DEPARTMENT OF TECHNICAL EDUCATION (DIPLOMA SECTOR)
UTTAR PRADESH

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

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Semester System

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(EFFECTIVE FROM YEAR 2026-27)

Prepared By:

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

UPDATED AND APPROVED BY BOARD OF TECHNICAL EDUCATION U.P. LUCKNOW IN C.D.C MEETING HELD ON 16.07.2026

CONTENTS

1. SALIENT FEATURES

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

7) **Industrial Training**

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

8) **Ecology and Environment**

As per Govt. of India directives a subject on Environmental Science has been incorporated in the curriculum.

9) **Entrepreneurship and Start-ups**

A full subject Entrepreneurship & Start-ups has been incorporated in the curriculum.

10) **Student Centred Activities**

A provision of 2-4 hrs per week has been made for organizing Student Centered Activities for overall personality development of students. Such activities will comprise of co–curricular activities such as expert lectures, self-study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS, library and other cultural activities.

11) **Project work**

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

2- PROGRAM OUTCOMES (POs)

PO1: Basics and Discipline specific Knowledge
Assimilate knowledge of basic mathematics, science, engineering fundamentals.

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.

STUDY AND EVALUATION SCHEME FOR CHEMICAL ENGINEERING (PETRO-CHEMICAL) (353)
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	Petroleum Refining And Petrochemical Technology	Program Core (Theory)	2	1	-	3	40	-	40	60	3	-	-	60	100
5.4	Petroleum Refining And Petrochemical Technology (Lab)	Program Core (Practical)	-	-	2	1		60	60	-	-	40	3	40	100
5.5	Program Elective-3	Program Core (Theory)	2	1	-	3	40	-	40	60	3	-	3	60	100
5.6	Program Elective-4	Program Core (Practicum)	2	-	4	4	40	-	40	60	3	-	-	60	100
5.7	Open Elective (Qualifying)	Open Elective -2	2	-	-	2	-	-	50*	-	-	-	-	-	-
	Advance Skill Certification	Certificate Course	-	-	-		-	-	-	-	-	-	-	-	NA
5.8	(Q) Indian Constitution	Audit Course	2	-	-	-	-	50*	50*	-	-	-	-	-	-
5.9	Summer Internship-II** (6 Weeks)	Summer Training	-	-	-	2	-	60	60	-	-	40	3	40	100
# Student Centered Activities			-	-	11	-	-	50	50	-	-	-	-	-	50
Total			**13**	**2**	**21**	**20**	**160**	**230**	**390**	**240**	**-**	**120**	**-**	**360**	**750**

(Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.

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

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. The lecture allotted to SCA can also be utilized for the course completion of other subjects.

STUDY AND EVALUATION SCHEME FOR CHEMICAL ENGINEERING (PETRO-CHEMICAL)

SIXTH SEMESTER

NORMAL PATHWAY

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	
6.1	PROCESS CONTROL AND INSTRUMENTATION	PROGRAM CORE (PRACTICUM)	2	-	4	4	40	-	40	60	3	-	-	60	100
6.2	Entrepreneurship And Start-Up	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	Open Elective -3	Open Elective	02	-	-	2	-	-	**50***	-	-	-	-	**-**	**-**
	Advance Skill Development	Certification Course	-	-	-		-	-	**-**	-	-	-	-	**-**	**-**
#STUDENT CENTERED ACTIVITIES			-	-	06		-	50	**50**	-	-	-	-	**-**	**50**
TOTAL			**10**		**26**	**20**	**80**	**290**	**370**	**120**		**160**		**280**	**650**

NOTE: -

1. (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
2. 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).
3. The above scheme can be customized as per the specific requirements of the respective courses.
4. (Q) It is compulsory to appear and to pass the examination, but marks will not be included for percentage and division of obtained marks.
5. # 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. The lecture allotted to SCA can also be utilized for the course completion of other subjects.

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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.

UDY AND EVALUATION SCHEME FOR CHEMICAL ENGINEERING (Petro Chamical)

PROGRAM ELECTIVE-1

SR. NO.	SUBJECT NAME
1	PETROLEUM ENGINEERING
2	ENERGY ENGINEERING

PROGRAM ELECTIVE-2

SR. NO.	SUBJECT NAME
1.	PLANT UTILITIES
2.	WASTE MANAGEMENT

PROGRAM ELECTIVE-3

SR. NO.	SUBJECT NAME
1.	EQUIPMENT DESIGN
2.	FERTILIZER ENGINEERING

PROGRAM ELECTIVE-4

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

OPEN ELECTIVE-2

SR. NO.	CERTIFICATE COURSES
1.	ENERGY EFFICIENCY AND AUDIT
2.	ARTIFICIAL INTELLIGENCE
SR.NO.	**ANY COURSE OF MINIMUM 02 CREDIT FROM**
1.	COURSES OFFERED BY TATA TECHNOLOGY (Annexure-1) OR OTHER REPUTED ORGNISATION.
2.	NPTEL
3.	MOOCS THROUGH SWAYAM
4.	AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
5.	C-DAC
6.	CERTIFICATES CONDUCTED BY THE INSTITUTE OF NATIONAL IMPORTANCE (IIT, NIT, IIT ETC.)
7.	ISRO E-LEARNING
8.	OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL PLATFORMS OF REPUTE, NEILIT

OPEN ELECTIVE-3

SR. NO.	CERTIFICATE COURSES
1	ECONOMIC POLICIES IN INDIA
2	PROJECT MANAGEMENT
3	INDUSTRIAL AUTOMATION AND MES (Course offered by TATA Technology)
4	FUNDAMENTALS OF INNOVATION AND DESIGN THINKING (Course offered by TATA Technology)
SR.NO.	**ANY COURSE OF MINIMUM 02 CREDIT FROM**
1.	COURSES OFFERED BY TATA TECHNOLOGY (Annexure-1) OR OTHER REPUTED ORGNISATION.
2.	NPTEL
3.	MOOCS THROUGH SWAYAM
4.	AICTE-ELIS AND CENTRALLY FUNDED TECHNICAL INSTITUTES
5.	C-DAC
6.	CERTIFICATES CONDUCTED BY THE INSTITUTE OF NATIONAL IMPORTANCE (IIT, NIT, IIT ETC.)
7.	ISRO E-LEARNING
8.	OTHER RELEVANT GOVERNMENT, INTERNATIONAL/NATIONAL PLATFORMS OF REPUTE, NEILIT

ANNEXTURE-A

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

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 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	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 (12 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 (10 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 (06 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 absorption isotherm

Unit-4: Membrane Separation and Crystallization (06 periods)

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

Unit-5: Crystallization (08 periods)

2. Concept of crystallization, saturation and super saturation and solubility curve, mechanism of crystallization/crystal formation, method of super saturation – Miers super saturation theory.
3. 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.

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

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SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	12	28
2	10	23
3	06	15
4	06	15
5	8	19
Total	42	100

PRACTICAL	5.2 MASS TRANSFER OPERATIONS-II (LAB)	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 (10 periods)

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

Unit-2: Extraction (10 periods)

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

Unit-3: Adsorption (10 periods)

1. To study adsorption of Dye using Charcoal.
2. To study the adsorption of water vapor on silica gel.

Unit-4: Membrane Separation (10 periods)

1. To study the separation of Particles or solutes using Microfiltration.
2. To study the effects of Membrane fouling on Membrane performance.

Unit-5: Crystallization (16 periods)

1. To study the Mechanism of Crystallization/ Crystal formation.
2. Study sketch of Batch Crystallizers.
3. Study sketch of Continuous Crystallizers.

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 Mc Cabe 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

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THEORY	5.3 PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY	L	T	P
		2	1	-

COURSE LEARNING OBJECTIVES

Petroleum industry is one among core chemical industries and it has large employment potential. In this subject, the students will be imparted detailed knowledge of petroleum refining and petroleum products along with major petrochemicals.

COURSE OUTCOMES:

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

CO1: Explain fundamentals of petroleum refining and major petrochemical plants.
CO2 Characterize and test properties of petroleum fractions and products.
CO3: Describe thermal and catalytic conversion processes used in petroleum refining and lube oil manufacture.
CO4: Explain manufacturing processes and applications of C1–C3 petrochemicals.
CO5: Explain manufacturing processes and applications of aromatic petrochemicals and polymers.

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	2	1	–	1	–	1	*	*
CO2	3	2	–	3	–	–	1	*	*
CO3	3	3	2	2	1	1	1	*	*
CO4	3	2	1	–	1	–	1	*	*
CO5	3	2	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 CONTENTS

Unit-1: Basic of Petroleum and Petrochemicals (8 Periods)

1. Theories of formation of crude oil, chemistry and composition of crude oil. Petroleum industry in India..
2. 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.
3. Introduction to major petrochemicals like Synthesis gas, Acetaldehyde, Ethylene, styrene, Acrylonitrile, Butadiene.

Unit-2: Petroleum Products and Crude Oil Distillation (8 Periods)

1. 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.
2. Impurities in crude oils, desalting of crude oils, atmospheric distillation of crude oil, vacuum distillation of

atmospheric residue.

Unit-3: Thermal and Catalytic Conversion Process and Lube Oil Manufacturing Process(14 Periods)

1. Thermal Conversion Process- Thermal cracking visbreaking (Conventional Visbreaking and soaker visbreaking), Coking (delayed coking, fluid coking, Flexi coking)
2. Fluid catalytic cracking, catalytic reforming, hydro cracking, catalytic alkylation, catalytic isomerization, catalytic polymerization
3. Finishing process- Hydrogen sulphide removal process, sweetening processes, solvent extraction process
4. Evaluation of crude oils for lube oil base stocks, solvent Deasphalting, solvent extraction of lube oil fractions, solvent dewaxing, hydro finishing

Unit-4: C_1,C_2 and C_3 petrochemicals (7 Periods)

1. Petrochemicals obtain from methanol, formaldehyde and chloro methane etc.
2. Petrochemicals obtain from ethylene, ethanolamine, ethylene dichloride,vinyl chloride, and ethylene oxide etc.
3. Petrochemicals obtain from propylene, CAN, Isopropanol, cumene etc.

Unit-5 Aromatic petrochemicals and polymers **(**5Periods)

1. Petrochemicals obtain from BTX separation,styrene, phthalic anhydrate etc
2. PVC, LDPE, HDPE, LLDPE, Polypropylene, Polystyrene, SBR, Polyesters etc

LIST OF 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.
6. Petrochemical Industries by Chitta ranjan lahri, Dipa biswas
7. Petroleum and Petrochemical Technology by Yogesh A. karpe

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

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Periods)	Marks Allotted (%)
1.	08	19
2.	08	19
3.	14	33
4.	07	17
5.	05	12
Total	**42**	**100**

PRACTICAL	5.4 PETROLEUM REFINING AND PETROCHEMICAL TECHNOLOGY (Lab)	L	T	P
		-	-	2

COURSE LEARNING OBJECTIVES

Petroleum industry is one among core chemical industries and it has large employment potential. In this subject, the students will be imparted detailed knowledge of petroleum refining and petroleum products along with major petrochemicals

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

CO1: Operate standard petroleum testing instruments such as Saybolt and Engler viscometers for viscosity measurement at different temperatures.
CO2: Perform characterization of petroleum products using smoke point and ASTM distillation methods.
CO3: Determine safety-related properties such as flash point, fire point, softening point, and penetration index using standard apparatus.
CO4: Measure low-temperature and solubility-related properties such as cloud point, pour point, and aniline point.
CO5: Evaluate carbon residue and stability characteristics of petroleum samples using Conradson apparatus.

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	2	–	3	–	1	1	*	*
CO2	3	2	–	3	–	1	1	*	*
CO3	3	2	–	3	1	1	1	*	*
CO4	3	2	–	3	1	1	1	*	*
CO5	2	2	–	3	1	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

Experiments:

Unit-1 (6 Periods)

Ex. 1 To determine the viscosity of given sample by using saybolt viscometer at different temperature ranges

Ex. 2 To determine the viscosity of given sample by using Engler viscometer at different temperature ranges

Unit- 2 (6 Periods)

Ex. 1 To determine the smoke point of given kerosene sample using smoke point apparatus.

Ex. 2 To characterize the given petroleum product (diesel and gasoline) by ASTM distillation.

Unit-3 (6 Periods)

Ex. 1 To determine flash and fire point of given sample of oil using pensky-martin apparatus.

Ex. 2 To determine the softening point and penetration index of bitumen

Unit-4 (6 Periods)

Ex. 1 To determine the cloud and pour point of given oil sample.
Ex. 2 To determine the aniline point of given sample

Unit- 5 (4 Periods)

Ex.1: To determine the carbon residue of the given sample by conradson appratus.

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

Practical work

LIST OF 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.
6. Petrochemical Industries by Chitta ranjan lahri, Dipa biswas
7. Petroleum and Petrochemical Technology by Yogesh A. karpe

Program Elective -3

THEORY	5.5.1 EQUIPMENT DESIGN (P.O.E-3)	L	T	P
		2	1	-

COURSE OBJECTIVES

A diploma holder in Chemical Engineering is expected to have knowledge of design procedure of pressure vessels, heat exchangers and distillation column. He should also be conversant with various fabrication and testing methods.

COURSE OUTCOMES (CO)

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

CO1: Explain the general design methodology, equipment classification, fabrication techniques, and basic considerations in process equipment design.

CO2: Perform stress analysis for process equipment components under static, thermal, and bending loads.

CO3: Design pressure vessels including shells and heads using codes, design criteria, and thickness calculations.

CO4: Design shell-and-tube heat exchangers using standards, layout rules, and Kern's method.

CO5: Select and design appropriate supports and fittings for process vessels.

CO6: Design and analyze distillation columns including tray selection and stage calculation using McCabe–Thiele method.

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	2	1	–	–	1	1	*	*
CO2	3	3	1	1	–	–	1	*	*
CO3	3	3	3	1	1	1	1	*	*
CO4	3	3	3	2	1	1	1	*	*
CO5	2	2	2	1	–	1	1	*	*
CO6	3	3	3	2	1	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 (04 Periods)

1. Introduction
2. The general design procedure
3. Fabrication Techniques
4. Equipment classification

Unit-2: Stress and Stress Analysis (06 Periods)

1. Introduction
2. Definition & types of stresses
3. Stresses due to static loads
4. Thermal stresses
5. Stresses caused by bending
6. Stresses in cylinders and spheres

Unit-3: Pressure Vessels (08 Periods)

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

Unit-4: Heat Exchanger (08 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-5: Supports for Vessels (06 Periods)

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

Unit-6: Distillation Column (12 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

LIST OF 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	04	7
2	06	14
3	08	18
4	08	18
5	06	14
6	12	29
Total	42	100

OR
Program Elective -3

		L	T	P
THEORY	**5.5.2 Fertilizer Engineering POE-3**	**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):

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 **(08 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 **(12 Periods)**

Types of nitrogeneous 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** (06 Periods)

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

4- **Potasic Fertilizer, Mixed/Compound Fertilizers** (10 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

LIST OF 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.	8	19
2.	12	28
3.	6	15
4.	10	23
5.	6	15
Total	42	100

Program Elective -4

PRACTICUM	**5.6.1 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 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	PSO1	PSO2
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 (6 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, NH_3, F, Cl, CFC, CO_2 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

PRACTICALS

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 (6 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

PRACTICALS

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.
5. Determination of sulphate in water
6. Determination of chloride in water
7. Removal of suspended solids from water by coagulation

Unit-3: Environment Protection & Pollution Acts (6 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 (4 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

PRACTICALS

1. Prepare chart for treatments of different solid waste

Unit-5: Safety in Chemical Industry (6 Periods)

1. Receiving and storing chemicals- transporting and moving chemicals- Safety in chemical reactions, pipelines with color coding in chemical factories.
2. 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.
3. 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

1. Case Study of any disaster should be undertaken. Study should be data based. Field visit to the industries should be planned.
2. Student should encourageto 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
Program Elective -4

PRACTICUM	**5.6.2 SAFETY IN CHEMICAL PROCESS INDUSTRIES 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**.

COURSE OUTCOMES (CO)

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

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 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	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

LIST OF 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**

OPEN ELECTIVE -2

THEORY	5.7 (a) - ENERGY EFFICIENCY AND AUDIT (O.E-2)	L	T	P

		2	**-**	**-**

Course Learning Objectives:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences. Undertake energy efficiency measures and energy audit.

Course Outcomes (COs)

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

CO1: Explain energy scenario, energy efficiency and conservation concepts, BEE roles, star labelling, and energy regulations.
CO2: Analyze performance and identify energy saving opportunities in pumping systems, fans, and blowers.
CO3: Evaluate efficiency and conservation measures in compressors and diesel generator systems.
CO4: Recommend suitable energy conservation techniques in lighting systems.
CO5: Apply energy efficiency methods in electrical machines, transformers, drives, and tariff systems.
CO6: Conduct basic energy audits using instruments, audit procedures, Sankey diagrams, and payback analysis, and prepare audit reports.

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	2	–	–	2	1	1	*	*
CO2	3	3	2	1	2	1	1	*	*
CO3	3	3	2	1	2	1	1	*	*
CO4	3	2	2	1	2	1	1	*	*
CO5	3	3	3	2	3	1	1	*	*
CO6	3	3	2	3	2	3	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 Introduction to Energy Efficiency

Energy Scenario: Energy demand and supply, National scenario.

Energy Efficiency and Energy Conservation; concepts, Indian Electricity Act 2001; relevant clauses of energy conservation, BEE and its Roles

Star Labelling: Need and its benefits.

Unit – II Pumping Systems, Fans and Blowers Factors affecting pump performance Efficient Pumping system operation

Energy conservation opportunities in Pumping systems

Fan types, flow control strategies

Fan performance Assessment

Energy Conservation opportunities in Pumping systems Tips for energy saving in fans and blowers

Unit – III Air Compressors and Diesel Power Generator sets

Classification of compressors

Pneumatic System components

Effect of various parameters on efficiency of Compressor

Capacity control of Compressors

Checklist for Energy Efficiency in Compressed air systems Operating guidelines for diesel generator, operational factors Effects of improper ventilation of genset

Energy saving measures for DG sets

Unit –IV Energy Conservation in Lighting System

Replacing Lamp sources

Using energy efficient luminaries

Using light controlled gears

Installation of separate transformer / servo stabilizer for lighting Periodic survey and adequate maintenance programs

Innovative measures of energy savings in lighting

Unit– V Energy Efficient Electrical Machines

Need for energy conservation in induction motor and transformer Energy conservation techniques in induction motor by:

Energy conservation techniques in Transformer

Energy Conservation Equipment: Soft starters, Automatic star delta convertor, Variable Frequency Drives, Automatic p. f. controller (APFC)

Energy efficient motor; significant features, advantages, applications and Limitations Energy efficient transformers, amorphous transformers; epoxy Resin cast transformer / Drytype of transformer

Aggregated Technical and commercial losses (ATC), Technical losses; causes and measures to reduce, Commercial losses: pilferage, causes and remedies

Application of tariff system to reduce energy bill

Co-generation and Tariff; concept, significance for energy conservation

Unit– VI Energy Audit of Electrical Systems

Energy audit (definition as per Energy Conservation Act)

Energy audit instruments and their use Questionnaire for energy audit projects Energy flow diagram (Sankey diagram)

Simple payback period, Energy Audit procedure (walk through audit and detailed audit). Energy Audit report format.

Reference Books:

1. Guide Books No. 1 and 3 for National Certification Examination for Energy Managers and Energy Auditors, Bureau of Energy Efficiency (BEE), Bureau of Energy Efficiency (A Statutory body under Ministry of Power, Government of India) (Fourth Edition 2015).
2. O.P. Gupta, Energy Technology, Khanna Publishing House, Delhi, Edition 2018, (ISBN: 978- 93-

86173-683).
3. Henderson, P. D., India - The Energy Sector, University Press, Delhi, 2016. ISBN*: 978*- 0195606539
4. Turner, W. C., Energy Management Handbook, Fairmount Press, 2012, ISBN 9781304520708
5. Sharma, K. V., Venkataseshaiah; P., Energy Management and Conservation, I K International Publishing House Pvt. Ltd; 2011 ISBN 9789381141298
6. Mehta,V.K.,PrinciplesofPowerSystem,S.ChandandCo.NewDelhi,2016,ISBN 9788121905947
7. Singh, Sanjeev; Rathore, Umesh, Energy Management, S K KatariaandSons,New Delhi ISBN- 13: 9789350141014.
8. Desai, B. G.; Rana, J. S.; A. Dinesh, V.; Paraman, R., Efficient Use and Management of Electricity in Industry, Devki Energy Consultancy Pvt. Ltd.
9. Chakrabarti, Aman, Energy Engineering And Management, e-books Kindle Edition

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 associatedwith the above mentioned competency:

- Undertake energy efficiency activities
- Use energy efficient pumps, compressors and blowers
- Use energy efficient Air Compressors and DG sets
- Use energy efficient Lighting Systems
- Apply energy efficient electrical machines.
- Use Co-generation and relevant tariff for reducing losses in facilities.

OR
OPEN ELECTIVE -2

THEORY	5.7.1 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

Suggested Learning Resources:

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

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	PSO 2
CO1	-	-	-	-	3	1	3	*	*
CO2	-	-	-	-	2	2	2	*	*
CO3	-	-	-	-	3	1	2	*	*
CO4	-	-	-	-	2	2	2	*	*
CO5	-	-	-	-	3	2	2	*	*
CO6	-	-	-	-	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 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 **(06 Periods)**
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:

- https://www.constitution.org/cons/india/const.html
- http://www.legislative.gov.in/constitution-of-india
- https://www.sci.gov.in/constitution
- https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of-india/
- 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**

Internship	5.9 SUMMER INTERNSHIP-II (6 Weeks) after 4th Semester	L	T	P
		-	-	-

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organized during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later.

An external assessment of 40 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva- voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

Punctuality and regularity	15%
Initiative in learning new things	15%
Presentation and VIVA	15%
Industrial training report	55%

PRACTICUM	6.1 PROCESS CONTROL AND INSTRUMENTATION	L	T	P
		2	-	4

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):

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	PSO1	PSO2
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

Experiments:

1. Measurement of Temperature by Thermocouple module.
2. Measurement of Temperature by of RTD module.
3. Level measurement by using Differential Pressure (DP) Transmitter.
4. Measurement of Pressure by Bourdon Pressure Transducer.

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. Ist order system - Examples of 1st order system: Naked bulb thermometer and its derivation; Stirred tank heater; Mixing process; Liquid levels (derivation excluded).
2. IInd 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.

Experiments:

1. Study of characteristics of control valve (Linear, Equal% and Quick opening).
2. Study the linearity of P/I and I/P converter (Transducers).
3. Study of P, PI, PD and PID controller using Pressure controller Trainer kit by monitoring the process in SCADA mode or Analog mode
4. To study the response of two tank in non-interacting liquid level system.
5. To study the response of two tank in interacting liquid level system.

Unit-4: Controller Characteristic or Modes of Control Action (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.

Experiments:

1. To study on-off controller for temperature control.
2. To calibrate pressure gauge with the help of dead weight pressure gauge

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	22
2	6	22
3	8	29
4	6	22
5	2	5
Total	28	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	PSO 1	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** (09 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 (08 Periods)

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

Unit-3: Idea to Start-up (12 Periods)

1. MarketingandAccounting- Definition and Importance.
2. MarketAnalysis–STP (Segmentation, Targeting, Positioning)
3. CompetitionevaluationandStrategyDevelopment – Vision, Mission, Goal, Objectives.
4. Riskanalysis- SWOT Analysis.

Unit-4 : Management (09 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 (12 Periods)

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

Unit-6 Succession, Dissolution and Harvesting strategy (06 Periods)

1. Ways of succession
2. Types of Dissolution

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 Entre-preneurs Use Continuous Innovation to Create Radically Successful Businesses, Clayton M. Chris-tensen, 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	09	17
2	08	14
3	12	20
4	09	17
5	12	21
6	6	11
Total	56	100

PROJECT	6.3 IN-HOUSE PROJECT	L	T	P
		4	-	16

COURSE LEARNING OBJECTIVES:

Project Work aims at developing innovative skills in the students whereby they apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project. In addition, the project work is intended to place students for project oriented practical training in actual work situation for the stipulated period.

LEARNING OUTCOMES

After undergoing the project work, the students will be able to:

1. Apply in totality the knowledge and skills gained through the course work in the solution of particular problem or by undertaking a project.
2. Develop understanding regarding the size and scale of operations and nature of field-work in which students are going to play their role after completing the courses of study
3. Develop understanding of subject based knowledge given in the classroom in the context of its application at work places.
4. Develop firsthand experience and confidence amongst the students to enable them to use and apply polytechnic/institute based knowledge and skills to solve practical problems related to the world of work.
5. Develop abilities like interpersonal skills, communication skills, positive attitudes and values etc.
6. Assemble/fabricate and test an electronics gadget.

GENERAL GUIDELINES

The individual students have different aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. The activity of problem identification should begin well in advance (say at the end of second year). Students should be allotted a problem of interest to him/her as a major project work. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments for their students. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given to a group. The project work identified in collaboration with industry should be preferred.

This practical training cum project work should not be considered as merely conventional industrial training in which students are sent at work places with either minimal or nosupervision. This experience is required to be planned in advance and supervised on regular basis by the polytechnic faculty. For the fulfillment of above objectives, polytechnics may establish close linkage with 8-10 relevant organization for providing such an experience to students. It is necessary that each organization is visited well in advance and activities to be performed by students are well defined. The chosen activities should be such that it matches with the curricular interest to students and of professional value to industrial/ field organizations. Each teacher is expected to supervise and guide 5-6 students.

THE PROJECT ASSIGNMENTS MAY CONSIST OF:

1. Development of prototypes
2. Study of different types of :
3. heat exchangers
4. distillation columns
5. evaporators
6. reactors
7. driying unit etc.
8. Study of different types of vessels, heads and joints (can be done through factory visit)
9. Study of pumps and valves used in process industries
10. Fabrication of components/equipments
11. Fault diagnosis and rectification experiences
12. Bringing improvements in the existing system/equipment
13. Audits of industry- energy audit, water audit, material audit etc.

14. Case Studies

NOTE:

1. The list is only the guideline for selecting a project; however, a student is at liberty to select any other related project of his choice independently under guidance of his teacher.

2. A suggestive criterion for assessing student performance by the external (person from industry) and internal (teacher) examiner is given in table below:

Sr. No.	Performance Criteria	Max.** Marks	Rating Scale				
			Excellent	Very Good	Good	Fair	Poor
1.	Selection of project assignment	10%	10	8	6	4	2
2.	Planning and execution of considerations	10%	10	8	6	4	2
3.	Quality of performance	20%	20	16	12	8	4
4.	Providing solution of the problems or production of final product	20%	20	16	12	8	4
5.	Sense of responsibility	10%	10	8	6	4	2
6.	Self-expression/ communication skills	5%	5	4	3	2	1
7.	Interpersonal skills/human relations	5%	5	4	3	2	1
8.	Report writing skills	10%	10	8	6	4	2
9.	Viva voce	10%	10	8	6	4	2
	Total marks	100 %	100	80	60	40	20

The overall grading of the practical training shall be made as per following table.

S.No.	Range of maximum marks	Overall grade
1.	More than 80	Excellent
2.	79 <> 65	Very good
3.	64 <> 50	Good
4.	49 <> 40	Fair
5.	Less than 40	Poor

In order to qualify for the diploma, students must get “Overall Good grade” failing which the students may be given one more chance to improve and re-evaluate before being disqualified and declared “not eligible to receive diploma ”. It is also important to note that the students must get more than six “goods” or above “good” grade in different performance criteria items in order to get “Overall Good” grade.

IMPORTANT NOTES

1. This criterion must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 200 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting

such awards.

5. The teachers are free to evolve other criteria of assessment, depending upon the type of project work.
6. It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organizations in such an exhibited.

Open Elective -3

THEORY	**6.4.1 ECONOMIC POLICIES IN INDIA**	**L**	**T**	**P**
	(O.E-3)	**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	PSO1	PSO2
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-I: **(06 PERIODS)**

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

UNIT-II: **(06 PERIODS)**

Sectoral composition of Indian Economy: Issues in Agriculture sector in India, land reforms Green Revolution and agriculture policies of India,

UNIT-III: **(06 PERIODS)**

Industrial development, small scale and cottage industries, industrial Policy, Public sector in India, service sector in India.

UNIT-IV: **(05 PERIODS)**

Economic Policies: 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-V: (05 PERIODS)

External sector in India: - 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.

Reference 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	6	25
2	6	25
3	6	20
4	5	15
5	5	15
Total	28	100

OR

OPEN ELECTIVE -3

THEORY	**6.4.2 PROJECT MANAGEMENT**	**L**	**T**	**P**
	(O.E-3)	**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: **(06 PERIODS)**

Concept of a project: 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: **(06 PERIODS)**

Capital budgeting process: 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: **(06 PERIODS)**

Financial estimates and projections: 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: **(05 PERIODS)**

Basic techniques in capital budgeting: 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: (05 PERIODS)

Project administration: 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 softwares.

Reference 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-Peason Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted(%)
1	6	25
2	6	25
3	6	20
4	5	15
5	5	15
Total	**28**	**100**

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-

1- 15 Marks for general behaviour and discipline
(by HODs in consultation with all the teachers of the department)

2- 10 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)

a) 75 - 80% 06 Marks

b) 80 - 85% 08 Marks

c) Above 85% 10 Marks

3- *** Even Semester:**

25 Marks maximum for Sports/NCC/Cultural/Co-curricular/NSSactivities 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.

RESOURCE REQUIREMENT

PHYSICALRESOURCES

(A) Spacerequirement

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

(B) Equipment Requirement:

Following Laboratories are required for diploma programme in Chemical Engineering (3^{rd}, 4^{th} ,5^{th} and 6^{th} Semester):

- Measuring Instruments and Measurements
- Mechanical Operations and Solid Handling/Fluid Flow Operation
- Process Heat Transfer / Mass Transfer Operations
- ChemicalTechnology
- ChemicalReaction Eng.
- ProcessControl
- Fertilizer Technology
- Pollution Control and Industrial Safety

LIST OF EQUIPMENT

5.2 MASS TRANSFER OPERATIONS-II		
S. N.	**Equipment Name**	**Qty**
1.	BATCH DISTILLATION EXPERIMENT SET-UP	1
2.	CONTINOUS DISTILLATION EXPERIMENT SET-UP	1
3.	LIQUID LIQUID EXTRACTOR EXPERIMENTAL SET-UP	1
4.	DISTILLATION PACKED COULMN APPARATUS	1
5.	LABORATORY ELECTRICAL TRAY DRYER	1
6.	BUBBLE CAP DISTILLATION COLUMN	1
7.	LABOARATORY 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.

5.4 PETROLEUM REFINING AND PETROCHEMICAL 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 APPARTAUS	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

5.6 POLLUTION CONTROL AND INDUSTRIAL SAFETY (P.O.E-4)		
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

6.1 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

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LIST OF Participants/EXPERTS

The following experts participated in various workshop for Developing the Curriculum's Structure and Contents of **Chemical Engineering (Petro- Chemical)** at I.R.D.T. Kanpur.

1. Mr. Rakesh Kumar, Head of Department (Chemical), Government Polytechnic, Kanpur
2. Dr. Shivcharan Prajapati, Lecturer (Paint Technology), Government Polytechnic, Bindki, Fatehpur
3. Mr. Vinod Prasad Sharma, Lecturer (Paint Technology), Government Polytechnic, Kanpur
4. Mr. Satyaveer Singh, Lecturer (Chemical), Government Polytechnic, Kotwan, Mathura
5. Dr. Shashi Bala Gautam, Lecturer (Chemical), Government Polytechnic, Kanpur
6. Mr. Mausam Kumar, Lecturer (P.M.T.), Government Polytechnic, Kanpur
7. Mr. Devesh Srivastava, Lecturer (Chemical), Government Polytechnic, Bindki, Fatehpur
8. Mrs. Kanchan Kushwaha, Lecturer (Petro-Chemical), Government Polytechnic, Kotwan, Mathura
9. Shri Shyam Lal, Text Book Officer, IRDT, Kanpur .
10. Shri Monit Kumar, Research/Technical Assistant IRDT, Kanpur.

Evaluation Method

ANNEXURE- 1

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 -13th 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.	Diagram	**5**
C.	Procedure	**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.	Diagram	**5**
C.	Procedure	**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 -13th 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.	Diagram	**5**
C.	Procedure	**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.	Diagram	**5**
C.	Procedure	**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	5th Week		10th Week		Regularly	12th -13th Week	

IA1 and IA2: A written assessment test worth 10 marks should be conducted for two **UNIT**s. 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.

(ANNEXURE-I)

PROCEDURES / FORMATS FOR ORGANIZING INTERNSHIPS.

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
Preferance-1			
Preferance-2			
Preferance-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)

(ANNEXURE-II)

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

(ANNEXURE-II)

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.

(ANNEXURE-II)

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.