



# Veermata Jijabai Technological Institute (V.J.T.I)

(Central Technological Institute, Maharashtra State, INDIA)

H. R. Mahajani Marg, Matunga, Mumbai 400019

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Fax: +91 22 24102874

Website: [www.vjti.ac.in](http://www.vjti.ac.in)

**Programme Name: Diploma In Chemical Engineering**

**Programme Code : DCHE**      **With Effect From Academic Year : 2023-24**

**Duration of Programme : 6 Semester**      **Duration : 16 WEEKS**

**Semester : Sixth**      **Scheme : R-2023**

Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Assessment Scheme										Total Marks		
						Actual Contact Hrs./Week			Self-Learning (Micro Projects/ Assignments/ Activities)	Notional Learning Hours /Week		Paper Duration (hrs.)	Theory				Based on LL & TL				Based on Self Learning			
						CL	TL	LL					FA-TH( MS T)	SA-TH( ESE )	Total		Practical		FA-PR( CA)	SA-PR (PR/OR)			SLA	
															Max	Min	Max	Min		Max	Min		Max	Min
1	ADVANCED SEPARATION TECHNOLOGIES	AST	DSC	235CH61		3	-	3	1	7	3.5	3	30	70	100	40	-	-	25#	10	25	10	150	
2	EMERGING TRENDS IN CHEMICAL ENGINEERING	ETCE	DSC	235CH62		3	2	-	2	7	3.5	3	30	70	100	40	25	10	-	-	25	10	150	
3	MASS TRANSFER AND APPLICATIONS	MTA	DSC	235CH63		3	1	3	-	7	3.5	3	30	70	100	40	25	10	25#	10	-	-	150	
4	ELECTIVE (Any One)	ELE	GE	235CH64		3	-	-	-	3	1.5	3	30	70	100	40	-	-	-	-	-	-	100	
5	SIMULATION TOOLS FOR CHEMICAL ENGINEERING	STCE	AEC	235CH65		2	-	3	1	6	3	-	-	-	-	-	50	20	50#	20	25	10	125	
6	ENTREPRENEURSHIP DEVELOPMENT AND START UP	EDS	VEC	235CH66		2	1	-	1	4	2	-	-	-	-	-	50	20	-	-	25	10	75	
7	PROJECT-II	PRJ	INP	235CH67		-	-	6	-	6	3	-	-	-	-	-	100	40	100#	40	-	-	200	
<b>Total</b>						-	16	4	15	5	40	20		120	280	400		250		200		100		950

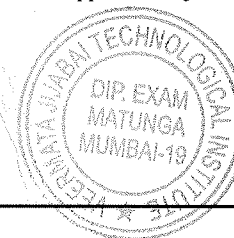
**Abbreviations:** CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

**Legends:** @ Internal Assessment, # External Assessment, \*# Online Examination. @\$ Internal Online Examination

**Course Category:** Discipline Specific Course Core (DSC) : 2, Discipline Specific Elective (DSE) : 0, Value Education Course (VEC) : 1, Intern./Apprenti./Project./Community (INP) : 0, Ability Enhancement Course (AEC) : 2, Skill Enhancement Course (SEC) : 2, Generic Elective (GE) : 0

*[Signature]*  
Curriculum Coordinator

*[Signature]*  
Head of the Diploma Chemical Engineering (DCHE)



*[Signature]*  
Dean Diploma



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Tel.No. +91 22 24198101-02 Fax: +91 22 24102874  
Website: [www.viti.ac.in](http://www.viti.ac.in)

Programme: Diploma in CHEMICAL ENGINEERING (DCHE)

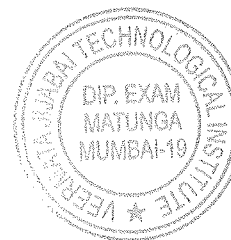
Semester: VI

Implemented from: 2023

SR NO	ELECTIVE SUBJECT
1	Polymer Technology
2	Fertilizer Technology
3	Petroleum and Petrochemical Technology
4	Food and Beverages Technology
5	Piping in Chemical Engineering
6	Application of Nanotechnology

Curriculum Coordinator

Head of the Department



Dean Diploma

DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: SIXTH
COURSE TITLE	: ADVANCED SEPARATION TECHNOLOGIES
COURSE CODE	: 235CH61

## I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
3	-	3	-	3	3	30	70	28	100	40	-	-	50#	20	-	-	150

Total IKS Hrs for Sem.: 0 Hrs

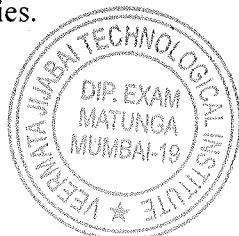
Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

## II. RATIONALE

Separation processes are a critical component of chemical and allied industries. While conventional methods like distillation, filtration, and extraction are widely used, they often become inefficient, costly, or environmentally unsustainable when dealing with complex mixtures or dilute solutions. Hence, there is a growing need for **Advanced Separation Technologies** that offer better selectivity, energy efficiency, and scalability. This course introduces students to **modern separation techniques** such as membrane processes, adsorption, ion exchange, chromatographic methods, and hybrid/emerging systems like forward osmosis and membrane bioreactors. These technologies are gaining widespread application in industries such as **pharmaceuticals, food processing, wastewater treatment, biotechnology, and petrochemicals**. These subject bridges academic fundamentals with **real-world industrial applications**, preparing diploma graduates to meet the challenges of **green manufacturing, process optimization, and environmental compliance** in today's process industries.



### III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1:** Understand the need and scope of advanced separation techniques.

**CO2:** Explain the working principles of various membrane processes and select suitable types for specific applications.

**CO3:** Analyze adsorption and ion exchange processes for industrial separation.

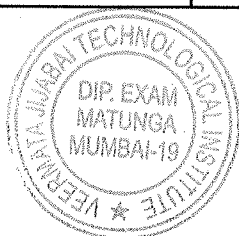
**CO4:** Demonstrate the fundamentals of supercritical fluid techniques.

**CO5:** Demonstrate the fundamentals of chromatographic.

**CO6:** Evaluate the integration and feasibility of hybrid and emerging separation technologies in industry.

### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
1	<b>Introduction to Advanced Separation Processes</b>	8	10	1	20%	30%	50%	
	1.1 Limitations of conventional separation techniques							
	1.2 Classification of advanced separation techniques							
	1.3 Selection criteria based on feed composition, efficiency, and cost							
2	<b>Membrane Separation Processes</b>	10	15	2	20%	30%	50%	
	2.1 Types of membranes: microfiltration, ultrafiltration, nanofiltration, reverse osmosis							
	2.2 Transport mechanisms and membrane configurations							
	2.3 Applications in water treatment, food, and pharma industries							
	2.4 Fouling and cleaning strategies							
3	<b>Adsorption and Ion Exchange Techniques</b>	06	10	3	20%	30%	50%	
	3.1 Principles of adsorption; isotherms (Langmuir, Freundlich)							
	3.2 Fixed-bed and fluidized-bed adsorption systems							

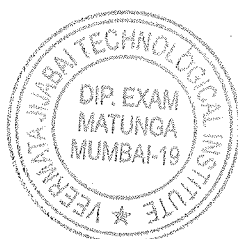


	3.3	Ion exchange resins and processes						
	3.4	Applications in wastewater and chemical industries						

### SECTION - II

Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
4	<b>Supercritical Fluid Extraction</b>	6	10	4	20%	30%	50%
	4.1 Properties of supercritical fluids.						
	4.2 Equipment and operational parameters.						
	4.3 Applications in extraction processes.						
5	<b>Chromatographic Separation Processes</b>	8	10	5	20%	30%	50%
	5.1 Fundamentals of chromatography.						
	5.2 Types: gas chromatography, liquid chromatography.						
	5.3 Industrial applications and case studies.						
6	<b>Hybrid and Emerging Separation Technologies</b>	10	15	6	20%	30%	50%
	6.1 Hybrid systems (e.g., membrane-biological reactors, RO-FO systems)						
	6.2 Emerging technologies: capacitive deionization, forward osmosis, membrane distillation						
	6.3 Techno-economic and environmental analysis						
	6.4 Future trends and industrial challenges						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).



## V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Sr. No.	Laboratory Experiment / Practical Titles/ Tutorial Titles	Nos. of hours	Relevant COs
1	Identify and classify advanced separation techniques through case studies on samples	3	1
2	Comparison of performance and cost between conventional and advanced separation techniques	3	1
3	Determine water flux and rejection rate using <b>microfiltration</b> membrane	3	2
4	Study of <b>ultrafiltration</b> and membrane pore size influence on separation efficiency	3	2
5	Demonstrate <b>reverse osmosis (RO)</b> setup operation and calculate salt rejection efficiency	3	2
6	Conduct membrane <b>fouling test</b> and demonstrate cleaning procedures	3	2
7	Prepare <b>Langmuir and Freundlich isotherms</b> using activated carbon adsorption	3	3
8	Study <b>breakthrough curve</b> in fixed-bed adsorption column (e.g., methylene blue)	3	3
9	Determine <b>ion exchange capacity</b> of a cation exchange resin	3	3
10	Study <b>regeneration efficiency</b> of ion exchange resins	3	3
11	Demonstration (or simulation) of <b>supercritical CO<sub>2</sub> extraction system</b> (video/animation)	3	4
12	Perform <b>thin-layer chromatography (TLC)</b> for separation of sample dyes or food colors	3	5
13	Conduct <b>paper chromatography</b> and analyze retention factors (R <sub>f</sub> values)	3	5
14	Simulate or demonstrate <b>gas chromatography (GC) / HPLC</b> experiment (software/video)	3	5
15	Case study/simulation on <b>forward osmosis</b> or <b>membrane distillation</b> in wastewater treatment	3	6
16	Group mini-project: Evaluate and present a <b>hybrid system</b> (e.g., RO-MBR or FO-RO) with cost analysis	3	6

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

Micro Project (if any)

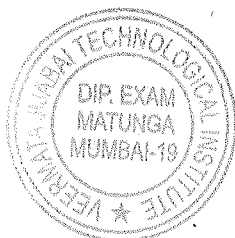
## VII. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test

**Summative Assessment (Assessment of Learning)**

- End Term Exam, End Term Practical Examination



### VIII. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	2	-	3	-	3	3	3
CO2	3	2	2	-	3	-	3	3	3
CO3	3	2	2	-	3	-	3	3	3
CO4	3	2	2	-	3	-	3	3	3
CO5	3	2	2	-	3	-	3	3	3
CO6	3	2	2	-	3	-	3	3	3

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

### IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	J.D. Seader, Ernest J. Henley, D. Keith Roper	Separation Process Principles	Wiley, ISBN-10. 0471464805
2	C.J. King	Separation Processes	Tata McGraw-Hill
3	J.M. Coulson, J.F. Richardson, J.R. Backhurst, J.H. Harker	Chemical Engineering Volume 2: Particle Technology and Separation Processes	Butterworth-Heinemann
4	Richard W. Baker	Membrane Technology and Applications	Wiley

### X. LEARNING WEBSITES & PORTALS

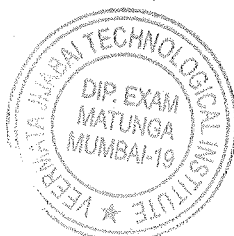
Sr. No	Link / Portal	Description
1	<a href="https://archive.nptel.ac.in/courses/103/105/103105060/">https://archive.nptel.ac.in/courses/103/105/103105060/</a>	Fundamental of Separation Process
2	<a href="https://courseware.cutmap.ac.in/home/course/advanced-separation-technologies-and-downstream-processing/237">https://courseware.cutmap.ac.in/home/course/advanced-separation-technologies-and-downstream-processing/237</a>	Advanced Separation Technologies and Downstream Processing

  
Curriculum Coordinator

  
Head of the Department

  
Dean Diploma

BOS VJTI Approval dated 10/07/2024



<b>DIPLOMA PROGRAMME</b>	<b>: DIPLOMA IN CHEMICAL ENGINEERING</b>
<b>PROGRAMME CODE</b>	<b>: DCHE</b>
<b>SEMESTER</b>	<b>: SIXTH</b>
<b>COURSE TITLE</b>	<b>: EMERGING TRENDS IN CHEMICAL ENGINEERING</b>
<b>COURSE CODE</b>	<b>: 235CH62</b>

### I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME											
CL	TL	LL	Self-learning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)	TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
										FA-PR (CA)		SA-PR (PR/OR)		SLA		
								Max	Min	Max	Min	Max	Min	Max	Min	
3	2	-	2	3.5	3	30	70	100	40	25	10	-	-	25	10	150

### II. RATIONALE

This subject will provide current trends and research in the field of chemical engineering

### III COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning  
**CO1:** Basic concept of green chemistry and life cycle assesment , able to design the process steps for minimizing the waste and energy consumption

**CO2:** Learn basic principles of process intensification

**CO3:** Knowledge of advance separation process used in chemical and allied industries

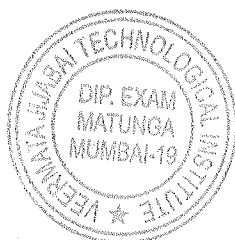
**CO4:** Knowledge of manufacturing practices for specialty chemicals

**CO5:** Application of the circular economy concept to industrial process

**CO6:** Knowledge of automation of industrial process and digitisation

### IV COURSE CONTENTS WITH SPECIFICATION TABLE

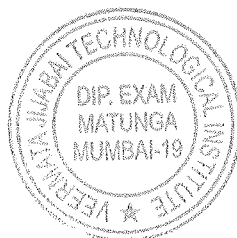
SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	C OS	R Level	U Level	A Level	
1	<b>Sustainable Process Engineering</b>	08	15	1	40%	40%	20%	
1.1	Introduction to Green chemistry principles, benefits of green chemistry							



	1.2	Waste minimization & cleaner production: strategies for waste minimization, energy reduction						
	1.3	Introduction to life cycle assessment, Phases of life cycle assessment, examples						
2		<b>Process intensification</b>	06	10	2	40%	40%	20%
	2.1	Introduction to process intensification, key features : miniaturization, integration of process, enhancement of efficiency.						
	2.2	Benefits of process intensification, Examples: Micro reactor, membrane bioreactor						
3		<b>Advanced Separation Processes</b>	10	10	3	40%	40%	20%
	3.1	Super critical fluid extraction, detail process, Applications in pharmaceuticals, food industry, and natural products						
	3.2	Magnetic Separation: detailed process, benefits and applications in metal extraction, pharmaceutical purifications						

### SECTION - II

Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
4	<b>Specialty Chemical Manufacturing</b>	12	10	4	40%	40%	20%
	4.1	What are specialty chemicals, examples of specialty products					
	4.2	Characteristics of Specialty Chemical Manufacturing , case study to manufacturing of specialty chemicals					
5	<b>Circular Economy and Waste Valorization</b>	06	15	5	40%	40%	20%
	5.1	Recycling and upcycling industrial waste: <b>Chemical Recycling</b> , Industrial Symbiosis, Upcycling Slag, Ash, and Mineral Waste					
	5.2	Designing processes for material recovery Introduction, steps for designing of design process					
6	<b>Process Automation and Industry 4.0</b>	06	10	6	40%	40%	20%
	6.1	Basics of PLC, SCADA, and DCS systems, concept Industrial IoT (IIoT)					



## V. LIST OF PRACTICALS/ASSIGNMENTS/TUTORIALS

Sr. No.	Practical/Assignment/Tutorial Title	No. of Hours	Relevant COS
1	Write a note on green chemistry	4	1
2	What are the different types of life cycle assessment, explain each type in detail	4	1
3	What is process intensification, explain in detail any one example of process intensification	4	2
4	Write a detailed note on cryogenic extraction with a suitable example	4	3
5	Write a case study report on manufacturing of fine chemicals	4	4
6	Design the process for any chemical product manufacturing with the circular economy	4	5
7	Describe the SCADA and PLC system in detail.	4	6
8	Presentation on designing of manufacturing process according to green chemistry principles with addition of circular economy concept	4	1,4,5

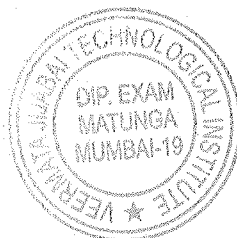
## VI. ASSESSMENTS METHODOLOGIES /TOOLS

Formative assessment (Assessment for Learning)

- Midterm Test Exam
- Term Work

Summative Assessment (Assessment of Learning)

- End Term Exam
- Practicals



## VII. SUGGESTED COS-POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	3	-		2	1	2	3
CO2	3	2	3	2	-	2	2	3	2
CO3	3	3	3	1	2	2	1	3	2
CO4	3	2	3	2	3	3	3	3	3
CO5	3	2	3	-	2	3	3	3	2
CO6	3	2	3	2	2	2	2	3	2

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PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VIII. SUGGESTED LEARNING MATERIALS TEXTBOOKS/REFERENCE

Sr. No	Author	Title	Publisher
1	W. L. McCabe, J.S. Smith, P. Harriot	Unit Operation of Chemical Engineering	Mc-Graw Hill Publications
2	Fritz Ullmans	Ullmann's Encyclopedia of Industrial Chemistry	Wiley International

## IX. LEARNING WEBSITES & PORTALS

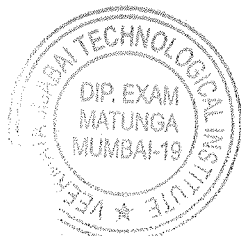
Sr. No	Link / Portal	Description
1	<a href="https://archive.nptel.ac.in/courses/103/105/103105060/">https://archive.nptel.ac.in/courses/103/105/103105060/</a>	Fundamental of Separation Process
2	<a href="https://courseware.cutmap.ac.in/home/course/advanced-separation-technologies-and-downstream-processing/237">https://courseware.cutmap.ac.in/home/course/advanced-separation-technologies-and-downstream-processing/237</a>	Advanced Separation Technologies and Downstream Processing

*[Signature]*  
Curriculum Coordinator

*[Signature]*  
Head of the Department

*[Signature]*  
Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: SIXTH
COURSE TITLE	: MASS TRANSFER AND APPLICATION
COURSE CODE	: 235CH63

### I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME													
CL	TL	LL	SL	CR	PAPER HRS	FA-TH (MST)		SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
						Max	Min	Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
												Max	Min	Max	Min	Max	Min	
3	1	3	1	4	3	30	70	28	100	40	25	10	50#	20	25	10	200	

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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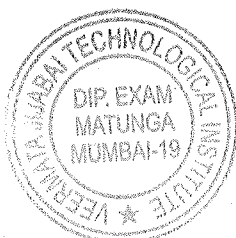
### II. RATIONALE

Piping Technology develops idea to arrange and optimize the piping facility required for transport of various fluids from one to other unit operations.

### III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 – To understand the basic principles of mass transfer by diffusion in gases, liquids and



solids

CO2 – To understand the gas absorption, absorption with chemical reaction.

CO3 – To study various contact patterns and equipment of extraction and leaching

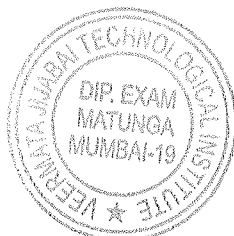
CO4 – To understand Vapor liquid equilibrium and study different types of distillation and equipment's for distillation

CO5 – To study drying and draw drying curve and calculate time of drying. To study working principles of different types of dryers.

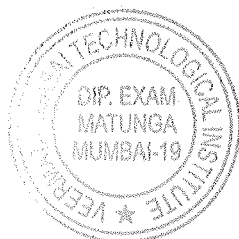
CO6 – To understand the Design based application of Mass Transfer operation

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

Section I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level	
1	<b>Diffusion in Mass Transfer</b>	09	13	1	40%	40%	20%	
1.1	Fundamentals of mass transfer: Molecular diffusion in fluids, mass transfer coefficients, and interface mass transfer, State different mass transfer theories. steady state theories of mass transfer, Whitman's two-film theory, film theory, surface renewal theory, penetration theory and its variations.							
1.2	Diffusion: Calculate the rate of diffusion in gas-gas and liquid-liquid system. Definition, Ficks Law, Flux equation, Molecular diffusion in gases, Steady state diffusion of A through non diffusing B, Steady state equimolar counter diffusion. Numericals. Analogy between mass transfer and heat transfer, Equilibrium, Numericals.							
2	<b>Absorption</b>	08	11	2	40%	40%	20%	
2.1	Introduction and Design: Calculate minimum liquid gas flow rate ratio to obtain a certain composition of outlet gas. State selection criteria for packing material in packed column and its effect on absorption Contents: Concept of Gas Absorption, comparison with distillation, selection criteria for solvent. Concept of equilibrium, minimum liquid-gas ratio, material balance, Concept of HETP. Loading and flooding of packed columns							



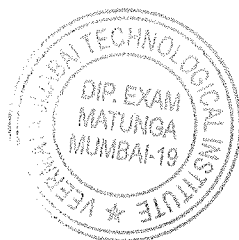
	2.2	Gas absorption equipments- mechanically agitated vessel, packed columns, types of packings, channelling in packed columns.						
3.		<b>Extraction</b>	07	11	3	40%	40%	20%
	3.1	Introduction: Distinguish between distillation and extraction. State the application of various extraction equipment, concept of extraction, liquid-liquid extraction, comparison between distillation and extraction, distribution coefficient, selection criterion of solvent						
	3.2	Extraction equipments- mixer settler, spray column, rotating disc contactor						
<b>Section II</b>								
4		<b>Distillation</b>	14	19	4	40%	40%	20%
	4.1	Introduction: Concept of distillation, boiling point diagram, change of pressure on boiling point diagram. Vapour liquid equilibrium diagram, henry's Law, Raoult's Law, determination of vapor composition by above laws. computing x – y data Volatility, relative volatility.						
	4.2	Methods of distillation: Describe various distillation methods- differential distillation, Rayleigh's equation, flash distillation rectification, azeotropic distillation, batch distillation & steam distillation						
	4.3	Design: Material balance on distillation column, Derivation of equation for feed line, top and bottom operating line, McCabe – Thiele method, Lewis – Sorel method, Calculate no. of equilibrium stages in distillation column, q line, derivation, effect of feed conditions on slope of q line, reflux ratio – minimum, total & optimum reflux ratio, equipments for distillation, rectification column, bubble cap plate, sieve plate, valve plate, downcomers & weirs, introduction to packed distillation column. Numericals.						
5		<b>Drying</b>	7	10	5	40%	40%	20%
	5.1	General Principles: Moisture content on dry and wet basis, Total, free, critical and equilibrium moisture content, Rate of drying-Constant and falling rate period, Time required for drying Numericals						



	5.2	Selection of dryer to be used for drying different materials.						
	5.3	Drying equipments & their Application: Tray dryer, Rotary dryer, Drum dryer, Spray dryer, Fluidized bed dryer, Pneumatic dryer.						
6		<b>Applications of Mass Transfer (design Based)</b>	3	6	6	40%	40%	20%
	6.1	Role of Mass Transfer in Industrial process design						
	6.2	Emerging Applications & Green Design Aspects. Energy efficient and sustainable separation processes. Use of computational tools(Aspen, MATLAB) in design validation.						
		<b>Total</b>	<b>64</b>	<b>80</b>				
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).								

#### V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Sr. No.	Unit	Practical/Assignment	Approx. Hours	CO
1	1	Determine the diffusivity of volatile liquids.	3	1
2	2	Construct equilibrium diagram from total pressure-vapour pressure data and relative volatility values.	3	2
3	2	Verify Rayleigh’s equation by carrying out simple distillation of methanol- water mixture	6	2
4	2	Perform fractional distillation to measure purity and verify material balance	6	2
5	2	Compare the purity of distillate in a packed column at total reflux and 0.5 reflux ratio	6	2
6	2	Analyze the parameters of distillation column by using process simulator	6	2
7	4	Calculate the pressure drop of a given packed column for wet and dry packing	3	3
8	4	Find out distribution coefficient for toluene- acetic acid and chloroform- acetic acid mixture	3	3
9	5	Carry out drying of wet saw dust or sand in a batch dryer and plot drying rate curve	3	4



### VIII. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	2	-	3	-	3	3	3
CO2	3	2	2	-	3	-	3	3	3
CO3	3	2	2	-	3	-	3	3	3
CO4	3	2	2	-	3	-	3	3	3
CO5	3	2	2	-	3	-	3	3	3
CO6	3	2	2	-	3	-	3	3	3

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

### IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No.	Author	Title	Publisher
1	K. A. Gavane	Mass Transfer Operations	Nirali Publications
2	Mr. Walter L. Badger & Mr. Julius T. Banchero	Introduction to Chemical Engineering	Tata Mc Graw Hill, New Delhi
3	Mc Cabe, W. L. Smith & Harriot.	Unit Operations of Chemical Engineering	Tata Mc Graw Hill International, New York
4	Treybal, Robert E	Mass Transfer Operations	Tata Mc Graw Hill International, New York
5	Richardson & Coulson	Chemical Engineering Vol. 2	Asian Books Pvt. Ltd., New Delhi

### X. LEARNING WEBSITES & PORTALS

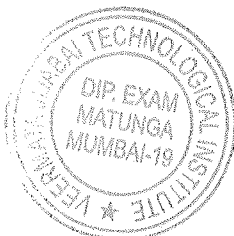
Sr.No	Link / Portal	Description
1	<a href="https://nptel.ac.in/courses/103103035/">https://nptel.ac.in/courses/103103035/</a>	NPTEL
2	<a href="https://nptel.ac.in/courses/103104046">https://nptel.ac.in/courses/103104046</a>	NPTEL

*[Signature]*  
Curriculum Coordinator

*[Signature]*  
Head of the Department

Dean Diploma

BOS VJTI Approval dated 10/07/2024



<b>DIPLOMA PROGRAMME</b>	<b>: DIPLOMA IN CHEMICAL ENGINEERING</b>
<b>PROGRAMME CODE</b>	<b>: DCHE</b>
<b>SEMESTER</b>	<b>:VI</b>
<b>COURSE TITLE</b>	<b>: POLYMER TECHNOLOGY</b>
<b>COURSE CODE</b>	<b>:235CH64</b>

## I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max					Min	Max	Min	Max	Min	Max	
3	-	-	-	1.5	3	30	70	30	100	40	-	-	-	-	-	-	100

**Total IKS Hrs for Sem.: 0 Hrs**

**Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment**

**Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination**

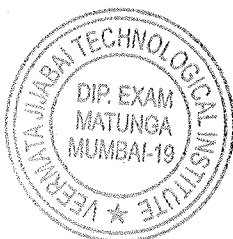
**Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0,**

**Value Education Course (VEC): 1; Intern/Apprentice/Project/Community (INP): 0, Ability**

**Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0**

## II. RATIONALE

Diploma chemical engineers have to operate and monitor various chemical manufacturing processes. Polymer manufacturing is one of the important processes in chemical engineering world. They have to deal with various polymerization processes and operate various equipment's related to it. They also deal with the safety aspects and environmental concerns related to polymerization process. This course is developed in the way by which the polymer manufacturing plant can be operated and related equipment's can be handled in safe manner.



### III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

**CO1** – Select relevant type of polymerization to manufacture required polymer..

**CO2** – Use relevant process for manufacturing of polymers

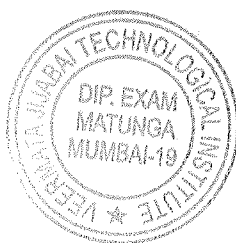
**CO3** – Select relevant manufacturing process of resin and elastomers..

**CO4** – Use relevant operation for plastic processing.

**CO5** – Apply relevant treatment methods in fiber processing.

### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

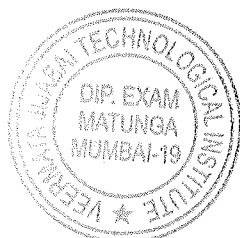
SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
1		<b>Introduction to polymers</b>	<b>8</b>	<b>12</b>	<b>1</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	1.1	Describe with sketches the relevant mechanism used for the given Polymer.						
	1.2	Describe the applications of given Polymerization Processes						
	1.3	Select relevant building blocks for manufacturing of the given monomers with justification						
	1.4	State field applications of the given polymers						
	1.5	Advantages And Limitations of polymers						
2		<b>Polymer manufacturing</b>	<b>7</b>	<b>10</b>	<b>2</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	2.1	Select the relevant raw material for polymer manufacturing in the given situation with justification.						
	2.2	Draw labelled PFD of the given polymer processes						
	2.3	Interpret the given parameters for polymerization process						
3		<b>Additive in Polymer Technology</b>	<b>8</b>	<b>13</b>	<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	3.1	Fillers , plasticizers , Stabilizer						
		Lubricants, Flame Retardants, Colorants.						
		Role additives in modifying properties.						



**SECTION – II**

Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>	<b>Resins and Elastomers</b>	<b>9</b>	<b>12</b>	<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	3.1						
	3.2						
	3.3						
	3.4						
<b>5</b>	<b>Plastic processing</b>	<b>7</b>	<b>10</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	4.1						
	4.2						
	4.3						
<b>6</b>	<b>Fiber processing</b>	<b>9</b>	<b>13</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	5.1						
	5.2						
	5.3						
	5.4						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).



## V. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test

### Summative Assessment (Assessment of Learning)

- End Term Exam, End Term Practical Examination

## VI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	1	1	2	-	2	2	2
CO2	3	2	1	1	2	-	2	2	2
CO3	3	2	1	1	2	-	2	2	2
CO4	3	2	1	1	2	-	2	2	2
CO5	3	2	1	1	2	-	2	2	2
CO6									

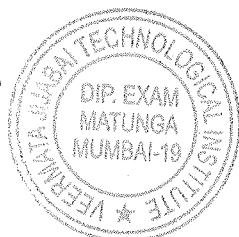
Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Ebewele, Robert	Polymer Science and Technology	CRC Press, New York (2000)
2	Billmeyer, Fred	Text book of Polymer Science	ISBN 0-8493-8939-9 Wiley India, New Delhi 3ed (2007)
3	Fried, Joel R.	Polymer Science and Technology	ISBN 9788126511105 Prentice Hall Professional Technical Reference 3 cd (2014)
4	Ghosh, Premamoy	Polymer Science and Technology: Plastics, Rubber. Blends and Composites	ISBN-978-0-13-703955-5 McGraw Hill Education; 3 edition (2011); ISBN-9780070707047



### VIII. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal
1	Test for identification of fiber <a href="http://content.inflibnet.ac.in/data-server/eacharya-documents/53e0c6cbe413016f234436ed_INFIEP_8/3/ET/8_ENG-3-ET-V1-S1_lesson.pdf">http://content.inflibnet.ac.in/data-server/eacharya-documents/53e0c6cbe413016f234436ed_INFIEP_8/3/ET/8_ENG-3-ET-V1-S1_lesson.pdf</a>
2	Types of polymers <a href="http://www.materials.unsw.edu.au/tutorials/online-tutorials/8-polymer-types">http://www.materials.unsw.edu.au/tutorials/online-tutorials/8-polymer-types</a>
3	Textile technology <a href="https://textechdip.wordpress.com/contents/textile-fiber/">https://textechdip.wordpress.com/contents/textile-fiber/</a>
4	Plastic molding <a href="http://www.plasticmoulding.ca/">http://www.plasticmoulding.ca/</a>
5	Elastomer <a href="https://www.britannica.com/science/elastomer">https://www.britannica.com/science/elastomer</a>
6	Testing of Polymer <a href="https://insights.globalspec.com/article/7810/how-to-perform-tensile-testing-on-polymers">https://insights.globalspec.com/article/7810/how-to-perform-tensile-testing-on-polymers</a>
7	Fiber testing <a href="https://www.youtube.com/watch?v=9CINtwH158A">https://www.youtube.com/watch?v=9CINtwH158A</a>
8	Molding machine <a href="http://www.injectionmoldingmachine.in/">http://www.injectionmoldingmachine.in/</a>
9.	Injection molding <a href="https://www.youtube.com/watch?v=b1U9W4iNDiQ">https://www.youtube.com/watch?v=b1U9W4iNDiQ</a>
10.	Blow molding <a href="https://www.youtube.com/watch?v=8W6P5KU5ONQ">https://www.youtube.com/watch?v=8W6P5KU5ONQ</a>

*Subhadra*

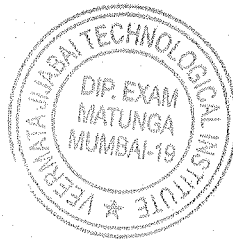
Curriculum Coordinator

*Shiradi*

Head of the Department

*Dehambhe*  
Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	:VI
COURSE TITLE	:FERTILIZER TECHNOLOGY
COURSE CODE	:235CH64

## I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		
3	-	-	-	1.5	3	30	70	30	100	40	-	-	-	-	-	-	100

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

## II. RATIONALE

Indian economy is dominated by the agriculture sector, so it is therefore vital for chemical technologists to understand each fertilizer product, its flow diagram for industry production. For this purpose students should have skills for arranging treatment, reaction, raw materials for variety of fertilizer including Nitrogenous, phosphatic, Potash, and Bio fertilizer is essential. Hence this course is designed to achieve this objective

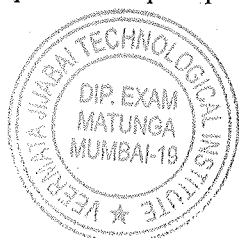
## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 – Use the proper micronutrients to improve the soil fertility.

CO2 – Use the relevant fertilizer on the basis of different properties.

CO3 – Select the relevant manufacturing properties for phosphatic fertilizer.



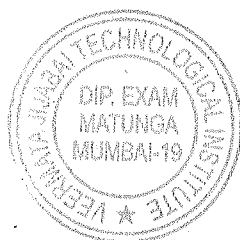
CO4 – Select the relevant manufacturing process for potassic fertilizer.

CO5 – Select the proper micro- nutrient to produce bio- fertilizer.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics		Hours	Marks	COS	R Level	U Level	A Level
1		<b>Overview of Fertilizer</b>	8	12	1	20%	30%	50%
	1.1	Essential elements: Role in plant growth, types and macro and micro elements.						
	1.2	List the secondary nutrients in the given type fertilizer.						
	1.3	List the secondary nutrients in the given type of fertilizer.						
	1.4	Name the location of the given fertilizer industry.						
2		<b>Nitrogenous Fertilizer</b>	7	10	2	20%	30%	50%
	2.1	State the specified properties of ammonia.						
	2.2	Describe with sketches the construction of the given type of converter.						
	2.3	Explain with sketches the working of given type of converter.						
3.		<b>Manufacturing of Nitrogenous Fertilizer</b>	9	13	3	20%	30%	50%
	3.1	Explain with flow diagram of manufacturing nitrogenous fertiliser.						
	3.2	Identify proper storage and handling of given nitrogenous fertiliser with justification						
	3.3	State the specified properties of ammonia.						

SECTION - II								
Unit & Sub-Unit	Topics/Sub-topics		Hours	Marks	CO	R Level	U Level	A Level
4		<b>Phosphatic Fertilizer</b>	9	12	4	20%	30%	50%
	3.1	Choose the relevant method for preparation of specified type of superphosphate, with justification.						



	3.2	Explain manufacturing the given type of phosphate fertiliser.						
	3.3	Select proper storage and transportation method for the given type of phosphatic Fertilizer.						
<b>5</b>		<b>Potassic fertilizer</b>	<b>8</b>	<b>10</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	4.1	Explain method for manufacturing of the given type of potassic fertilizer.						
	4.2	Explain the sketch method of manufacturing of NPK type of fertilizer.						
	4.3	Identify the devices for storage and handling of potassic fertilizer.						
<b>6</b>		<b>Bio – fertilizer</b>	<b>7</b>	<b>13</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	5.1	Introduction of bio fertilizer, types of biofertilizer, application and type of biofertilizer, Describe with sketches the construction of the given bio-fertilizer equipment						
	5.2	Explain with sketches the working of the given bio-fertilizer equipment						
	5.3	Identify the merits and demerits given bio-fertilizer.						
	5.4	Explain the production of Vermicomposting.						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).								

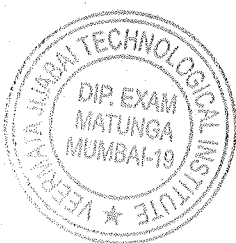
## V. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test

### Summative Assessment (Assessment of Learning)

- End Term Exam, End Term Practical Examination



## VI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	1	1	2	-	2	2	2
CO2	3	2	1	1	2	-	2	2	2
CO3	3	2	1	1	2	-	2	2	2
CO4	3	2	1	1	2	-	2	2	2
CO5	3	2	1	1	2	-	2	2	2
CO6									

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Collings , G,H	Commercial Fertilizer	5 <sup>th</sup> Edn Mc Graw Hill , New York , 1955,ISBN -2045728/1/g16416
2	Editorial Board	Handbook Fertilizer technology	The fertiliser association of India , new delhi ,1977,ISBN -9781855734616
3	Sauchelli	The Chemistry and technology of fertilizer	Oxford and IBH publishing Co. New Delhi , ISBN - 9788120407916
4	Collings , G,H	Commercial Fertilizer	5 <sup>th</sup> Edn Mc Graw Hill , New York , 1955,ISBN -2045728/1/g16416

## VIII. LEARNING WEBSITES & PORTALS

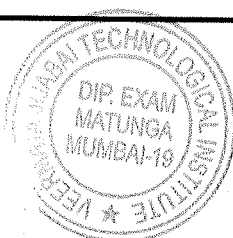
Sr.No	Link / Portal
1	<a href="https://lecturenotes.in/subject/235/fertilizer-technology-ft">https://lecturenotes.in/subject/235/fertilizer-technology-ft</a> .
2	<a href="https://ifdc.org/fertilizer-technology-development">https://ifdc.org/fertilizer-technology-development</a>
3	<a href="https://book.google.com/books/about/handbook-on-fertilizer-technology">https://book.google.com/books/about/handbook-on-fertilizer-technology</a>
4	<a href="https://lecturenotes.in/subject/235/fertilizer-technology-ft">https://lecturenotes.in/subject/235/fertilizer-technology-ft</a> .

*Subodh*  
Curriculum Coordinator

*[Signature]*  
Head of the Department

*[Signature]*  
Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: SIXTH
COURSE TITLE	: PETROLEUM AND PETROCHEMICAL TECHNOLOGY
COURSE CODE	: 235CH64

## I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
											FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max	Max	Min	Ma x	Mi n	Max	Mi n	Max	Min	Max	Mi n	
3	-	-	-	1.5	3	30	70	28	100	40	-	-	-	-	-	-	100

Total IKS Hrs for Sem.: 4 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*\* Online Examination, @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

## II. RATIONALE

To get idea of different refining and extraction of crude oil and petroleum products

## III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning.

CO1 - Identify the components of petroleum.

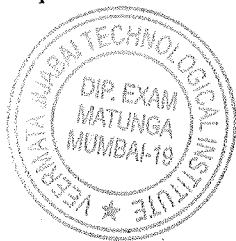
CO2 - Identify fractions and its properties after fractionation of petroleum.

CO3 - Use the different refinery processes to enhance the properties of refinery fractions.

CO4 - Demonstrate the manufacturing of pure chemicals from C1 to C4 chemicals through flow chart.

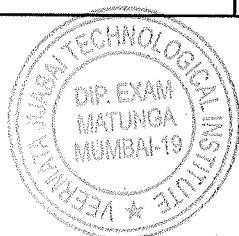
CO5 - Use Udex process to separate aromatic hydrocarbons from reformate.

CO6 - Identify the various hazard and safety aspects in Petrochemical Industry.



#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

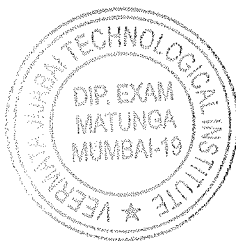
SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
1	<b>Introduction to Petroleum</b>	6	10	1	20%	30%	50%	
	1.1 Overview of petroleum reserves in India							
	1.2 Exploration methods of petroleum: Seismic method, Gravity method, Magnetic method, Electrical method							
	1.3 Drilling methods of petroleum: Cable tool method and Rotary table method.							
	1.4 Physical properties of petroleum: Appearance, API (American Petroleum Institute) gravity and viscosity							
	1.5 Composition of petroleum: Hydrocarbons, Nonhydrocarbons, Metallic constituents							
	1.6 Indian petroleum refineries with their location and capacity.							
	1.7 Global crude oil producer countries (Name only).							
2	<b>Petroleum Refining</b>	8	10	2	20%	30%	50%	
	2.1 Primary processing of petroleum: Methods of dehydration and desalting (Gravity settling, Chemical treatment, Centrifugal separation and Electric desalter)							
	2.2 Fractionation of petroleum (Atmospheric and Vacuum): Process flow diagram, Process description							
	2.3 Petroleum fractions with their boiling range, carbon number and uses.							
	2.4 Test properties of each petroleum fractions with definition and significance: API gravity, Viscosity, Flash point, Fire point, Aniline point, Smoke point, Pour point, Cloud point, Octane number, Cetane number, Diesel index, Drop melting point of wax, Calorific value, Carbon residue, Penetration index.							



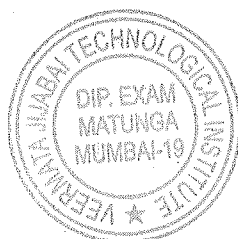
	2.5	Petroleum test properties apparatus (Sketch only): Redwood viscometer, Flash and fire point apparatus (Pensky-Martens apparatus, Abel's apparatus, Cleveland open cup), Cloud point apparatus, Pour point apparatus, Drop melting point apparatus, Smoke point apparatus, Aniline point apparatus, Conradson carbon residue apparatus.						
<b>3</b>		<b>Petroleum Refinery Processes</b>	<b>10</b>	<b>15</b>	<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	3.1	Thermal cracking: Visbreaking and Delayed coking.						
	3.2	Catalytic cracking: Fluidized catalytic cracking (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
	3.3	Catalytic reforming process (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
	3.4	Isomerization process (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
	3.5	Polymerization process (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
	3.6	Hydrocracking (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
	3.7	Alkylation: Sulphuric acid process (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
	3.8	Esterification process (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						

### SECTION - II

Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>	<b>Petrochemicals from C1 to C4 chemicals</b>	<b>10</b>	<b>15</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>



4.1	Petrochemical from C1 chemicals (Flow sheet, Process description, Reactions, and Thermodynamic aspects) a) Methanol b) Formaldehyde						
4.2	Petrochemical from C2 chemicals (Flow sheet, Process description, Reactions, and Thermodynamic aspects) a) Ethanol from chemical synthesis route (Hydration of ethylene). b) Ethylene oxide.						
4.3	Petrochemical from C3 chemicals (Flow sheet, Process description, Reactions, and Thermodynamic aspects) a) Acetaldehyde b) Cumene (Isopropyl benzene)						
4.4	Petrochemical from C4 chemicals (Flow sheet, Process description, Reactions, and Thermodynamic aspects) a) Butadiene b) Methyl tertiary butyl ether						
<b>5</b>	<b>Aromatics</b>	<b>10</b>	<b>15</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
5.1	Physical properties and industrial applications of benzene, toluene, xylene, and ethyl benzene						
5.2	Separation of aromatics (benzene, toluene, xylene, and ethyl benzene) from reformate by using Udex process (Flow sheet, Process description, Reactions, and Thermodynamic aspects)						
5.3	Aniline manufacturing process from hydrogenation of nitrobenzene.						
<b>6</b>	<b>Hazards and safety</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
6.1	Hazards associated in petrochemical industry						
6.2	Safety in petrochemical industry.						
6.3	Case Study (Bhopal Gas Tragedy, Piper Alpha Disaster, BP's Massive oil spill)						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy).							



## V. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test

### Summative Assessment (Assessment of Learning)

- End Term Exam

## VI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	2	-	-	1	1	2	2
CO2	3	2	2	2	1	1	2	2	2
CO3	3	2	2	2	1	1	2	2	2
CO4	3	2	2	2	1	1	2	2	2

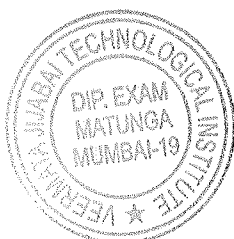
Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	B. K. Bhaskara Rao	Modern Petrochemical Refining processes	Oxford – IBH Publications, Delhi ISBN: 9788120417115
2	B. K. Bhaskara Rao	A Text on Petrochemicals	Khanna Publishers, Delhi ISBN: 9788174090444
3	W. L. Nelson	Petroleum Refinery Engineering	McGraw Hill, New York Publications, ISBN: 9780070855366
4	Gary, James H Glenn E Handwork Mark J Kai sen	Petroleum Refining Technology and Economics	CRC Press, USA Publications, ISBN -9780849370380
5	M. Gopal Rao and Sitting, Marshal	M. Gopal Rao and Sitting, Marshal	East-West Press Pvt. Ltd., Delhi Publications, ISBN- 9788185938790
6	Austin G.T.	Shreve's Chemical Process Industries	McGraw Hill India, Pune Publications, ISBN-9781259029455
7	Dr. Ram Prasad	Petroleum Refining Technology	Khanna Publishers, Delhi ISBN9788174090645
8	Sukumar Maiti	Introduction to Petrochemicals	Oxford - IBH Publications, Delhi ISBN:9788120406636
9	James G. Speight	Handbook of petrochemical processes	CRC Press Publications, ISBN: 10: 1498729703



### VIII. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal
1	<a href="https://nptel.ac.in/courses/103102022/">https://nptel.ac.in/courses/103102022/</a>
2	<a href="https://nptel.ac.in/courses/103103029/5">https://nptel.ac.in/courses/103103029/5</a>



Curriculum Coordinator



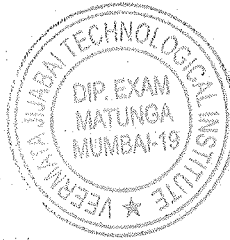
Head of the Department



Dean Diploma

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BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: SIXTH
COURSE TITLE	: FOOD AND BEVERAGES TECHNOLOGY
COURSE CODE	: 235CH64

### I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
3	-	-	-	1.5	3	30	70	30	100	40	-	-	-	-	-	-	100

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

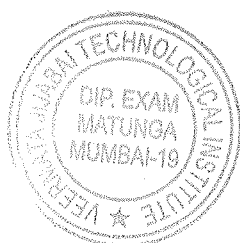
### II. RATIONALE

To learn different preservation and storage methods and get introduced with testing and manufacturing processes of food and beverages technologies.

### III. COURSE OUTCOMES (COS)

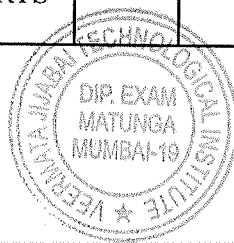
Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 – Learn food analysis methods and food regulations
- CO2 – Knowledge of various food preservation processes as canning and non thermal dehydration
- CO3 – Learn freeze drying and refrigeration for food storage
- CO4 – Learn various manufacturing technologies for soya, spices, meat
- CO5 – Knowledge of alcoholic and non alcoholic beverages technology
- CO6 - Learn various operations involved in milk processing industry



#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION-I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level	
1		<b>Introduction to Food Industry</b>	06	10	1	40%	40%	20%
	1.1	Proximate analysis of food						
	1.2	Sensory Analysis of Foods, food additives						
	1.3	Food Regulation						
2		<b>Preservation methods: Canning, dehydration and Non thermal methods</b>	12	15	2	40%	40%	20%
	2.1	Introduction to methods of food preservation						
	2.2	Canning-History, Outline of canning operations, metal containers, spoilage of canned foods						
	2.3	Preservation of foods by dehydration, Sun drying						
	2.4	Classification of dryers, Spray drying, Dehydration methods applied to various food						
	2.5	Non thermal Methods of Preservation., Ultra high Pressure Tech, Minimal Processing, Hurdle Technology.						
3		<b>Preservation methods: Freezing and refrigeration</b>	06	10	3	40%	40%	20%
	3.1	Freezing and cold storage of foods, , Types of freezing, Freeze concentration and freeze drying of foods						
	3.2	Preservation of foods by refrigeration, principles, methods and applications.						
SECTION-II								
4		<b>Technology of food products</b>	10	15	4	40%	40%	20%
	4.1	Technology of cereals, soya products and edible oils						
	4.2	Technology of confectionery products						
	4.3	Technology of spices, & condiments						
	4.4	Technology of meat, fish and poultry products						
	4.5	Technology of tea, coffee, cocoa products						
5		<b>Technology of beverages</b>	06	10	5	40%	40%	20%
	5.1	Technology of fruit syrup, squash, RTS drinks, aerated drinks						



	5.2	Alcoholic Beverages-Classification, Raw Materials & Manufacture of Grape Wine, Beer & Vinegar.						
6		<b>Technology of Milk &amp; Milk Products</b>	<b>08</b>	<b>10</b>	<b>6</b>	<b>40%</b>	<b>40%</b>	<b>20%</b>
	6.1	Processing, storage and distribution of milk and milk products						
	6.2	Standards for milk and milk products						
		Manufacturing of Butter, cheese, curd, Ghee, Milk powder etc.						
		<b>Total</b>	<b>48</b>	<b>70</b>				

**Legends:** R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).

## V. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

Assignments (if any)

Micro Project (if any)

## VI. ASSESSMENT METHODOLOGIES/TOOLS

**Formative Assessment (Assessment of Learning)**

- Mid semester test
- Tutorial

**Summative Assessment (Assessment of Learning)**

- End Term Exam

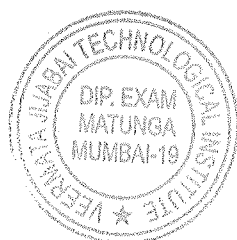
## VII. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	1	1	2	-	2	2	2
CO2	3	2	1	1	2	-	2	2	2
CO3	3	2	1	1	2	-	2	2	2
CO4	3	2	1	1	2	-	2	2	2
CO5	3	2	1	1	2	-	2	2	2
CO6									

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.



Sr. No.	Author	Title	Publisher and Edition
1	Jacobs M.B.	The Chemistry & Technology of Food and Food products	Intercedence Publishers, 1944
2	Desrosier N. W	The Technology of Food Preservation	Avi Pub Co; 4 <sup>th</sup> ed, 1977

**SUGGESTED LEARNING MATERIALS / BOOKS**

**VII. LEARNING WEBSITES & PORTALS**

Sr. No	Link / Portal	Description
1	<a href="https://nptel.ac.in/courses/103107088">https://nptel.ac.in/courses/103107088</a>	NPTEL food technology

*Subramaniam*

Curriculum Coordinator

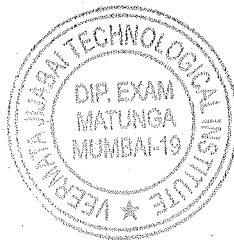
*Shree*

Head of the Department

*Debanika*

Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: SIXTH
COURSE TITLE	: PIPING IN CHEMICAL ENGINEERING
COURSE CODE	: 235CH64

## I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME															
C	L	T	L	L	S	L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARKS
										Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
									Max					Min	Max	Min	Max	Min	Max	
3	-	-	-	-	-	1.5	3	30	70	28	100	40	-	-	-	-	-	-	100	

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

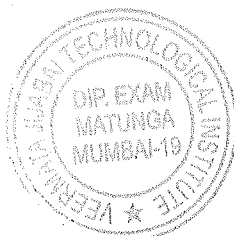
## II. RATIONALE

Piping Technology develops idea to arrange and optimize the piping facility required for transport of various fluids from one to other unit operations

## III. COURSE OUTCOMES (COS)

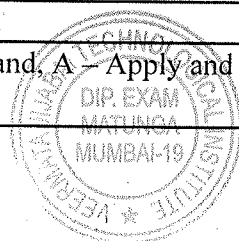
Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 – Learn basics of piping and pipe classification
- CO2 – Knowledge of pipe material and able to read and analyze ASME codes
- CO3 – Able to estimate insulation thickness required
- CO4 – Troubleshoot for leakage in piping
- CO5 – Design piping system and draw various pipe layouts
- CO6 - Calculate primary and secondary stress on pipes



#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION-I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
1	<b>Piping Basics</b>	4	10	1	40%	40%	20%
	1.1 Introduction of process plant, piping in process plant						
	1.2 Classification of pipes						
	1.3 Piping Codes and standards, pipe fittings						
2	<b>Piping Material</b>	10	15	2	40%	40%	20%
	2.1 Piping Material						
	2.2 Selection of piping material, valve selection						
	2.3 Pipe supports and span calculations						
	2.4 Piping design codes ASME						
3	<b>Piping Insulation</b>	10	10	3	40%	40%	20%
	3.1 Design parameters insulation system design, service types for insulation design						
	3.2 Critical thickness, estimation of thickness of insulation, insulation materials						
SECTION-II							
4	<b>Piping Installation and Leak Testing</b>	08	15	4	40%	40%	20%
	4.1 Installation drawings, erection planning, cold spring						
	4.2 Methods of leak testing, hydrostatic, pneumatic vacuum and head testing						
	4.3 Types of heat tracing: Types of heat tracing systems, self-regulating heater, steam tracing, skin effect						
5	<b>Piping Design and Layout</b>	10	15	5	40%	40%	20%
	5.1 Piping arrangement drawing, pipe rack spacing						
	5.2 Isometric drawings, column piping, condenser, tank piping						
	5.3 Procedure for pipe layout, Piping layout						
6	<b>Analysis of Pipe stress</b>	06	5	6	40%	40%	20%
	6.1 Material specification, preliminary load calculations						
	6.2 Primary and secondary load calculations						
	<b>Total</b>	<b>48</b>	<b>70</b>				
<b>Legends:</b> R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy).							



## V. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test
- Tutorial

### Summative Assessment (Assessment of Learning)

- End Term Exam

## VI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	3	2	2	-	-	-	2	2	-
CO2	3	2	2	-	-	1	1	2	2
CO3	3	2	2	2	1	1	2	2	2
CO4	3	2	2	2	1	1	2	2	2
CO5	3	2	2	2	1	1	2	2	2
CO6	3	2	2	2	1	1	2	2	2

Legends: - High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No.	Author	Title	Publisher and Edition
1	Bausbacher, Hunt R	Process Plant Layout and Piping Design	Pearson Prentice Hall
2	Smith P.	The Fundamentals of Piping Design	Gulf Publishing Company

## VII. LEARNING WEBSITES & PORTALS

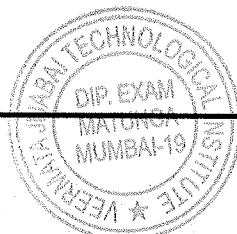
Sr. No	Link / Portal	Description
1	<a href="https://www.msubbu.in/sp/pc/">https://www.msubbu.in/sp/pc/</a>	Solved Numerical in Process Calculation
2	<a href="https://unacademy.com/goal/gate-ese/QGFRK/free-platform/chemical-engineering/process-calculation/LBVWG">https://unacademy.com/goal/gate-ese/QGFRK/free-platform/chemical-engineering/process-calculation/LBVWG</a>	Video Lectures

Curriculum Coordinator

Head of the Department

Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: VI
COURSE TITLE	: APPLICATION OF NANOTECHNOLOGY
COURSE CODE	: 235CH64

### I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max					Min	Max	Min	Max	Min	Max	
3	-	-	-	1.5	3	30	70	30	100	40	-	-	-	-	-	-	100

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

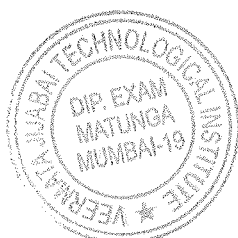
Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

### II. RATIONALE

Nanotechnology introduces diploma students to the fundamentals of materials at the nanoscale and their unique properties. The subject helps in understanding practical applications such as nano-catalysts, nano-membranes, wastewater treatment, coatings, and energy devices. It supports core chemical engineering areas like reaction engineering, separation processes, and environmental engineering. This course enhances technical skills, industrial awareness, and employability in emerging technology sectors.

### III. COURSE OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning



**CO1:** Explain fundamentals of nanotechnology, classification of nanomaterials (0D, 1D, 2D, 3D), and reasons for their distinctive properties such as high surface-to-volume ratio and Van der Waals forces.

**CO2:** Describe mechanical, electrical, optical, thermal, magnetic, and catalytic properties of nanomaterials and relate them to nanoscale effects.

**CO3:** Explain and differentiate various top-down and bottom-up synthesis methods including physical, chemical, and biological techniques used for preparation of nanomaterials.

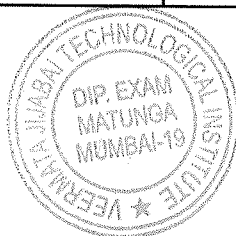
**CO4:** Explain principles and applications of spectroscopic and microscopic techniques (UV, FTIR, XRD, Raman, SEM, TEM, AFM) used for characterization of nanomaterials.

**CO5:** Describe preparation, properties, functionalization, and applications of important nanomaterials such as graphene, CNTs, nanofibres, polymeric nanomaterials, and metallic nanoparticles.

**CO6:** Explain applications of nanotechnology in catalysis, drug delivery, biosensing, wastewater treatment, electronics, automobile, aerospace, and environmental remediation.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1	<b>Introduction to Nanotechnology</b>	8	12	1	20%	30%	50%
	1.1 Definition, history of nanotechnology,						
	1.2 Introduction to nanomaterials, classification of nanomaterials 0D, 1D, 2D, and 3D						
	1.3 Reasons for distinctive properties of nanomaterials, surface to volume ratio, van-der waals forces						
2	<b>Properties of nanomaterials</b>	7	10	2	20%	30%	50%
	2.1 Mechanical, Electrical, Optical, Thermal properties						
	2.2 Catalytic activity, Magnetic properties						
3.	<b>Synthesis of nanomaterials</b>	9	13	3	20%	30%	50%
	3.1 Bottom up and top-down approach and self-assembly, Physical, chemical and biological methods						
	3.2 High energy ball milling, sono-chemical						
	3.3 PVD, VD, MBE, Lithography						

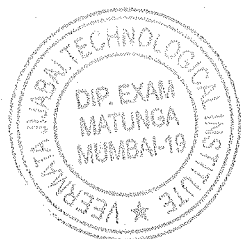


3.4	Electrodeposition, Electric arc deposition Electrospun						
3.5	Colloidal method, precipitation						
3.6	Sol gel method, Micro emulsion method						

**SECTION – II**

Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>	<b>Characterization techniques</b>	<b>9</b>	<b>12</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
4.1	Spectroscopic techniques UV, FTIR, XRD and Raman						
4.2	Particle size analysis, Zeta potential analysis						
4.3	AFM, SEM, TEM						
<b>5</b>	<b>Important nanomaterials</b>	<b>8</b>	<b>13</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
5.1	Nano sheets and tubes: Graphene and CNT Preparation, functionalization, characterization, properties, and applications						
5.2	Nano fibres and composites: Preparation, functionalization, characterization, properties and applications						
5.3	Stimuli-responsive and polymeric nanomaterials: Characteristics and applications						
5.4	Metallic NPs: SPION NPs: Synthesis, functionalization, and applications.						
<b>6</b>	<b>Applications of nanotechnology</b>	<b>7</b>	<b>10</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
5.1	Catalyst, Drug delivery, Tissue engineering, Biosensing.						
5.2	Electronics, Wastewater treatment, Environmental remediation						
5.3	Automobile and aerospace						

Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).



## V. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test

### Summative Assessment (Assessment of Learning)

- End Term Exam, End Term Practical Examination

## VI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	1	1	2	-	2	2	2
CO2	3	2	1	1	2	-	2	2	2
CO3	3	2	1	1	2	-	2	2	2
CO4	3	2	1	1	2	-	2	2	2
CO5	3	2	1	1	2	-	2	2	2
CO6									

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

## VII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Charles P. Poole Jr. and Frank J. Owens	Introduction to Nanotechnology	Wiley
2	Sulabha K. Kulkarni	Nanotechnology: Principles and Practices	Springer
3	Guozhong Cao and Ying Wang	Nanostructures and Nanomaterials: Synthesis, Properties and Applications	World Scientific

## VIII. LEARNING WEBSITES & PORTALS

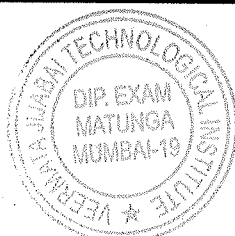
Sr.No	Link / Portal
1	<a href="https://nptel.ac.in/courses/118102003">https://nptel.ac.in/courses/118102003</a>

  
Curriculum Coordinator

  
Head of the Department

  
Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: SIXTH
COURSE TITLE	: SIMULATION TOOLS FOR CHEMICAL ENGINEERING
COURSE CODE	: 235CH65

## I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/ØR)		SLA		
						Max					Min	Max	Min	Max	Min	Max	
2	-	3	-	2.5	-	-	-	-	-	-	50	10	50#	20	-	-	100

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

## II. RATIONALE

The objective of this curriculum is to provide chemical engineering students a solid foundation in process simulation software. Chemical engineering student will be able to accurately enter data, analyse and optimize processes using process simulation software.

## III. COURSE OUTCOMES (COS)

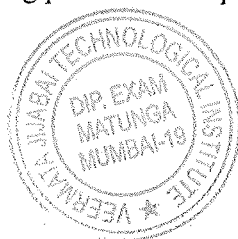
Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 - Use the given process simulation software.

CO2 - Utilize the interface of process simulation software.

CO3 - Analyze the process simulation within the given software.

CO4 - Simulate process equipment by adjusting parameters in process simulation software.

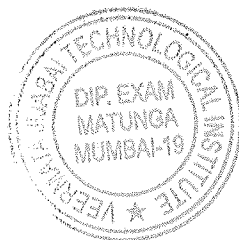


CO5 - Use process simulation software for process optimization through sensitivity analysis.

**IV. COURSE CONTENTS WITH SPECIFICATION TABLE**

SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
1	<b>Introduction to Process Simulation Software</b>	6	-	1	20%	30%	50%	
	1.1 Process simulation: Basic concept, steady-state and dynamic process simulation.							
	1.2 Process simulation software: Use of DWSIM (Open source) and other commercial software							
2	<b>Process Simulation Software Interface</b>	8	-	2	20%	30%	50%	
	2.1 Overview of process simulation software interface.							
	2.2 Steps involve in process simulation software.							
	2.3 Create basic flowsheets for given process.							
	2.4 Thermodynamic models: Types (NRTL, UNIQUAC, SRK, Peng-Robinson) and selection of model.							

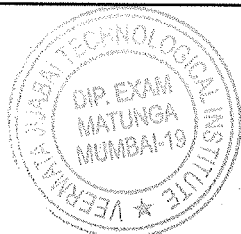
SECTION - II								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level	
3	<b>Data Input and Result Analysis</b>	6	-	3	20%	30%	50%	
	3.1 Data input for feed stream.							
	3.2 Data input for unit operations (compressor, distillation, heat exchangers, pumps, CSTR, PFR).							
	3.3 Process convergence.							
	3.4 Analysis of results: Graphical and tabular.							
4	<b>Simulation of Process Equipment</b>	6	-	4	20%	30%	50%	
	4.1 Overview of process simulation of distillation column (binary systems)							



	4.2	Overview of continuous stirred tank reactor (CSTR) process simulation.						
		Pump and compressor process simulation.						
		Process simulation of mixer for mixing operation.						
		Heat exchanger process simulation (shell and tube: co-current and counter current)						
<b>5</b>		<b>Case Studies and Applications</b>	<b>6</b>	<b>-</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
		Simulation of basic chemical operations to design process data (distillation, absorption)						
		Case studies on material and energy balance.						
		Process optimization: Introduction, basic concept, sensitivity analysis.						
		Applications of process simulation in chemical engineering.						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).								

#### V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Sr. No.	Laboratory Experiment / Practical Titles/ Tutorial Titles	Nos. of hours	Relevant COs
1	Installation of given simulation software and interact with its interface.	3	4
2	Creation of any one simple flowsheet in given simulation software.	3	4
3	Draw distillation column flowsheet, add feed stream and operation input data using simulation software.	3	4
4	Creation of compressor flowsheet and enter the stream and compressor data.	3	4
5	Simulation of compressor to find outlet temperature and tabulate the result	3	3,4
6	Generation of rigorous distillation column flowsheet and enter the stream, operation data and find out purity of product.	3	2,3,4
7	Simulation of shortcut distillation column to calculate minimum reflux ratio.	3	3,4
8	Calculation of number of stages for gas absorption column using process simulation software.	3	3,4
9	Calculation of condenser duty using process simulation software.	3	3,4
10	Simulation of pump for different fluids to calculate its work done.	3	3,4
11	Calculation of utility outlet stream temperature from shell and tube heat	3	3,4



	exchanger using simulation software.		
12	Generation of boiling point diagram (Txy plot) at given pressure for any binary system using simulation software	3	3,4
13	Calculation of conversion percentage from conversion function in CSTR using simulation software.	3	3,4
14	Calculation of conversion percentage from conversion function in Plug Flow Reactor (PFR) using simulation software	3	4
15	Calculation of dew point and bubble point of component mixture at different concentration and pressure using simulation software.	3	4
16	Optimization of feed stage location in distillation column by sensitivity analysis (use experiment number 6)	3	5

## VI. SUGGESTED SELF LEARNING ASSIGNMENTS/MICROPROJECT/ACTIVITIES

Micro Project (if any)

## VII. ASSESSMENT METHODOLOGIES/TOOLS

Formative Assessment (Assessment of Learning)

- Term work - 50 marks

Summative Assessment (Assessment of Learning)

- Practical Examination - 50 Marks

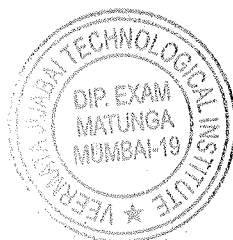
## VIII. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	2	-	-	3	-	-	2	3	3
CO2	2	2	2	3	-	-	2	3	3
CO3	3	2	2	3	2	1	3	3	3
CO4	3	2	2	3	2	1	3	3	3
CO5	3	2	2	3	2	1	3	3	3

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.



### IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Dominic Foo	Chemical Engineering Process Simulation	Elsevier ISBN 9780323984553,032398455X
2	Thomas A. Adams, II	Learn Aspen Plus in 24 Hours, 2nd Edition	McGraw Hill ISBN9781264266654
3	Juma Haydary	Chemical Process Design and Simulation: Aspen Plus and Aspen Hysys Applications	Wiley, ISBN 9781119311430,1119311438

### X. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	<a href="https://spoken-tutorial.org/tutorial-search/?search_foss=DWSIM&amp;search_language=English">https://spoken-tutorial.org/tutorial-search/?search_foss=DWSIM&amp;search_language=English</a>	Spoken tutorials
2	<a href="https://dwsim.org/index.php/download/">https://dwsim.org/index.php/download/</a>	DWSIM Open source Software
3	<a href="https://onlinecourses.nptel.ac.in/noc21_ch44/preview">https://onlinecourses.nptel.ac.in/noc21_ch44/preview</a>	Aspen Plus® simulation software - a basic course for beginners

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Curriculum Coordinator

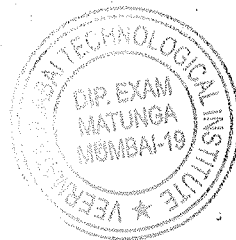
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Head of the Department

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Dean Diploma

BOS VJTI Approval dated 10/07/2024



DIPLOMA PROGRAMME	: DIPLOMA IN CHEMICAL ENGINEERING
PROGRAMME CODE	: DCHE
SEMESTER	: VI
COURSE TITLE	: ENTREPRENEURSHIP DEVELOPMENT
COURSE CODE	: 235CH66

### I. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	S L	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self-learning		TOTAL MARK S
							Max	Min	Ma x	Mi n	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
2	1	-	2	2.5	-	--	---	--	-	-	25	10	-	-	25	10	50

Total IKS Hrs for Sem.: 0 Hrs

Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LJ- Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination, @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC): 3, Discipline Specific Elective (DSE): 0,

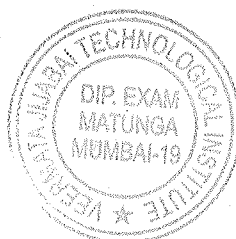
Value Education Course (VEC): 1, Intern/Apprentice/Project/Community (INP): 0, Ability

Enhancement Course (AEC): 2, Skill Enhancement Course (SEC): 2, Generic Elective (GE): 0

### II. RATIONALE

Diploma chemical engineers have to operate and monitor various chemical manufacturing processes. Polymer manufacturing is one of the important processes in chemical engineering world. They have to deal with various polymerization processes and operate various equipment's related to it. They also deal with the safety aspects and environmental concerns related to polymerization process. This course is developed in the way by which the polymer manufacturing plant can be operated and related equipment's can be handled in safe manner.

### III. COURSE OUTCOMES (COS)



Students will be able to achieve & demonstrate the following COs on completion of course based learning

CO1 – Identify your entrepreneurial traits.

CO2 – Identify the business opportunity

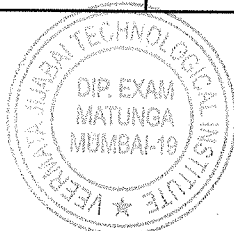
CO3 – Use the support system to zero down to your business idea.

CO4 – Develop the comprehensive plan.

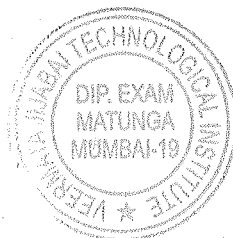
CO5 – Prepare the plans the manage plans effectively.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I								
Unit & Sub-Unit		Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
1		<b>Entrepreneurship Development-Concept and Scope</b>	3		1	20%	30%	50%
	1.1	Describe the procedure to evaluate your entrepreneurial traits as a career option for the given product to be manufactured or services to be rendered.						
	1.2	Explain the given terms related to Entrepreneurship						
	1.3	Describe the salient features of the resources required for starting the specified enterprise.						
	1.4	Identify the characteristics for a given type of enterprise						
2		<b>Entrepreneurial Opportunities and selection process</b>	4		2	20%	30%	50%
	2.1	Arrive at a business opportunity in the basis of given data/circumstances with justification						
	2.2	Describe the scheme(s) offered by the government for starting the specified enterprise						
	2.3	Suggest a suitable place for setting up the the specified enterprise on the basis of given data/circumstances with justification						
	2.4	Suggest the steps for the selection process of an enterprise for the specified product or service with justification						
	2.5	Describe the market study procedure of the specified enterprises.						



3		<b>Support Systems</b>	3		3	20%	30%	50%
	3.1	Describe the support system required for the specified enterprise.						
	3.2	Describe the help provided by the government agencies for the specified product/service						
	3.3	Describe the help provided by the non-governmental agencies for the specified						
	3.4	Compute the breakeven point for the specified						
<b>SECTION – II</b>								
4		<b>Business Plan Preparation</b>	2		4	20%	30%	50%
	4.1	Justify the importance of the business plan for the given product/service						
	4.2	Explain the key elements for the given business plan with respect to their purpose/size						
	4.3	Prepare the budget for the given venture						
	4.4	Prepare the details of the given component of the given startup business plan.						
5		<b>Managing Enterprise</b>	2		5	20%	30%	50%
	5.1	Justify the USP of the given product/service from marketing point of view.						
	5.23	Formulate a business policy for the given product/service.						
	5.3	Choose the relevant negotiation techniques for the given product/service with justification						
	5.4	Choose the relevant negotiation techniques for the given product/service with justification.						
	5.5	Identify the risks that you may encounter for the given type of business/enterprise with justification						
	5.6	Describe the role of the incubation centre for the given product/service.						
6		<b>Technical Marketing</b>	2		5	20%	30%	50%



6.1	Interoduction of technical Marketing ,Understanding Technical Products and markets						
6.2	Developing Technical Value preposition , Measuring Success In technical Marketing .						
6.3	Sales and technical enablement ,and engagement						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).							

## V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Sr. No.	Laboratory Experiment / Practical Titles/ Tutorial Titles	Nos. of hours	Relevant COs
1.	Submit the profile summary ( 500 words ) of a successful entrepreneur indicating milestone achievements.	3	1
2	Undertake the SWOT analysis to arrive at your business idea of a product .	3	1
3.	Generate business ideas(product/service) for intrapreneurial and entrepreneurial opportunities through brainstorming.	3	2
4.	Undertake self-assessment test to discover your entrepreneurial traits.	3	2
5.	Identify the business opportunity suitable for you.	3	3
6.	Arrange an exhibition cum sale of products prepared out of waste	3	4
7.	Survey industries of your stream, grade them according to the level of scale of production, investment, turnover, pollution to prepare report on it .	3	4
8.	prepare a report on it. Visit a bank/financial institution to enquire about various funding 111 schemes for small scale enterprise.	3	4
9.	Collect loan application forms of nationalise banks/other financial institutions	3	5
10.	Compile the information from financial agencies that will help you set up your business enterprise.	3	5
11.	Compile the information from the government agencies that will help you set up your business enterprise.	3	5
12.	Prepare Technological feasibility report of a chosen product/service.	3	5

## VI. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test

### Summative Assessment (Assessment of Learning)

- End Term Exam, End Term Practical Examination



## VII. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2
CO1	3	2	1	1	2	-	2	2	2
CO2	3	2	1	1	2	-	2	2	2
CO3	3	2	1	1	2	-	2	2	2
CO4	3	2	1	1	2	-	2	2	2
CO5	3	2	1	1	2	-	2	2	2

Legends:- High: 03, Medium: 02, Low: 01, No Mapping: -

PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.

PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

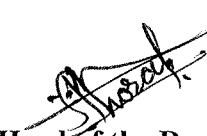
## VIII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Mehta, Monica	The Entrepreneurial Instinct: How Everyone Has the Innate Ability to Start a Successful Small Business	McGraw-Hill, 2012
2	Sareen, S.B.	Readings in Entrepreneurship Education	Entrepreneurship Development Institute of India (EDI), GOI.
3	Gujral, Raman	Reading Material of Entrepreneurship Awareness Camp	Entrepreneurship Development Institute of India (EDI), GOI.

## IX. LEARNING WEBSITES & PORTALS

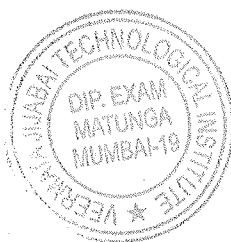
Sr. No	Link / Portal
1	<a href="http://www.mced.nic.in/allproduct.aspx">http://www.mced.nic.in/allproduct.aspx</a>
2	<a href="http://niesbud.nic.in/Publication.html">http://niesbud.nic.in/Publication.html</a>
3	<a href="http://niesbud.nic.in/docs/1standardized.pdf">http://niesbud.nic.in/docs/1standardized.pdf</a>
4	<a href="https://www.entrepreneur.com/lists">https://www.entrepreneur.com/lists</a>
5	<a href="https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530">https://www.nabard.org/content1.aspx?id=23andcatid=23andmid=530</a>
6	<a href="http://www.businessstoday.in/markets">http://www.businessstoday.in/markets</a>
7	<a href="http://www.startupindia.gov.in/pdf/file.php?title">http://www.startupindia.gov.in/pdf/file.php?title</a>

  
Curriculum Coordinator

  
Head of the Department

  
Dean Diploma

BOS VJTI Approval dated 10/07/2024



<b>DIPLOMA PROGRAMME</b>	<b>: DIPLOMA IN CHEMICAL ENGINEERING</b>
<b>PROGRAMME CODE</b>	<b>: DCHE</b>
<b>SEMESTER</b>	<b>: SIXTH</b>
<b>COURSE TITLE</b>	<b>: PROJECT II</b>
<b>COURSE CODE</b>	<b>: 235CH67</b>

### 1. TEACHING AND EXAMINATION SCHEME

TEACHING SCHEME					EXAMINATION SCHEME												
C L	T L	L L	Self - lear ning	CR	PAPER HRS	FA-TH (MST)	SA-TH (ESE)		TOTAL		Based on LL & TL Practical				Based on Self- learning		TOTAL MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max					Min	Max	Min	Max	Min	Max	
-	-	6		3	-	-	-	-	-	-	100	40	100#	40	-	-	200

Total IKS Hrs for Sem. : 0Hrs

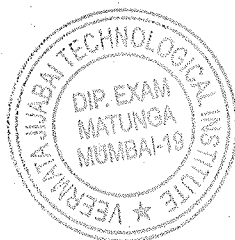
Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# Online Examination , @\$ Internal Online Examination

Course Category: Discipline Specific Course Core (DSC) : 3, Discipline Specific Elective (DSE) : 0, Value Education Course (VEC) : 1, Intern/Apprentice/Project/Community (INP) : 0, Ability Enhancement Course (AEC) : 2, Skill Enhancement Course (SEC) : 2, Generic Elective (GE) : 0

### II. RATIONALE

The students are expected to take up any subject related to chemical engineering and study it in detail and make a presentation on their plan of action. In the next semester provision is made for the students to conduct a study or fabricate the elements if necessary and present them as a continuation of their project.



### III. COURSE OUTCOMES (COs)

Students will be able to achieve the following COs on completion of course based learning

CO1 Work in a team, plan and coordinate the work

CO2 Analyze the project requirements and review the available literature

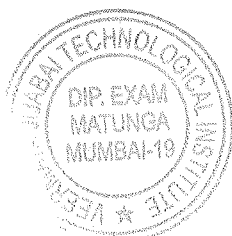
CO3 Formulate the methodology to solve the identified problem

CO4 Apply the principles, tools and techniques from the acquired knowledge to solve the problem

CO5 Develop technical writing skills with effective communication

### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I							
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO S	R Level	U Level	A Level
1	Perform introductory Task: form groups, identify a topic according to area of interest			1	20%	20%	60%
2	Perform Literature Survey: refer various Periodicals, Journals, Books, Internet literature related to project topic			2	20%	20%	60%
3	Plan and perform the project work			3	20%	20%	60%
4	Test Project work			4	20%	20%	60%
5	Test Project work			4	20%	20%	60%
6	Prepare a brief report: Each group shall submit one soft and one hard copy of the project report. The project report shall be of 50 to 70 pages. The structure of the report shall be as follows: <ul style="list-style-type: none"> <li>• Title page</li> <li>• Certificate</li> <li>• Abstract</li> <li>• Acknowledgement</li> <li>• Table of contents</li> <li>• List of tables and figures (if applicable)</li> <li>• Introduction</li> <li>• Objective of project</li> <li>• Methodology used: Design, Drawing Assembly, Testing, Costing</li> <li>• Results</li> <li>• Conclusions</li> <li>• Scope for future work</li> </ul>			5	20%	20%	60%



	<ul style="list-style-type: none"> <li>References</li> <li>Annexure</li> </ul> <p>The format shall be as below:</p> <ul style="list-style-type: none"> <li>Font type – Times new roman</li> <li>Font size: Heading – 14 font (bold), content – 12 font</li> <li>Alignment – Justified</li> <li>Line spacing – 1.5</li> <li>Header content – left side – name of department, right side – name of project</li> <li>Footer – Page number (Center)</li> <li>Numbering of chapters, sections and subsections: Decimal form e.g. Chapter 2, section 2.1, 2.2, etc and subsection 2.2.1, 2.2.2, etc.</li> <li>Numbering of tables and figures: Chapter wise e.g. Chapter 2, Table No. 2.1, 2.2, etc. and Figure No. 2.1, 2.2, etc.</li> </ul>						
7	Present project work			5	20%	20%	60%
<b>Legends:</b> R- Remember, U – Understand, A – Apply and above levels (Blooms’s Revised Taxonomy).							

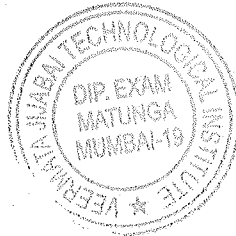
## VI.ASSESSMENTS METHODOLOGIES /TOOLS

### Formative assessment (Assessment for Learning)

- Self-learning
- Term Work
- Seminar/Presentation

### Summative Assessment (Assessment of Learning)


- Seminar/Presentation performance assessment




## VII. SUGGESTED COS-POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes * (PSOs)	
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO- 1	PSO- 2
CO1	2	2	3	0	1	3	3	3	3
CO2	2	3	2	2	1	1	1	2	1
CO3	2	1	3	2	1	1	1	3	2
CO4	3	1	2	3	3	2	2	3	1
CO5	1	0	0	0	0	3	2	1	3

Legends : High:03, Medium:02, Low:01, No Mapping: -  
 PSO1: Ability to apply knowledge of selecting raw materials, machines and process parameters using standard methods and engineering tools for designing solutions to meet specific needs of the chemical industry.  
 PSO2: Understand the impact of chemical processes in societal and environmental context and demonstrate the knowledge for sustainable development through teamwork and effective communication for lifelong learning.

  
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