Flanges

Unit-5: Distillation Column (16 Periods)

1. Introduction
2. Columns internals
3. Selection of key component for multicomponent distillation
4. Advantages and limitation of vacuum distillation
5. Determination of number of theoretical stages of binary distillation
6. Using McCabe Thiele Method
7. Selection of trays
8. Checking of conditions for weeping, down comer flooding and liquid entrainment

INSTRUCTION STRATEGY

As far as possible, the teaching of the subject must be supplemented by showing the videos on designing of various parts.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Process equipment design by M.V. Joshi and V.V.Mahajan; McMillan India
2. Chemical Engineering by J.M. Coulson and J.F. Richardson; Pergamon Press, New York
3. Engineering Mechanics by R.S.Khurmi, S. Chand and Company Ltd., New Delhi
4. Process Equipment Design by B.E. Brownell and E.M. Young; John Wiley & Sons

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	10	20
2	10	20
3	10	20
4	10	20
5	16	20
Total	56	100

AUDIT COURSE	6.2 ENTREPRENEURSHIP AND START-UPS	L	T	P
		2	-	-

COURSE OBJECTIVES

To foster an entrepreneurial mindset by equipping students with the skills to identify business opportunities, formulate comprehensive business plans, understand management functions, and navigate the financial and legal landscapes of starting and sustaining a venture.

COURSE OUTCOMES:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

CO1: Explain the concept of entrepreneurship, classify business structures, and distinguish between the roles of an entrepreneur, intrapreneur, and manager.

CO2: Identify feasible business ideas using activity maps and develop a preliminary Business Plan based on case study analysis.

CO3: Analyze market strategies using STP and SWOT analysis, and formulate the Vision, Mission, and Objectives for a start-up.

CO4: Discuss the fundamental functions of management, organizational structures, and the processes of recruitment, selection, and training.

CO5: Select appropriate financing methods (Govt schemes, Venture Capital) and apply Intellectual Property Rights (IPR) concepts to protect business ideas.

CO6: Describe the strategies for business succession, harvesting, and the legal types of dissolution.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	-	-	-	-	2	3	2	*	*
CO2	-	2	2	-	1	3	2	*	*
CO3	-	2	2	-	2	3	2	*	*
CO4	-	-	-	-	1	3	1	*	*
CO5	-	2	-	-	2	3	2	*	*
CO6	-	-	-	-	1	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENTS

Unit-1 : Introduction to Entrepreneurship and Start – Ups (05 Periods)

1. Definitions, Classification of Entrepreneur
2. Traits of an Entrepreneur, Entrepreneurship, Motivation
3. Types of Business Structures- On the Basis of size and On the basis of ownership
4. Similarities/differences between entrepreneurs and managers

Unit-2: Business Ideas and their implementation (05 Periods)

1. Discovering ideas and visualizing the business
2. Activity map
3. Business Plan (Case Study)

Unit-3: Idea to Start-up (05 Periods)

1. Marketing and Accounting- Definition and Importance.
2. Market Analysis–STP (Segmentation, Targeting, Positioning)
3. Competition evaluation and Strategy Development – Vision, Mission, Goal, Objectives.
4. Risk analysis- SWOT Analysis.

Unit-4 : Management (05 Periods)

1. Definition Concept and Functions of Management
2. Company's Organization Structure- Concept and Classification
3. Recruitment and Selection- Definition,
4. Training and Development- Importance.

Unit-5: Financing and Protection of Ideas (04 Periods)

1. Financing methods available for Entrepreneurship/ Startups in India (Government Scheme, Banking, NBFCs, SHG and Micro Financing).
2. Intellectual Property Rights- Overview of - Copyrights, Trademark, Geographical Indicators, Patenting and Licenses
3. Communication of Ideas to potential investors–Investor Pitch.

Unit-6 Succession, Dissolution and Harvesting strategy (04 Periods)

1. Ways of succession
2. Types of Dissolution

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial and start-up qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organizations on visit. Approach extracted reading and handouts may be provided.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Model/Proto type making.

LIST OF RECOMMENDED BOOKS

1. The Startup Owner's Manual: The Step-by-Step Guide for Building a Great Company, Steve Blank and Bob Dorf, K&S Ranch, ISBN-978-0984999392
2. Entrepreneurship Development (A new Venture creation) Vasant Desai, Himalya Publication.
3. Entrepreneurship Development, Khanka S.S, S Chand & Company Limited New Delhi.
4. Entrepreneurship Development, Gupta and Srinivsan, S Chand & Company Limited New Delhi.
5. Demand: Creating What People Love Before They Know They Want It, Adrian J. Slywotzky with Karl Weber, Head line Book Publishing ISBN-978-0755388974
6. The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses, Clayton M. Christensen, Harvard business ISBN:978-142219602

WEBSITES FOR REFERENCE:

1. <https://www.fundable.com/learn/resources/guides/startup>
2. <https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate-structure/>
3. <https://www.finder.com/small-business-finance-tips>
4. <https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your-business/>
5. NPTEL Course on Entrepreneurship https://onlinecourses.nptel.ac.in/noc23_mg74/preview
6. National Geographic Channel you tube Video on "GI Tag Crafts of Bharat"

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	05	15
2	05	15
3	05	15
4	05	15
5	04	20
6	04	20
Total	28	100

THEORY	6.4 ECONOCOMIC POLICIES IN INDIA (O.E-3)	L	T	P
		2	-	-

COURSE OBJECTIVES:

The objective of this course is to familiarize the students of different streams with the basic concepts, structure, problems and issues concerning Indian economy.

COURSE OUTCOMES:

CO1: Explain the basic features of the Indian economy, including demographic trends, and analyze major economic problems like poverty, unemployment, and inflation.

CO2: Discuss the role of the agricultural sector, the impact of land reforms and the Green Revolution, and evaluate current agricultural policies.

CO3: Describe the industrial development pattern, the significance of small-scale industries, and the growth of the service sector in India.

CO4: Analyze the framework of economic planning (Planning Commission vs. NITI Aayog), and the impact of Monetary, Fiscal, and LPG policies.

CO5: Interpret India's external sector performance, including foreign trade composition, Balance of Payments, and the impact of Globalization and WTO.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PS O1	PS O2
CO1	1	2	-	-	2	1	2	*	*
CO2	1	2	-	-	2	1	1	*	*
CO3	1	1	-	-	2	2	2	*	*
CO4	1	2	-	-	3	3	2	*	*
CO5	1	2	-	-	2	2	2	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

Unit – 1: Basic features and problems of Indian Economy: (08 Periods)

Economic History of India; Nature of Indian Economy, demographic features and Human Development Index, Problems of Poverty, Un employment, Inflation, income inequality, Black money in India.

Unit – 2: Sectorial composition of Indian Economy: (05 Periods)

Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

Unit – 3: Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India. (04 Periods)

Unit – 4: Economic Policies: (06 Periods)

Economic Planning in India, Planning commission v/s NITI Aayog, Five Year Plans, monetary policy in India, Fiscal

Policy in India, Centre state Finance Relations, Finance commission in India. LPG policy in India.

Unit – 5: External sector in India:

(05 Periods)

India's foreign trade value composition and direction, India Balance of payment since 1991, FDI in India, Impact of Globalization on Indian Economy, WTO and India.

RECOMMENDED BOOKS:

1. Dutt Rudder and K.P.M Sunderam (2017). Indian Economy. S Chand & Co. Ltd. New Delhi.
2. Mishra S.K & V.K Puri (2017). Indian Economy and –Its Development Experience. Himalaya Publishing House.
3. Singh, Ramesh, (2016): Indian Economy, Tata-McGraw Hill Publications, New Delhi.
4. Dhingra, I.C., (2017): March of the Indian Economy, Heed Publications Pvt. Ltd.
5. Karam Singh Gill, (1978): Evolution of the Indian Economy, NCERT, New Delhi
6. Kaushik Basu (2007): The Oxford Companion to Economics of India, Oxford University Press.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	08	23
2	05	20
3	04	17
4	06	20
5	05	20
Total	28	100

THEORY	6.4 PROJECT MANAGEMENT (O.E-3)	L	T	P
		2	-	-

COURSE OBJECTIVES:

The aim of this course is to help the students to develop the idea of project plan, from defining and confirming the project goals and objectives, identifying tasks and how goals will be achieved.

COURSE OUTCOMES:

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry-oriented COs associated with the above-mentioned competency:

CO1: Explain the fundamental concepts of project management, including the project life cycle and priorities, and construct a Work Breakdown Structure (WBS) for a given project.

CO2: Apply the capital budgeting process to generate and screen project ideas and analyze market feasibility using demand forecasting techniques.

CO3: Estimate project costs, working capital requirements, and prepare projected financial statements including Cash Flow and Break-Even analysis.

CO4: Evaluate the financial viability of projects using discounting (NPV, IRR) and non-discounting (Payback, ARR) capital budgeting techniques and social cost-benefit analysis.

CO5: Develop project schedules using Network Planning techniques (CPM/PERT) to analyze time-cost trade-offs and determine the least cost duration.

SUGGESTED COURSE ARTICULATION MATRIX (CAM):

CO No.	PO1 Basic and Discipline Specific Knowledge	PO2 Problem Analysis	PO3 Design/ Development of Solutions	PO4 Engineering Tools	PO5 Engineering Practices for Society, Sustainability and Environment	PO6 Project Management	PO7 Life Long Learning	PSO1	PSO2
CO1	2	1	1	-	-	3	1	*	*
CO2	2	2	-	-	1	3	2	*	*
CO3	2	2	-	-	-	3	1	*	*
CO4	2	2	-	-	2	3	2	*	*
CO5	2	3	1	2	-	3	1	*	*

Legend: High (3), Medium (2), Low (1) and No mapping (-)

* PSOs will be developed by respective programme coordinator at institute level. As per latest NBA guidelines, formulating PSOs is optional.

COURSE CONTENT

UNIT-I: Concept of a project:

(04 Periods)

Classification of projects- importance of project management- The project life cycle- establishing project priorities (scope-cost-time) project priority matrix- work break down structure.

UNIT-II: Capital budgeting process:

(06 Periods)

Planning- Analysis-Selection-Financing-Implementation-Review.

Generation and screening of project ideas- market and demand analysis- Demand forecasting techniques. Market planning and marketing research process- Technical analysis

UNIT-III: Financial estimates and projections:

(06 Periods)

Cost of projects-means of financing-estimates of sales and production-cost of production-working capital requirement and its financing-profitability , projected cash flow statement and balance sheet. Break even analysis.

UNIT-IV: Basic techniques in capital budgeting:

(06 Periods)

Non discounting and discounting methods- payback period- Accounting rate of return-net present value-Benefit cost ratio-internal rate of return.

Project risk. Social cost benefit analysis and economic rate of return. Non-financial justification of projects.

UNIT-V: Project administration:

(06 Periods)

Progress payments, expenditure planning, project scheduling and network planning, use of Critical Path Method (CPM), schedule of payments and physical progress, time-cost trade off.

Concepts and uses of PERT cost as a function of time, Project Evaluation and Review Techniques/cost mechanisms. Determination of least cost duration. Post project evaluation. Introduction to various Project management software.

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment, seminar or case study method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial and start- up qualities in the students.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term written tests
- Model/Proto type making.

RECOMMENDED BOOKS:

1. Project planning, analysis, selection, implementation and review – Prasannachandra – Tata McGraw Hill
2. Project Management – the Managerial Process – Clifford F. Gray & Erik W. Larson – McGraw Hill
3. Project management - David I Cleland - McGraw Hill International Edition, 1999
4. Project Management – Gopala krishnan – Mcmillan India Ltd.
5. Project Management-Harry-Maylor-Pearson Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
I	04	18
II	06	22
III	06	20
IV	06	20
V	06	20
Total	28	100

7. GUIDELINES FOR ASSESSMENT OF STUDENT-CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 50 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

i. 15 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)

ii. 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)

- a) 75 - 80% 6 Marks
- b) 80 - 85% 8 Marks
- c) Above 85% 10 Marks

iii. * Even Semester:
25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSS activities as per following: (by In-charge Sports/NCC/Cultural/Co-curricular/NSS)

- a) State/National Level participation
- b) Participation in two of above activities
- c) Inter-Polytechnic level participation

**Odd Semester:

25 Marks maximum

- a) Language Lab Practices / foreign language practices
- b) Group Discussion and Personality Development
- c) Industrial Visits/Industrial Talks
- d) Power Point Presentations and Resume Making
- e) Development of Aptitude and Reasoning Skills
- f) Participation in the technical Exhibitions, Symposiums, Seminars, Workshops at the Institute /District/State/National Level.

8. RESOURCE REQUIREMENT

8.1. PHYSICAL RESOURCES

8.1.1. Space requirement

Norms and standards laid down by All India Council for Technical Education (AICTE) are to be followed to work out space requirement in respect of classrooms, tutorial rooms, drawing halls, laboratories, space required for faculty, student amenities and residential area for staff and students.

8.1.2. Equipment Requirement:

Following Laboratories are required for diploma programme in Chemical Engineering (3rd and 4th Semester)

- Fluid Flow Operations
- Chemical technology-I
- Mechanical Operations and Solid Handling
- Process Heat Transfer
- Chemical Reaction Engineering
- Chemical Technology-II

MASS TRANSFER OPERATIONS		
S. N.	Equipment Name	Qty
1.	BATCH DISTILLATION EXPERIMENT SET-UP	1
2.	CONTINUOUS DISTILLATION EXPERIMENT SET-UP	1
3.	LIQUID LIQUID EXTRACTOR EXPERIMENTAL SET-UP	1
4.	DISTILLATION PACKED COLUMN APPARATUS	1
5.	LABORATORY ELECTRICAL TRAY DRYER	1
6.	BUBBLE CAP DISTILLATION COLUMN	1
7.	LABORATORY REFRACTOMETER	1
8.	LIQUID DIFFUSION APPARATUS	1
9.	LABORATORY COOLING TOWER SET-UP	1
10.	LABORATORY CRYSTALLIZER APPARATUS	1
11.	REVERSE OSMOSIS LABORATORY APPARATUS	1
12.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	MISC.

PETROLEUM REFINING TECHNOLOGY		
S. N.	Equipment Name	Qty
1.	CLEAVE LAND FLASH AND FIRE POINT APPARATUS	1
2.	CLOUD AND POUR POINT APPARATUS	1
3.	REDWOOD VISCOMETER	1
4.	ENGLER VISCOMETER	1
5.	PENSKY MARTENS VISCOMETER	1
6.	SMOKE POINT APPARATUS	1
7.	ANILINE POINT APPARATUS	1
8.	ASTM DISTILLATION OF PETROLEUM PRODUCTS APPARATUS	1
9.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	MISC
10.	MUFFLE FURNACE LAB SCALE	1
11.	CONRADSON AND RAMSBOTTOM APPARATUS	1
12.	SILICA CRUCIBLE WITH LID	1
13.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requirement

FERTILIZER ENGINEERING		
S. N.	Equipment Name	Qty
1.	CARBON DIOXIDE GENERATOR	1
2.	COMBUSTION ASSEMBLY	1
3.	K-JELDAHL FLASK (300.CC), CONNECTING KJELDAL FLASK, DISTILLATION UNIT, RECEIVER, HEATER CONNECTING PIPINGS AND SUITABLE HOLDING FIXTURES	6
4.	ELECTRIC OVEN	2
5.	ELECTRONICS BALANCE 200-300 GM, 0.001 GM, BACK LIGHT LED WITH GLASS ENCLOSURE AND LAB WEIGHT FOR CALIBRATION	1
6.	REFLUX CONDENSER WITH K-JACKETED FLASK & FIXTURE	1
7.	ROUND BOTTOM FLASK WITH JOINT B-24, 500ML	1
8.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requirement

POLLUTION CONTROL AND INDUSTRIAL SAFETY		
S. N.	Equipment Name	Qty
1.	BOD INCUBATOR (5 C- 50C) WITH DIGITAL TEMPERATURE INDICATOR	1
2.	COD HEATER	1
3.	REFRIGERATOR, 280 LTRS.	1
4.	LABORATORY OVEN 2'X2'X2'	1
5.	TURBIDITY METER (0-4000 NTU)	1
6.	TDS PORTABLE METER	1
7.	ELECTRONIC BALANCE (0.001 GRAMS)	1
8.	BEAKERS	1
9.	CONICAL FLASK, ROUND BOTTOM FLASKS	1
10.	CONDENSER, REFLUX CONDENSER	1
11.	BOD BOTTLES, RUBBER PIPE, BURETTE, PIPETTE ETC.	As per requirement
12.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requirement

PROCESS CONTROL AND INSTRUMENTATION		
S. N.	Equipment Name	Qty
1.	APPARATUS FOR CALIBRATION OF PRESSURE GAUGE- BOURDEN TUBE	1
2.	BIMETALLIC THERMOMETER FOR TEMPERATURE MEASUREMENT	1
3.	U-TUBE MANOMETERS FOR PRESSURE MEASUREMENT	1
4.	ON-OFF CONTROLLER	1
5.	THERMOCOUPLE MODULE SETUP	2
6.	PNEUMATIC VALVE SETUP	1
7.	SET UP FOR STUDY RESPONSE OF TWO TANK IN NON-INTERACTING AND INTERACTING SYSTEM	1
8.	P CONTROLLER, PD CONTROLLER PID CONTROLLER	1
9.	RTD MODULE FOR TEMPERATURE MEASUREMENT	1
10.	LABORATORY RELATED GLASSWARES AND RAW MATERIALS	As per requirementt

8.1.3 Furniture Requirement

Norms and standards laid down by AICTE -APH (latest) be followed for working out furniture requirement for diploma courses

8.2 Human Resources:

Weekly work schedule, annual work schedule, student teacher ratio for various group and class size, staffing pattern, workload norms, qualifications, experience and job description of teaching staff workshop staff and other administrative and supporting staff be worked out as per norms and standards laid down by the AICTE.

9. EVALUATION SCHEME GUIDELINES: As Per AICTE ATTACHED (ANNEXURE- 2)

a. Theory Courses:

- Internal Assessment: 40%
- End Semester Examination: 60%
- Passing Criteria: A student must secure a minimum of 40% marks separately in both internal assessment and end semester examination to pass the course.

b. Practical Courses:

- Internal Assessment: 60%
- End Semester Examination: 40%
- Passing Criteria: A student must secure a minimum of 40% marks separately in both internal assessment and end semester examination to pass the course.

c. Summer Internship / Projects / Seminars, etc.:

- Evaluation is based on the following components:
 - Quality of work completed
 - Report preparation and documentation
 - Viva-voce performance
 - Presentation skills

Note:

Internal assessment is conducted based on the student's overall performance, which includes:

- Two best out of three mid-semester tests
- Quizzes and assignments
- Class participation and attendance
- Viva-voce and lab records (for practical subjects)

ANNEXURE- 2

EVALUATION METHODOLOGY

1. EVALUATION METHOD for THEORY

	Internal Assessment (40 marks)				External Assessment (60 marks)
	IA 1	IA 2	IA 3	IA 4	
Mode	Written Test	Written Test	Attendance and Assignments	Pre – Semester Examination	End Semester Examination
Portion	2 units	2 units	Regularly	All units	All units
Duration1hr	1hr	1hr	-	3hrs	3hrs
Exam Marks	20	20	20	60	60
Converted to	10	10	15	15	60
Tentative Schedule	5 th Week	10 th Week	Regularly	12 th -13 th Week	

IA1 and IA2: A written assessment test worth 20 marks should be conducted for two units. The marks earned (20 marks) will be converted to 10 marks. The best of the two assessments will be evaluated for an internal 10-mark assessment.

IA3: Assignments given after the completion of each unit, along with attendance throughout the semester, will be assessed for a total of 15 marks.

IA4: The pre-semester examination should follow the end-semester examination question pattern. The marks should be adjusted to 15 for internal assessment.

2. EVALUATION METHOD for PRACTICAL

	Internal Assessment (60 marks)				External Assessment (40 marks)
	IA 1	IA 2	IA 3	IA 4	
Mode	Practical Test	Practical Test	Attendance and Practical Documentation	Practical Test and Quiz – Viva Voce	Practical Examination
Portion	50% Practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	3 hrs	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13 th Week	

IA1 and IA2: Complete all exercises and experiments as outlined and retain them for the practical test. The test should be conducted in accordance with the evaluation scheme. The best of the two practical tests will be internally evaluated for a total of 20 marks.

IA3: Maintain a practical file for each exercise while ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, and practical test along with a valid certificate (Progress Card). This will be assessed for 20 marks.

IA4: The pre-semester practical examination, quiz, and viva-voce should follow the end-semester practical examination pattern, with marks adjusted to 20 for internal assessment.

SUGGESTED DISTRIBUTION OF MARKS FOR **INTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	5
B.	Circuit Diagram	5
C.	Procedure and Connections	10
D.	Observation Table and Calculation	10
E.	Result and its Discussion, Conclusion	10
F.	Practical Test	20
	Total	60

SUGGESTED DISTRIBUTION OF MARKS FOR **EXTERNAL** EVALUATION

Part	Description	Marks Allotted
A.	Objective	5
B.	Circuit Diagram	5
C.	Procedure and Connections	5
D.	Observation Table and Calculation	5
E.	Result and its Discussion, Conclusion	10
F.	Viva-Voce	10
	Total	40

3. EVALUATION METHOD for PRACTICUM (End Exam-Practical)

	Internal Assessment (60 marks)	External Assessment (40 marks)

	IA 1	IA 2	IA 3	IA 4	
Mode	Practical Test	Practical Test	Attendance and Practical Documentation	Micro Project	Practical Examination
Portion	50% practical	50% practical	All practical	All practical	All practical
Duration	3hrs	3 hrs	Regularly	Regularly	3hrs
Exam Marks	20	20	20	20	40
Tentative Schedule	5th Week	10th Week	Regularly	12th -13 th Week	

- **IA1 and IA2:** Complete all exercises and experiments as instructed and retain them for the practical test. The test should be conducted according to the evaluation scheme. The best of the two practical tests will be internally assessed for a total of 20 marks.
- **IA3:** Maintain a practical file for each exercise, ensuring attendance throughout the semester. Submit the required documents for the practical file, quiz, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be evaluated by 20 marks.
- **IA4:** Submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be assessed by both the laboratory supervisor and an internal examiner. This evaluation will contribute 20 marks.

SUGGESTED DISTRIBUTION OF MARKS FOR INTERNAL EVALUATION

Part	Description	Marks Allotted
A.	Objective	5
B.	Circuit Diagram	5
C.	Procedure and Connections	10
D.	Observation Table and Calculation	10
E.	Result and its Discussion, Conclusion	10
F.	Mini Project	20
	Total	60

SUGGESTED DISTRIBUTION OF MARKS FOR EXTERNAL EVALUATION

Part	Description	Marks Allotted
A.	Objective	5
B.	Circuit Diagram	5
C.	Procedure and Connections	5
D.	Observation Table and Calculation	5
E.	Result and its Discussion, Conclusion	10
F.	Viva-Voce	10
	Total	40

4. EVALUATION METHOD for PRACTICUM (End Exam-Theory)

	Internal Assessment (40 marks)						External Assessment (60marks)
	IA 1		IA 2		IA 3	IA 4	
Mode	Written Test	Practical Test	Written Test	Practical Test	Attendance and Practical Documentation	Pre Semester Examination and Micro Project	End Semester Examination
Portion	2 units	Practical related to the units	2 units	Practical related to the units	All unit	All Practical	All unit
Duration	1hr	3hrs	1hr	3 hrs	3hrs	Regularly	3hrs
Exam Marks	10	20	10	20	60	60	60
	30		30				
Converted to	10		10		15	15	60
Tentative Schedule	5 th Week		10 th Week		Regularly	12 th -13 th Week	

IA1 and IA2: A written assessment test worth 10 marks should be conducted for two **UNITs**. Complete all exercises and experiments as outlined and retain them for the practical test worth 20 marks. The practical test should be conducted in accordance with the evaluation scheme. The total marks earned (30 marks) will be converted to 10 marks. The best of the two assessments will be internally evaluated for a total of 10 marks.

IA3: Attendance and the pre-semester examination should follow the end-semester examination question paper pattern. The marks should be adjusted to 15 for internal assessment.

IA4: Maintain a practical file for each exercise. Submit the required documents for the practical file, quiz/viva-voice, practical test, and end-semester examination, along with a valid certificate (Progress Card). This will be assessed for 40 marks. Additionally, submit a micro-project report along with a fabrication model or analysis report. The performance of each student in the group will be evaluated by both the laboratory supervisor and an internal examiner. The total of 60 marks will be converted to 15 marks.

SUGGESTED DISTRIBUTION OF MARKS FOR INTERNAL EVALUATION FOR IA4

Part	Description	Marks Allotted
A.	Objective	5
B.	Circuit Diagram	5
C.	Procedure and Connections	5
D.	Observation Table and Calculation	5
E.	Result and its Discussion, Conclusion	10
F.	Attendance & Mini Project	10
	Total	40

10. LIST OF EXPERTS

1. Shri Rakesh Kumar, HOD Chemical Engineering, Govt. Poly. Kanpur.
2. Dr. Shashi Bala, Lecturer, Chemical Engineering, Govt. Poly. Kanpur.
3. Shri. Abhinav Jain, Lecturer Chemical Engineering, Govt. Poly. Sutawali, Amroha.
4. Dr. Anuj Chaturvedi, Lecturer, Chemical Engineering, MMIT, Auraiya.
5. Dr. Devesh Kumar Srivastava, Lecturer, Chemical Engineering, Govt. Poly. Bindki, Fatehpur.
6. Shri. Pawan Kumar, Lecturer, Chemical Engineering, Govt. Poly. Firozabad.
7. Basudha Maurya, Lecturer, Chemical Engineering, Govt. Poly. Kanpur.
8. Shri. Yatendra Kumar, Lecturer, Chemical Engineering, Govt. Poly. Kotvan Mathura.
9. Shri. Satyaveer Singh, Lecturer, Chemical Engineering, Govt. Poly. Kotvan Mathura.
10. Dr. Baijnath, Lecturer, Chemical Engineering, Govt. Poly. Kanpur.

(ANNEXURE-I)

PROCEDURES / FORMATS FOR ORGANIZING INTERSHIPS.

STUDENT INTERNSHIP PROGRAM APPLICATION

Complete and submit to the TPO/ Internship Program Coordinator.

1. Student Name:		Enroll. No.:	
2. Campus Address:		Phone:	
3. Home Address:		Phone:	
4. Student email address:			
5. Branch:	6. Internship Semester: _____		
7. Internship Preferences			
	Company/Industry	Core Area	Location
Preference-1			
Preference-2			
Preference-3			
Faculty mentor Signature: _____ Date_____.			
Student Signature: _____ Date_____.			
Signature confirms that the student agrees to the terms, conditions, and requirements of the Internship Program			

Signature with seal
HOD/Principal

(ANNEXURE-I)

REQUEST LETTER FROM INSTITUTE TO INTERNSHIP/INDUSTRIAL TRAINING PROVIDER

Ref. No.: _____

Date: _____

To,
The HR Manager/Training Coordinator
.....
.....

Subject: Request for Internship/Industrial Training for Diploma Students

Sir/Madam,

We are pleased to introduce....., a premier institution affiliated with Board of Technical Education, Uttar Pradesh, offering diploma programs in various diploma disciplines.

As a part of the curriculum, our students are required to undergo Internship/Industrial Training to gain practical exposure and enhance their technical competencies. Therefore, we kindly request your esteemed organization to provide Internship/Training opportunities to our students during the period from to

S. No.	Name	Enroll. No.	Semester/Year	Discipline

Yours sincerely,

(Head of Department/Principal)

PROFORMA FOR EVALUATION OF INTERNSHIP BY INDUSTRY

Student Name:Evaluation Date:

Industry Supervisor Name:

Company/Organization:

Title of the Project:

Please evaluate your intern by indicating the frequency with which you observed the following behaviors:

Parameters	Max. Marks	Marks Given
Attendance and Punctuality	20	
Discipline and Professional Behavior	20	
Technical Knowledge and Understanding of Processes	30	
Practical Skills and Quality of Work	20	
Ability to Apply Theoretical Knowledge	20	
Problem Solving and Analytical Ability	10	
Communication and Interpersonal Skills	20	
Teamwork and Collaboration	10	
Internship Report/Documentation	20	
Presentation and Viva-Voce	30	
Total Marks	200	

Additional comments, if any:

Signature with seal of Industry supervisor

HR Manager

INTERNSHIP REPORT

STUDENT'S DIARY/ DAILY LOG

The main purpose of writing daily diary is to cultivate the habit of documenting and to encourage the students to search for details. It develops the students' thought process and reasoning abilities. The students should record in the daily training diary the day to day account of the observations, impressions, information gathered and suggestions given, if any. It should contain the sketches & drawings related to the observations made by the students.

The daily training diary should be signed after every day by the supervisor/ in charge of the section where the student has been working. The diary should also be shown to the Faculty Mentor visiting the industry from time to time and got ratified on the day of his visit.

Student's Diary and Internship Report should be submitted by the students along with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. It will be evaluated on the basis of the following criteria:

- Regularity in maintenance of the diary.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

INTERNSHIP REPORT

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria:

- i. Originality.
- ii. Adequacy and purposeful write-up.
- iii. Organization, format, drawings, sketches, style, language etc.
- iv. Variety and relevance of learning experience.
- v. Practical applications, relationships with basic theory and concepts taught in the course.

MONITORING & EVALUATION OF INTERNSHIP

The industrial training of the students will be evaluated in three stages:

1. Evaluation by Industry.
2. Evaluation by faculty supervisor of Industry.
3. Evaluation through seminar presentation/viva-voce at the Institute.

1. EVALUATION BY INDUSTRY

The industry will evaluate the students based on the Punctuality, eagerness to learn, Maintenance of Daily Diary and skill test in addition to any remarks.

2. MONITORING/ SURPRISE VISIT BY TPO/ STAFF/ FACULTY MENTOR

TPO/Staff/ Faculty Mentor of the institutes will make a surprise visit to the internship site, to check the student's presence physically, if the student is found absent without prior intimation to the T & P Cell, entire training will be cancelled. Students should inform the TPO, faculty mentor as well as the industry supervisor at least one day prior to availing leave by email. Students are eligible to avail 1-day leave in 4 weeks and 2 days leave in 6 weeks of the internship period apart from holidays and weekly offs.

3. EVALUATION THROUGH SEMINAR PRESENTATION/VIVA-VOCE AT THE INSTITUTE

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- Quality of content presented.
- Proper planning for presentation.
- Effectiveness of presentation.
- Depth of knowledge and skills.
- Attendance record, daily diary, departmental reports shall also be analyzed along with the Internship Report.

Seminar presentation will enable sharing knowledge & experience amongst students & teachers and build communication skills and confidence in students.