



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

(Central Technological Institute, Maharashtra State, INDIA)

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### Programme Name: Diploma In Chemical Engineering

<b>Programme Code</b> : DCHE	With Effect From Academic Year	: 2023-24
<b>Duration of Programme</b> : 6 Semester	<b>Duration</b>	: 16 WEEKS
<b>Semester</b> : Fourth	<b>Scheme</b>	: R-2023

Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Paper Duration (hrs.)	Assessment Scheme												Total Marks
						Actual Contact Hrs./Week			Self-Learning (Term Work + Assignment)	Notional Learning Hours /Week			Theory					Based on LL & TL				Based on Self Learning			
						CL	TL	LL					FA-TH(MS T)	SA-TH (ESE)	Total		Practical		SLA						
															Max	Min	Max	Min	Max	Min	Max	Min			
						CL	TL	LL	FA-TH(MS T)	SA-TH (ESE)			Max	Min	Max	Min	Max	Min	Max	Min	Max	Min			
1	PLANT ECONOMICS AND ENERGY MANAGEMENT	PEEM	AEC	235CH41		3	1	-	2	6	3	3	30	70	28	100	40	25	10	-	-	25	10	150	
2	INSTRUMENTATION AND PROCESS CONTROL	IPC	DSC	235CH42		3	-	3	-	6	3	3	30	70	28	100	40	25	10	25#	10	-	-	150	
3	FLUID FLOW OPERATIONS	FFO	DSC	235CH43		3	-	3	2	8	4	3	30	70	28	100	40	25	10	50#	20	25	10	200	
4	CHEMICAL ENGINEERING THERMODYNAMICS	CET	DSC	235CH44		3	2	-	1	6	3	3	30	70	28	100	40	25	10	-	-	25	10	150	
5	PLANT UTILITIES	PU	DSC	235CH45		3	-	3	-	6	3	3	30	70	28	100	40	25	10	25#	10	-	-	150	
6	INDUSTRIAL WASTE WATER TREATMENT	IWWT	SEC	235CH46		1	2	-	1	4	2		-	-		-	-	25	10	-	-	25	10	50	
7	ENVIRONMENTAL SUSTAINABILITY	ES	VEC	235CH47		1	2	-	1	4	2		-	-		-	-	25	10	--	--	25	10	50	
<b>Total</b>					-	17	7	9	7	40	20		150	350		500		175		100		125		900	

**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

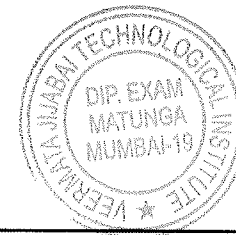
**Course Category:** Discipline Specific Course Core (DSC) : 2, Discipline Specific Elective (DSE): 0, Value Education Course (VEC): 1, Intern. /Apprenti./Project./Community (INP) : 0, Ability Enhancement Course (AEC) : 2, Skill Enhancement Course (SEC) : 2, Generic Elective (GE) : 0

*[Signature]*

Curriculum Coordinator

*[Signature]*

Head of the Diploma Chemical Engineering (DCHE)



*[Signature]*  
Dean Diploma

<b>DIPLOMA PROGRAMME</b>	<b>: DIPLOMA IN CHEMICAL ENGINEERING</b>
<b>PROGRAMME CODE</b>	<b>: DCHE</b>
<b>SEMESTER</b>	<b>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: PLANT ECONOMICS AND ENERGY MANAGEMENT</b>
<b>COURSE CODE</b>	<b>: 235CH41</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 MARKS
							Max	Min	Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
													Max	Min	Max	Min	Max	Min	
3	1	-	2	3	3	30	70	28	100	40	25	10	-	-	25	10	150		

Total IKS Hrs for Sem.: 0 Hrs

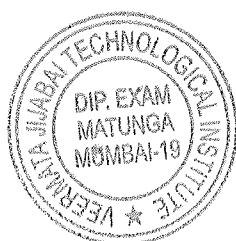
Abbreviations: CL- Classroom Learning, TL- Tutorial Learning, LL-Laboratory Learning, SL- Self Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

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

In the development of any country, Energy management and economics plays a very important role. The depletion of fossil fuel, problem of global warming, environmental issues related to energy and effect of all these on business climate are critically faced by chemical industries. Efficient utilization of available resources and development of upgraded technologies for energy conversion are the significant responsibility of diploma chemical engineer. This will lead the diploma chemical engineers to plant economics. Economics where technology meet business. This course is designed to provide basic understanding about the energy resources, environmental impact, different renewable energy resources, technology for energy conservation, management, money and market, capital investment, cost estimation, taxes, depreciation, budgeting and business plans.



### III. COURSE OUTCOMES (COS)

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

CO1 - Calculate the cost, taxes and insurance liability for chemical process industry.

CO2 – Estimate the depreciation for chemical process industry.

CO3 - Identify different kinds of profits and taxation

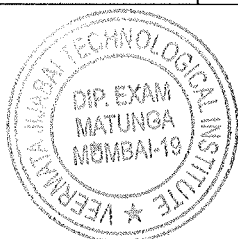
CO4 – Identify forms of energy and its impact on plant environment.

CO5 – Select the energy sources and method for energy conservation.

CO6 – Perform energy conservation audit for chemical process industry.

### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

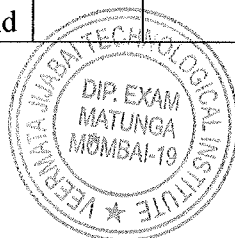
SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
1	<b>Introduction to Plant Economics</b>	8	10	1	20%	30%	50%	
	1.1 Economics: Definitions and concept Different types of market.							
	1.2 Concept of cost, Total cost, fixed cost, variable cost, direct and indirect cost.							
	1.3 Demand and supply: Law of demand and supply. Demand and supply schedule. Method of measurement.							
	1.4 Cost accounting: Basics and procedure of accounting. Methods of accounting. Balance sheet.							
	1.5 Tax and insurance: Concept and types, income tax, excise tax, property tax. Benefits of insurance.							
2	<b>Cost Estimation and Interest</b>	10	15	2	20%	30%	50%	
	2.1 Interest: Concept and types of interest (Simple, compound and continuous)							
	2.2 Cost Estimation: Factors affecting on cost estimation. Total cost, variable cost, fixed cost.							
	2.3 Depreciation: Meaning and Definition. Purpose of charging and factors affecting on depreciation. Method of calculation of depreciation. Straight line method. Annuity method, Written down value method.							



	2.4	Profitability: Concept of profitability, Evaluation of profitability by Rate of return on investment method. Net present worth method, Pay out period method. Advantages and disadvantages of above methods.						
<b>3</b>		<b>Estimate of working result of a project</b>	<b>6</b>	<b>10</b>	<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	3.1	Cumulative cash flow, net profit, gross profit, corporate tax, dividend						
	3.2	Various ratios analysis, incremental analysis						
	3.3	Equity analysis, stakeholders, concept of interest, EMI calculations						

### SECTION - II

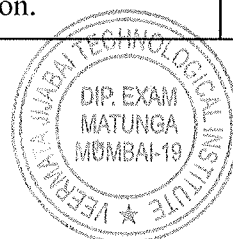
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>	<b>Energy and Energy Policy</b>	<b>6</b>	<b>10</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	4.1	Energy and development: National and international energy policy, Energy sources. Classification of energy sources. Quality and concentration of energy sources.					
	4.2	Energy Sources: Units of various energy, conversion, calorific value, Formation, important properties, conversion and uses of Coal, Petroleum and Natural gas.					
	4.3	Future Energy system. Clean energy technologies.					
<b>5</b>	<b>Renewable and Non- renewable Sources of Energy</b>	<b>10</b>	<b>15</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	5.1	Solar Energy: Concept, Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer, solar stills.					
	5.2	Biomass: Biomass as energy sources. Classification and production. Physiochemical and Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Types, installation, operation and					



		maintenance of digesters. Utilization and storage of biogas.						
	5.3	Wind energy: History, current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy. Economics of wind energy. Introduction, classification, advantages of Hydropower.						
	5.4	New Energy sources: Need and types. Hydrogen energy: Production method, storage, transportation and applications. Ocean energy resources. Tidal energy conversion. Geothermal energy concept. Origin and power plants.						
<b>6</b>		<b>Energy management and Audit</b>	<b>8</b>	<b>10</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	6.1	Energy: Commercial and non-commercial energy. Primary energy resources.						
	6.2	Energy security: Energy conservation and its importance.						
	6.3	Energy management program. Concept of energy audit. Types and procedure of energy audit, energy losses and control.						
	6.4	Energy conservation act. Duties and responsibilities of energy manager and auditor.						
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	Determine the volatile content in given coal sample.	2	4
2	Determine the ash content in given solid fuel sample.	2	4
3	Determine the efficiency of sample solar plate.	2	5
4	Determine the thermal characterisation of given biomass.	2	5
5	Determine the fuel components from kitchen waste.	2	5
6	Prepare the energy audit document for the given organization.	2	6



7	Estimate the simple and compound interest on given project cost in specific conditions.	2	2
8	Determine the insurance price for the given area of the state.	2	1
9	Measure the impact of net profit and sales on stock prices of given company through the implementation of regression equation.	2	3
10	Prepare the cost sheet for the given industrial data.	2	2
11	Prepare the balance sheet for the given company account.	2	1
12	Measure the profitability of given project using development of cases and virtual situations for the given economic conditions.	2	1
13.	Determine the calorific value of given solid fuel.	2	4
14.	Determine the calorific value of given liquid fuel.	2	4
15.	Determine the calorific value of given Gaseous fuel.	2	4
16.	Determine the moisture content in given coal sample.	2	4

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

### Assignments (if any)

- Visit nearby industry to study energy consumption.
- Prepare report on energy consumption in your institute.
- Visit nearby energy auditor to understand auditing process.
- Prepare list of equipment from nearby industry which conserve energy.
- Prepare report on different laboratories from institute where energy can be conserved.
- Suggest method to save energy in institute during practical hour.

### Micro Project (if any)

- **Visit to plant:** Visit nearby industry and prepare report on technologies adopted for energy conservation.
- **Visit of chemical process plant:** Prepare flow chart for energy conservation process.
- **Prepare the report:** Prepare the report for energy conservation of the institute.
- **Preparation of model:** Prepare model of energy conservation in practical lab.
- **Collection of different account samples:** Collect the accounting data from different organization/process industries/laboratory.

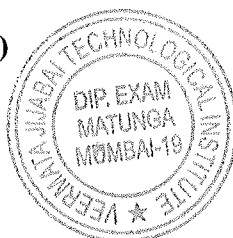
## VII. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test

### Summative Assessment (Assessment of Learning)

- End Term Exam



### 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	-	-	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
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.

### IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Culp, A. W.	Principal of energy conversions	McGraw-Hill, 1991, ISBN-007014902X, 9780070149021
2	D.E. Garrett	Chemical Engineering Economics	Springer Science & Business Media, 2012, ISBN-9401165440, 9789401165440
3	Max S. Peters, Klaus D. Timmerhaus, Ronald Emmett West	Plant design and economics for chemical engineers	McGraw-Hill Education, ISBN:9780072392661, 0072392665

### X. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	Link	<a href="https://en.wikipedia.org/wiki/Energy_management">https://en.wikipedia.org/wiki/Energy_management</a>
2	Link	<a href="https://www.energylens.com/">https://www.energylens.com/</a>

*Subhankar*

Curriculum Coordinator

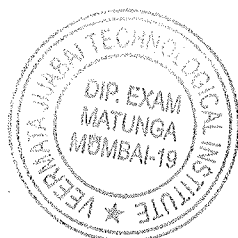
*Shrawan*

Head of the Department

*P. Debnath*

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>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: INSTRUMENTATION AND PROCESS CONTROL</b>
<b>COURSE CODE</b>	<b>: 235CH42</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 MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max					Min	Max	Min	Max	Min	Max	
3	-	3	-	3	3	30	70	28	100	40	25	10	25#	10	-	-	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**

**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**

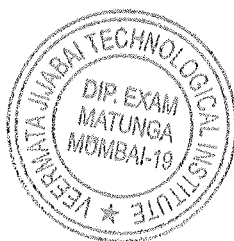
## II. RATIONALE

Monitoring and control of the process are an important activity needs to perform by the Diploma Chemical Engineer. This course gives the knowledge of various instruments used to measure various process parameters. With the knowledge of this course, the Diploma Chemical Engineer will be able to handle various instruments and control the process parameter as per the desired value for the optimization of the process.

## III. COURSE OUTCOMES (COS)

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

- CO1 - Identify applicable instruments for measuring process variables in the chemical industry.
- CO2 - Measure temperature using various temperature measuring instruments in the chemical industry.
- CO3 - Measure pressure using various pressure measuring instruments in the chemical industry.
- CO4 - Measure the flow using various flow measuring instruments in the chemical industry.

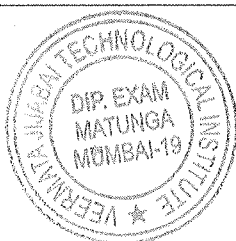


CO5 - Measure the level using various level measuring instruments in the chemical industry.

CO6 - Integrate a control system with different controllers in the chemical industry.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

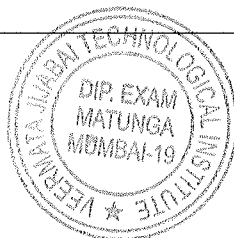
SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics		Hours	Marks	COS	R Level	U Level	A Level
1		<b>Introduction to Instrument Measurement System</b>	06	10	1	50%	50%	0%
	1.1	Measurement and its Aim: Definition and application.						
	1.2	Measurement methods – Direct and Indirect method.						
	1.3	Functional elements - Primary, Secondary, manipulating element, Data transferring element.						
	1.4	Static characteristics – Definition of Calibration, Accuracy, Precision, Repeatability, Drift, Sensitivity, Dead zone, Causes of Dead Zone and Static error.						
	1.5	Dynamic characteristics – Speed of Response, Time lag, Dynamic Error.						
2		<b>Temperature Measuring Instrument.</b>	09	10	2	20%	30%	50%
	2.1	Temperature Scales- Centigrade, Kelvin, Fahrenheit, Rankine and Reaumur.						
	2.2	Expansion thermometer: Principle, Construction, Working and Application of Spiral Bimetallic thermometer and Mercury in glass thermometer.						
	2.3	Electrical Temperature Sensor: Principle, Construction, Working and Application of Resistance Temperature Detector, Thermocouple and Thermistor.						
	2.4	Pyrometer: Principle, Construction, Working and Application of Optical and Radiation pyrometer.						
3		<b>Pressure Measuring Instrument.</b>	09	15	3	20%	30%	50%
	3.1	Units of Pressure & Methods for Pressure Measurement.						



	3.2	C-type Bourdon tube and Bellows: Principle, Construction and Application.						
	3.3	Force balance pressure gauge – Principle, Construction, Workings and Application of Dead Weight Tester.						
	3.4	Electrical Pressure Transducer – Principle, Construction, Workings and Application of LVDT and Strain gauge.						
	3.5	Vacuum Measurement – Principle, Construction, Workings and Application of McLeod gauge.						

### SECTION - II

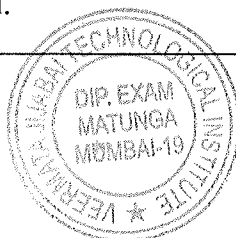
Unit & Sub-Unit		Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>		<b>Flow Measuring Instrument</b>	<b>09</b>	<b>12</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	4.1	Piston type flow meter: Principle, Construction, Working and Application.						
	4.2	Electromagnetic flow meter, Ultrasonic flowmeter, Turbine flow meter: Principle, Construction, Working and Application.						
	4.3	Positive displacement flow meter: Rotating vane meter- Principle, Construction, Working and Application.						
	4.4	Thermal mass flow meter: Heat transfer type-Principle, Construction, Working and Application.						
<b>5</b>		<b>Level Measuring Instrument</b>	<b>06</b>	<b>10</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	5.1	Direct method for level measurement: Principle, Construction, Working and Application of High-pressure Sight glass level indicator.						
	5.2	Indirect method for level measurement: Principle, Construction, Working and Application of hydrostatic level measurement (pressure gauge, differential pressure and air purge)						
	5.3	Ultrasonic, Radioactive and Capacitance probe type level measurement: Principle, Construction, Working and Application.						
<b>6</b>		<b>Automated Control System</b>	<b>09</b>	<b>13</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>



6.1	Types of system- single input system and multi-input system.						
6.2	Control system classification- open loop and closed loop.						
6.3	Control action- ON-OFF, P, PI, PID (Only Pneumatic Controller)						
6.4	Cascade and Ratio controller- Diagram and Working.						
6.5	Distributed control system and Programmable logic controller-principle and block diagram						
6.6	Types of control valve-air to open, air to close, Valve characteristics-linear, equal %, quick opening.						
6.7	Valve actuator and valve positioner- Function in Control Valve.						
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	Calibrate mercury glass thermometer.	3	1, 2
1	Measure temperature using Resistance Temperature Detector or Thermistor or Thermocouple	3	2
2	Measure high temperature by using Pyrometer.	3	2
3	Calibrate pressure gauge by using dead weight tester.	3	3
4	Measure pressure by using Linear Variable Differential Transducer (LVDT).	3	3
5	Measure pressure by using strain gauge.	3	3
6	Measure the flow rate of fluid using Electromagnetic flow meter.	3	4
7	Measure the flow rate of fluid by using Turbine flow meter.	3	4
8	Measure the level of liquid by using Bubbler Method	3	4
9	Measure the level of liquid by using capacitance probe method.	3	4
10	Use ON-OFF Controller to measure given process variable.	3	5
11	Use PD controller to measure given process variable.	3	5
12	Calculate % flow and % valve opening of control valve and draw characteristics of control valve.	3	5
13	Measure low pressure by using McLeod.	3	3



14	Use PD controller to measure given process variable.	3	6
15	Use PID Controller to measure given process variable.	3	6
16	Understand the operation of DCS/PLC through industrial visit.	3	6

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

**Assignments (if any)**

**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 Exam

## 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	-	-	1	-	-	3	2	2
CO2	3	2	1	2	2	1	3	2	2
CO3	3	2	1	2	2	1	3	2	2
CO4	3	2	1	2	2	1	3	2	2
CO5	3	3	2	3	3	1	3	2	2
CO6	2	2	2	2	2	1	2	2	2

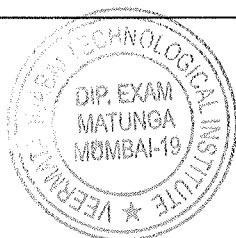
Legends: - High: 03, Medium: 02, Low: 01, No Mapping: -

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.

## IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	W. M. Morgan	Chemical Process Control: An Introduction to Theory and Practice	CBS Publishers & Distributors Pvt. Ltd, 2000 ISBN: 9788123904306
2	H. F. Payne	Industrial Instrumentation and Control	John Wiley & Sons Inc (1961) ISBN:9780471673538



3	V.C. Malshe and Meenal Sikchi	Fundamental of Industrial Instrumentation	Antar Prakash Centre for Yoga, 2004 ISBN:9788190329859
4	Dr. Swaraj Paul	Industrial Control and Instrumentation	John Wiley and Sons Ltd.2014ISBN:9788126552559
5	S. K. Singh	Industrial Instrumentation & Control	ISBN: 9780070678200

#### X. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	<a href="https://nptel.ac.in/courses/103103037">https://nptel.ac.in/courses/103103037</a>	Cascade and Ratio Controller
2	<a href="https://archive.nptel.ac.in/courses/103/105/103105064/">https://archive.nptel.ac.in/courses/103/105/103105064/</a>	Pressure Measurement
3	<a href="https://archive.nptel.ac.in/courses/103/105/103105064/">https://archive.nptel.ac.in/courses/103/105/103105064/</a>	Pneumatic Control System
4	<a href="https://archive.nptel.ac.in/courses/103/105/103105130/">https://archive.nptel.ac.in/courses/103/105/103105130/</a>	General Principles and Representation of Instruments
5	<a href="https://archive.nptel.ac.in/courses/103/105/103105130/">https://archive.nptel.ac.in/courses/103/105/103105130/</a>	Performance Characteristics of Instruments
6	<a href="https://archive.nptel.ac.in/courses/103/105/103105130/">https://archive.nptel.ac.in/courses/103/105/103105130/</a>	Transducer Element

*[Handwritten Signature]*

Curriculum Coordinator

*[Handwritten Signature]*

Head of the Department

*[Handwritten Signature]*

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>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: FLUID FLOW OPERATIONS</b>
<b>COURSE CODE</b>	<b>: 235CH43</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 MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
3	-	3	2	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**

**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

Most of the chemical reactions in chemical or petroleum process, biological, food, pharmaceutical or polymer industries take place in liquids and gaseous phase. Due to diverse applications of fluids in various industries, it is very important to know the nature, properties and behaviour of fluids. The course includes the study of behaviour of fluids showing relationships between the driving forces and flow rates, transportation various process fluids, as well as the characteristics of equipment handling the fluids.

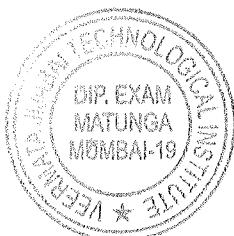
## III. COURSE OUTCOMES (COS)

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

CO1 - Identify the different properties of fluid used in chemical process.

CO2 - Apply law of conservation of mass and energy to the flowing fluids.

CO3 - Estimate the flow rate of fluid in conduit and in open channels by using different flow meters.



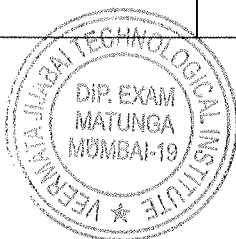
CO4 - Know different types of pumps, working principle, calculation power required for pumps (application of burnollie's equation), pipe fittings.

CO5 - Select the appropriate pumping device for transportation of liquids in chemical industries.

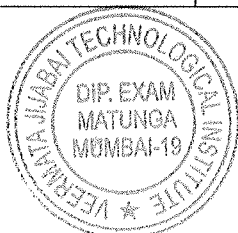
CO6 - Choose the suitable pumps for transportation of gases in chemical industries.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I								
Unit & Sub-Unit		Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
<b>1</b>		<b>Fluid Properties</b>	<b>6</b>	<b>10</b>	<b>1</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	1.1	Introduction to fluids and it's properties: Properties of fluids: pressure, volume, density, surface tension, capillarity, viscosity  Classification of fluids: • Ideal & actual fluids • Compressible & incompressible fluids • Newtonian & non-newtonian fluids  Newton's law of viscosity: Statement, derivation, absolute & kinematic viscosity, Measurement of viscosity  Redwood viscometer: construction and working, Numerical						
	1.2	Principle of hydrostatic equilibrium: Statement and derivation						
	1.3	Measurement of pressure: by using manometers  Types: Simple U tube and U tube differential manometers, equations, simple numerical on U-tube manometer, Numerical						
	1.4	Dimensional analysis: Importance and Dimensional homogeneity  Methods of dimensional analysis: Rayleigh and Buckingham's pi method  Method of finding dimensionless numbers, Selection of variables, Common dimensionless numbers and their physical significance  Numerical						



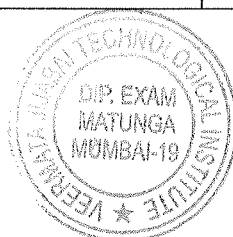
2		<b>Flow of Incompressible Fluids</b>	<b>11</b>	<b>15</b>	<b>2</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	2.1	Equation of continuity: Statement, derivation calculation of mass flow rate, volumetric flow rate, average velocity & mass velocity						
	2.2	Equations of motion: Eulers's equation of motion						
	2.3	Bernoulli's equation from Euler's equation for Ideal fluid: Statement, assumptions, derivation, corrections in Bernoulli's equation for real fluids, Numerical						
	2.4	Reynolds experiment: Significance in determining turbulent, laminar & transition regime. Reynolds number, critical velocity, Numerical						
	2.5	Friction in pipe: Friction Types: Form friction & skin friction, Fanning and Darcy Weis batch friction factor, the standard friction factor chart, relation between friction factor and Reynolds number, friction losses due to sudden expansion/reduction of pipe & in pipefittings, equivalent length of pipe, concept of Boundary layer, significance of Hagen Poiseuille equation: mathematical equation (no derivation), Numerical						
3		<b>Measurement of Fluid Flow</b>	<b>7</b>	<b>10</b>	<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	3.1	Classification of flow measuring instruments in conduits: Based on variation in pressure drop: Principle, construction, working, derivation for calculating the flow rates/coefficient of discharge of Venturimeter and Orifice meter, Numerical						
	3.2	Classification of flow measuring instruments in conduits: based on variation in flow area: Construction, principle, working and calibration of Rotameter						
	3.3	Measurement of local velocity: Principle, construction, working, derivation for calculating the flow rates/coefficient of discharge of Pitot tube, numerical						



	3.4	Advantages and Disadvantages: Venturimeter, orifice meter, rotameter and pitot tube						
	3.5	Measurement of flow rate of fluids in open channels: Notches and weirs: classification, construction, principle, working derivation for discharge over Rectangular, Triangular, Trapezoidal notch or weir, Numerical						

### SECTION - II

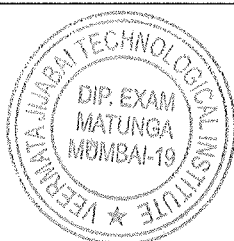
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>	<b>Pipe, Fittings and Valves</b>	<b>6</b>	<b>10</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	4.1	Pipe and it's fittings: Necessity in industry, material of construction, difference in pipes and tubes, Schedule number, Birmingham Wire Gauge, different types of pipe fittings with sketches					
	4.2	Valves: Construction, working and applications of Gate valve, Globe valve, Butterfly valve, Needle valve, Ball valve, Safety valve, Rupture disc					
<b>5</b>	<b>Transportation of Liquids</b>	<b>11</b>	<b>15</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	5.1	Types of pumps used for handling liquids: Necessity, broad Classification, factors considered for selection of pump					
	5.2	Centrifugal pump: Principle, construction, working, cavitation, air binding, priming of pump, Net Positive Suction Head (NPSH), characteristics curve, derivation for power requirement, head developed and mechanical efficiency, advantages and disadvantages, Numerical					
	5.3	Positive Displacement Reciprocating Pump: Principle, classification: construction, working, derivation of power required, mechanical efficiency. Numerical  • Single and double acting pump  • Piston and Plunger					



	5.4	Positive Displacement Rotary Pump: Principle, construction and working of Mono/Screw and Gear pump						
<b>6</b>		<b>Transportation of Gases</b>	<b>7</b>	<b>10</b>	<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	6.1	Gas pumping and devices: Need of pumping devices in industries and concept of interstage cooling						
	6.2	Fans: Construction, working and applications of Induced and forced draft Fans and Axial and centrifugal Fans.						
	6.3	Blowers: Construction, working and applications of Reciprocating & centrifugal blower						
	6.4	Compressors: Construction, working and applications of Reciprocating & centrifugal compressors						
	6.5	Vacuum pump: Steam Jet ejectors, principle, construction, working and applications						
	6.6	Fluidization: Basic concept, minimum fluidization velocity and applications						
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	Determination of viscosity of a given liquid at different temperatures by using redwood viscometer	4	1
2	Calculation the viscosity of different liquids by using redwood viscometer at constant temperature.	4	1
3	Determination of gauge pressure and differential pressure by using a set-up of U-tube manometer.	4	1
4	Determination of various types of flows by using reynold’s experiment set-up.	4	2
5	Calculation the total energy of the fluids by using experimental setup of Bernoulli’s theorem.	4	2
6	Calculation of the head loss due to sudden expansion /sudden contraction in a given pipe.	4	1, 2



7	Determination of friction factor by using friction factor set-up	4	1, 2
8	Calculation of the coefficient of discharge of fluid in venturimeter	4	1, 2, 3
9	Calculation of the coefficient of discharge of fluid orificemeter	4	1, 2, 3
10	Plot the curve of area vs float position vs actual discharge using rotameter.	4	2, 3
11	Determination of the velocity coefficient of closed-circuit pitot tube apparatus	4	1, 2, 3
12	Calculation the coefficient of discharge of triangular notch/rectangular notch/trapezoidal notch.	4	1, 2, 3
13	Determination the efficiency of a centrifugal pump and plot the characteristics curves.	4	1, 4
14	Calculation of the equivalent length of the pipe fittings such as globe/gate valve, bend/elbow.	4	1,4
15	Determination of the fluidization velocity for the bed of solid materials by using fluidized bed.	4	1,6
16	Plot the flow rate vs head developed by using the reciprocating pump.	4	1,5

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

### Assignments (if any)

### Micro Project (if any)

- Collect different samples of pipe fitting and valves from scrap yard
- Prepare cut section of pipe fitting/valve
- Visit water pumping station of municipal or local body and prepare report on pumps and piping arrangement
- Fabricate venturi tube using plastic pipe/fitting and prepare experimental setup demonstrating its use as pumping device.
- Prepare a list of different grades of lubricating machine oil
- Prepare model of gear pump/different types of impellers using any waste material

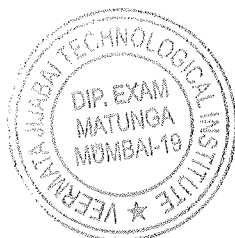
## VII. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test
- Assignments

### Summative Assessment (Assessment of Learning)

- End Term Exam



### 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	1	-	2	2	-	2	2	2
CO2	3	1	-	2	1	-	2	2	2
CO3	3	2	1	2	1	1	2	2	2
CO4	3	2	1	2	2	1	2	2	2
CO5	3	2	1	2	2	1	2	2	2
CO6	3	2	1	2	2	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.

### IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	R. K. Bansal	A Textbook of Fluid Mechanics and Hydraulic Machines	Laxmi Publications ISBN: 9788131808153, 8131808157
2	Robert W. Fox, Alan T. McDonald, Philip J. Pritchard	Introduction to fluid mechanics	Wiley ISBN: 9780470234501, 0470234504
3	Warren McCabe, Julian Smith, Peter Harriott	Unit Operations of Chemical Engineering	McGraw-Hill Education ISBN: 9780072848236, 0072848235
4	Shiv Kumar	Fluid Mechanics (Vol. 2) Basic Concepts and Principles	Springer International Publishing ISBN: 9783030997540, 3030997545
5	Paul J. LaNasa, E. Loy Upp	Fluid Flow Measurement A Practical Guide to Accurate low Measurement	Elsevier Science ISBN: 9780124095328, 0124095321

### X. LEARNING WEBSITES & PORTALS

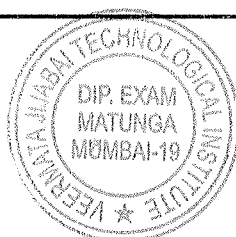
Sr. No	Link / Portal	Description
1	<a href="https://nptel.ac.in/courses/105101082">https://nptel.ac.in/courses/105101082</a>	(Videos and Texts) Fluid Mechanics, IIT Bombay
2	<a href="https://archive.nptel.ac.in/courses/112/106/112106200/">https://archive.nptel.ac.in/courses/112/106/112106200/</a>	(Videos and Texts) Fluid Dynamics and Turbomachines, IIT Madras

  
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>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: CHEMICAL ENGINEERING THERMODYNAMICS</b>
<b>COURSE CODE</b>	<b>: 235CH44</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 MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
3	2	-	1	3	3	30	70	28	100	40	25	10	-	-	25	10	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

**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

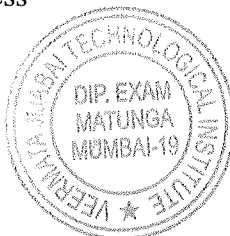
## II. RATIONALE

Diploma chemical engineer deals with industrial processes, where laws of thermodynamics play a vital role. The concepts and laws of thermodynamics develop an ability in diploma chemical engineers to evaluate heat and work interaction involved in industrial chemical processes.

## III. COURSE OUTCOMES (COS)

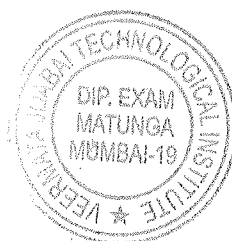
Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Use basic concepts of thermodynamics for given chemical processes.
- CO2 - Apply first law of thermodynamics to improve the chemical process.
- CO3 - Apply second law of thermodynamics to describe entropy of system.
- CO4 - Use P-V-T graphical representation of fluids for different process.
- CO5 - Apply concept of chemical equilibrium in chemical process.
- CO6 - Use properties of solution in chemical process



#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

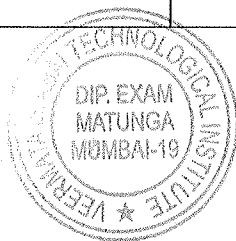
SECTION - I								
Unit & Sub-Unit		Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
<b>1</b>		<b>Basic Concept of Thermodynamics</b>	<b>6</b>	<b>10</b>	<b>1</b>	<b>30%</b>	<b>30%</b>	<b>40%</b>
	1.1	Introduction to thermodynamics: System, boundary and surrounding						
	1.2	Classification of system: Homogeneous and heterogeneous, closed, open, isolated, and adiabatic						
	1.3	Properties: Extensive and intensive, concept of energy, heat, work and power, simple numerical (based on heat and work)						
	1.4	Function: State and path function. (work and heat as path function)						
	1.5	Process: Isobaric, isothermal, isochoric, adiabatic, reversible, irreversible, quasi static and cyclic process						
	1.6	Types of equilibrium: Stable, unstable, metastable, mechanical, chemical, thermal, and thermodynamic equilibrium						
	1.7	Zeroth law of thermodynamics and its application						
<b>2</b>		<b>First Law of Thermodynamics</b>	<b>10</b>	<b>15</b>	<b>2</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	2.1	First law of thermodynamics: Mathematical equation and its application						
	2.2	Internal energy, standard enthalpy changes, temperature dependence of enthalpy. Simple numerical on enthalpy calculation						
	2.3	Relation between heat capacity at constant volume ( $C_v$ ) and heat capacity at constant pressure ( $C_p$ )						
	2.4	Derivation for work done for following processes: Isobaric process, isochoric/isometric, isothermal, adiabatic and polytropic process (simple numerical on						



		determination of Q, W, $\Delta U$ & $\Delta H$ for the above processes)						
<b>3</b>		<b>Second Law of Thermodynamics</b>	<b>8</b>	<b>10</b>	<b>3</b>	<b>30%</b>	<b>30%</b>	<b>40%</b>
	3.1	Second law of thermodynamics. (Kelvin-Planck statement, Clausius statement) and its application, limitations of first law of thermodynamics						
	3.2	Basic concepts: heat reservoir, heat engine and heat pump or refrigerator, thermal efficiency and Coefficient of Performance (C.O.P), entropy						
	3.3	Clausius inequality statement and mathematical expression						
	3.4	Entropy changes of an ideal gas. Phase change, ideal gas processes, adiabatic, mixing, and isothermal mixing (numerical on entropy change)						
	3.5	Third law of thermodynamics and its application						

### SECTION - II

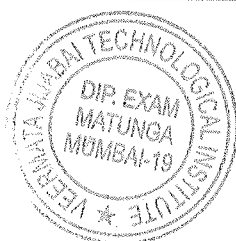
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level
<b>4</b>	<b>Pressure-Volume-Temperature(P-V-T) Behaviour of Pure Fluids</b>	<b>10</b>	<b>15</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	4.1	P-V-T behaviour of pure fluids: Graphical presentation of different thermodynamic processes on P-H (Pressure-Enthalpy), T-S (Temperature-Entropy), H-T (Enthalpy – Temperature) and H-S (Enthalpy – Entropy) diagram. Phase diagram for water system					
	4.2	Ideal gas and equation of state					
	4.3	Equations of state for real gas: Vander Waals and Virial equation, numerical on Vander Waals equation only. Compressibility factor					
	4.4	Degree of freedom, Gibb's phase rule, numerical					
	4.5	Fugacity and fugacity coefficient					



<b>5</b>		<b>Chemical Equilibria</b>	<b>10</b>	<b>15</b>	<b>5</b>	<b>30%</b>	<b>30%</b>	<b>40%</b>
	5.1	Concept of chemical equilibria, equilibrium constant for gaseous mixture, derivation and numerical						
	5.2	Gibbs free energy change and feasibility of chemical reaction from free energy change. Le-Chatelier's principle						
	5.3	Chemical potential, law of mass action, relation between Gibbs free energy( $\Delta G$ ) & equilibrium constant (K)						
	5.4	Van't Hoff's equation, variation of equilibrium constant with temperature for exothermic and endothermic reaction, numerical (based on Van't Hoff's equation)						
<b>6</b>		<b>Properties of solutions</b>	<b>04</b>	<b>05</b>	<b>6</b>	<b>30%</b>	<b>30%</b>	<b>40%</b>
	6.1	Ideal solution, Phase equilibrium in ideal solutions, phase diagram for ideal solutions						
	6.2	Henry's law, Raoult's law, non-ideal solutions, deviation of properties from ideality						
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	Numerical based on heat (Q), work (W) and internal energy (U)	2	1
2	Derive an expression for work done for isobaric process, isochoric/isometric, isothermal, adiabatic and polytropic reversible process	2	1, 2
3	Numerical on $\Delta U$ using first law of thermodynamics	2	1, 2
4	Numerical on $\Delta H$ using first law of thermodynamics	2	1, 2
5	Derivation between $C_p$ , $C_v$ and R	2	2
6	Numerical on entropy changes for adiabatic mixing	2	3
7	Numerical on entropy changes of for ideal gas	2	3
8	Numerical on entropy changes for isothermal mixing	2	3



9	Plot the curve of P-V-T (pressure-volume-temperature), T-S (temperature-entropy), H-T(enthalpy – temperature), P-H (pressure-enthalpy) and H-S (enthalpy – entropy)	2	4
10	Numerical on Vander Waals equation	2	4
11	Numerical on Gibb's phase rule	2	4
12	Derivation for the equilibrium constant ( $K_p$ & $K_c$ ) and ( $K_p$ & $K_y$ )	2	5
13	Numerical on Van't Hoff's equation and Le-Chatelier's principle	2	5
14	Numerical on Henry's law and Raoult's law	2	6

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

### Assignments (if any)

### Micro Project (if any)

1. Identify the Homogeneous and heterogeneous, closed, open, isolated, and adiabatic systems in your home or nearby industry.
2. Identify the Isobaric, isothermal, isochoric, adiabatic, reversible, irreversible, quasi static and cyclic process in your home or nearby industry.
3. Identify the system or process in your home or nearby industry where first law of thermodynamics is applicable.
4. Identify the system or process in your home or nearby industry where second law of thermodynamics is applicable.

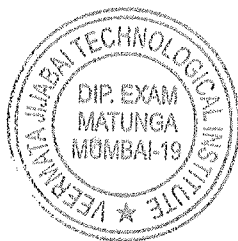
## VII. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test
- Tutorial

### Summative Assessment (Assessment of Learning)

- End Term Exam



### 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	2	1	-	1	-	1	2	2
CO2	2	2	1	1	2	-	1	2	2
CO3	2	2	1	1	2	-	1	2	2
CO4	2	2	2	1	2	-	1	2	2
CO5	2	2	2	-	1	-	1	2	2
CO2	2	2	-	-	2	-	1	-	-

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. V. Narayanan	A Textbook of Chemical Engineering Thermodynamics	Prentice Hall India Pvt., Limited, ISBN:9788120317321, 8120317327
2	Joseph Mauk Smith, Hendrick C. Van Ness, Michael M. Abbott, M.T. Swihart	Introduction to Chemical Engineering Thermodynamics	McGraw-Hill, ISBN: 9780071270557, 0071270558
3	Stanley I. Sandler	Chemical and Engineering Thermodynamics	Wiley, ISBN: 9780471017745, 0471017744
4	Y. V. C. Rao	Chemical Engineering Thermodynamics	Sangam Books, ISBN:9788173710483, 8173710481
5	P. K. Nag	Engineering Thermodynamics	Tata McGraw Hill, ISBN:9780070591141, 0070591148

### X. LEARNING WEBSITES & PORTALS

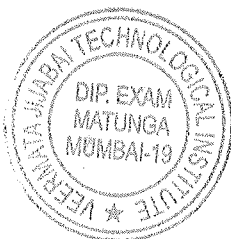
Sr. No	Link / Portal	Description
1	<a href="https://archive.nptel.ac.in/courses/103/103/103103144/">https://archive.nptel.ac.in/courses/103/103/103103144/</a>	Video Lectures, Transcripts
2	<a href="https://unacademy.com/course/part-1-thermodynamics-chemical-engineering/PPQGVSG1">https://unacademy.com/course/part-1-thermodynamics-chemical-engineering/PPQGVSG1</a>	Video Lectures

  
Curriculum Coordinator

  
Head of the Department

  
Dean Diploma

BOS VJTI Approval dated 10/7/2024



<b>DIPLOMA PROGRAMME</b>	<b>: DIPLOMA IN CHEMICAL ENGINEERING</b>
<b>PROGRAMME CODE</b>	<b>: DCHE</b>
<b>SEMESTER</b>	<b>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: PLANT UTILITIES</b>
<b>COURSE CODE</b>	<b>: 235CH45</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 MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
3	-	3	-	3	3	30	70	28	100	40	25	10	25#	10	-	-	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**

**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**

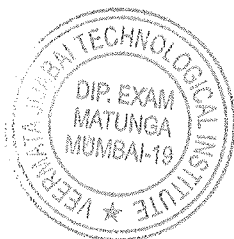
## II. RATIONALE

Diploma chemical engineers should have knowledge of chemical plant utilities such as process water & boiler feedwater, steam generation, air & refrigeration, and psychrometric processes used in various chemical industries. They should also have knowledge of different methods of plant maintenance procedures used for various chemical process equipment in the chemical industry. It helps to keep all equipment in working conditions and minimizes the loss of production time due to any equipment failure.

## III. COURSE OUTCOMES (COS)

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

- CO1 - Select suitable method of water softening for boiler feed water and process plants.
- CO2 - Select appropriate refrigeration system for the chemical process industry.
- CO3 - Apply relevant maintenance procedures for chemical process plant equipment.



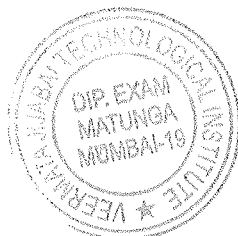
CO4 - Identify steam generators and non-steam heating systems for chemical industries.

CO5 - Use the humidification and dehumidification process for chemical process industries.

CO6 - To read and interpret the psychometric chart, air, fuel properties.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

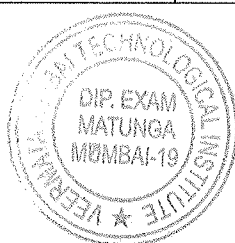
SECTION - I								
Unit & Sub-Unit		Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
<b>1</b>		<b>Industrial Water</b>	<b>12</b>	<b>16</b>	<b>1</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	1.1	Industrial water: Properties, Uses, Hard & Soft water						
	1.2	Hardness: Total Hardness, Permanent Hardness, Temporary Hardness, Units of hardness, Numerical						
	1.3	Boiler Feed water, Scale and Sludge Formation, Corrosion, Priming and Foaming, Caustic Embrittlement						
	1.4	Methods of water softening processes (Principle, Construction, Working and Application): a. Lime soda process (cold and hot) b. Zeolite process c. Ion exchange process d. Reverse Osmosis.						
<b>2</b>		<b>Refrigeration</b>	<b>8</b>	<b>12</b>	<b>2</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	2.1	Refrigeration: Concept, Unit of Refrigeration, Coefficient of Performance (COP), Numerical.						
	2.2	Types of Primary and Secondary Refrigerants, Selection criteria of Refrigerants.						
	2.3	Refrigeration Cycle: Reverse Carnot Cycle, Bell Coleman air refrigeration Cycle, Vapor compression and absorption cycle (Li-Br absorption cycle).						
<b>3</b>		<b>Plant Maintenance</b>	<b>4</b>	<b>7</b>	<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	3.1	Purpose of plant maintenance.						



3.2	Types of maintenance: Preventive maintenance, Predictive maintenance, Corrective maintenance, Routine / Scheduled maintenance, Emergency maintenance, Online maintenance and Shutdown maintenance.						
3.3	Duties and responsibility of plant maintenance department.						

### SECTION - II

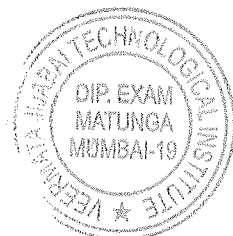
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level
<b>4</b>	<b>Steam and Non- Steam Heating System</b>	<b>12</b>	<b>16</b>	<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
4.1	Steam: Uses, Properties and types of steam.						
4.2	Steam Generator: Classification, comparison, components of boiler.						
4.3	Construction and working of: a. Lancashire boiler b. Babcock and Wilcox Boiler						
4.4	Function of all boiler Mountings and Accessories. Numerical on performance of boiler.						
4.5	Boiler Act: Indian Boiler Act and duties of boiler inspector.						
4.6	Construction and working of non- Steam Heating System (Thermic Fluid Heater).						
4.7	Properties of Thermic fluid.						
<b>5</b>	<b>Air and Psychrometry</b>	<b>8</b>	<b>12</b>	<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
5.1	Concept and Application of process air and instrument air.						
5.2	Psychrometry, Dry Bulb Temperature, Wet Bulb Temperature, Dew Point Temperature, Adiabatic saturation temperature, Humidity, Specific Humidity, Specific Volume, Relative Humidity						
5.3	Sling Psychrometer, Psychrometric Chart, Numerical on Psychrometric Chart						



	5.4	Psychrometric Process: Humidification and dehumidification						
6		<b>Industrial fuel</b>	4	7	6	20%	30%	50%
	6.1	Salient features of common solid, liquid and gaseous fuels						
	6.2	Classification, common properties and uses						

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

Sr No	Laboratory Experiment / Practical Titles /	Nos. of hours	Relevant COs
1	Determine total alkalinity of well water.	2	1
2	Determine the total, temporary and permanent hardness of borewell water / tap water/ lake water.	2	1
3	Determine pH of various acidic and alkaline water using pH meter.	2	1
4	Calculate the dryness fraction of steam at different pressure and temperature conditions by using a steam table.	2	4
5	Identify boiler mountings and accessories of boiler by visiting any chemical plant.	2	4
6	Calculate enthalpy and entropy of steam at various pressures by using a Steam Table.	2	4
7	Identify different parts of the domestic refrigerator in view of compressor, condenser, expansion valve and evaporator.	2	2
8	Determine psychrometric properties like DPT, % Relative humidity, specific enthalpy and specific volume at various DBT and WBT by using psychrometric chart.	2	5
9	Calculate the relative humidity of outer atmosphere by using sling psychrometer.	2	5
10	Perform maintenance procedure for the Centrifugal Pump.	2	3
11	Analyze raw water, RO water and rejected RO\ water quality based on Total Dissolved Solid (TDS), pH and Conductivity.	2	1
12	Calculate Coefficient of Performance (COP) of vapour compression refrigeration cycle.	2	2
13	Measure different air pressures of cycle, motorcycle, car and heavy vehicles by using a pressure gauge.	2	5
14	Determine % efficiency of cooling tower.	2	5
15	Perform maintenance procedure for the ball mill in the laboratory.	2	3
16	Perform maintenance procedure for shell and tube heat exchanger in the laboratory.	2	3



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

### Assignments (if any)

- Prepare a table of types of thermic fluids on the basis of temperature ranges and applications in chemical industry.
- Refer to the boiler manufacturing companies' websites like Thermax, Forbes Marshall, Alfa Laval etc. and prepare a report on boilers manufactured by them.
- Prepare a report on problems with solutions that occurred in boiler operation w.r.t priming, foaming, caustic embrittlement, corrosion, scale and sludge formation.
- Make a report on boiler mountings and accessories with their function.
- Visit textile / sugar/ chemical / dairy / pharmaceutical / fertilizer/ paper industry and prepare a report on utilities used by them for different processes.
- Visit the industry and identify source of waste heat to run waste heat recovery boiler.
- Visit the municipality water treatment plant and prepare a report on Physical, Chemical and Biological treatment process.
- Visit the Malls/Theatre and prepare a report on the humidification & dehumidification process used.

## VII. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Mid semester test
- Timely practical journal completion
- Performance in practical

### Summative Assessment (Assessment of Learning)

- End Term Exam
- Practical exam

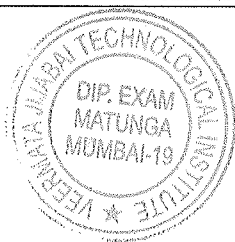
## VIII. SUGGESTED COS - POS MATRIX FORM

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	3	2	3	2	3	2	1
CO2	3	2	1	2	2	-	2	2	1
CO3	3	2	1	2	2	-	2	2	1
CO4	3	2	1	2	2	1	2	2	1
CO5	3	2	-	3	1	2	2	2	1
CO6	3	2	-	2	2	-	2	2	1

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.

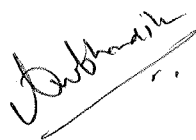


## IX. SUGGESTED LEARNING MATERIALS / BOOKS

Sr. No	Author	Title	Publisher
1	Sathiyamoorthy Manickkam	Chemical Plant Utilities	Lambert Academic Publishing, October 2016,
2	R. K. Jain	Plant maintenance engineering and management	Khanna Publication, ISBN: 9789392549090
3	James K. Carson	Refrigeration : Theory and Application	Mc. Graw Hill, New York, 2009, ISBN: 078-87-403-0363-6
4	D. B. Dhone	Plant Utilities	Nirali Prakashan
5	Kraus, Milton N.	Safe and Efficient Plant Operation and Maintenance	Mc. Graw Hill Inc. New York US, 1980, ISBN:978-0070107076

## X. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	<a href="https://www.sciencedirect.com/bookseries/advances-in-chemical-engineering">https://www.sciencedirect.com/bookseries/advances-in-chemical-engineering</a>	Chemical Engineering books
2	<a href="https://www.google.com/search?q=nptel+videos+on+chemical++plant+maintenance">https://www.google.com/search?q=nptel+videos+on+chemical++plant+maintenance</a>	Plant Maintenance



Curriculum Coordinator

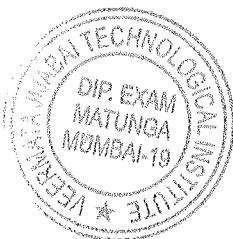


Head of the Department



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>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: INDUSTRIAL WASTE WATER TREATMENT</b>
<b>COURSE CODE</b>	<b>: 235CH46</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 MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
											Max	Min	Max	Min	Max	Min	
1	2	-	1	2	-	-	-	-	-	-	25	10	-	-	25	10	50

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

This course introduces the basics of industrial wastewater treatment, focusing on practical approaches for managing and treating industrial effluents. Students will learn about treatment techniques, industry-specific applications, and environmental regulations.

## III. COURSE OUTCOMES (COS)

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

CO1- Understand sources and types, Environmental impact and importance of treatment of Industrial wastewater

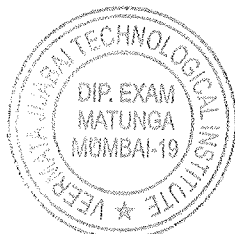
CO2- Recognize wastewater characteristics and pollution indicators.

CO3- Select appropriate treatment processes for different industries.

CO4- Understand the operation of treatment units and equipment.

CO5- Apply regulatory standards to wastewater management.

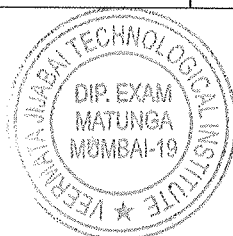
CO6- Understand the Sustainable Practices and New Technologies



#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
<b>1</b>	<b>Introduction to Industrial Waste Water</b>	<b>2</b>	<b>-</b>	<b>1</b>	<b>20%</b>	<b>50%</b>	<b>30%</b>	
	1.1 Sources and types of industrial wastewater							
	1.2 Environmental impact of untreated wastewater							
	1.3 Importance of industrial wastewater treatment							
<b>2</b>	<b>Basics of Wastewater Characteristics</b>	<b>3</b>	<b>-</b>	<b>2</b>	<b>20%</b>	<b>50%</b>	<b>30%</b>	
	2.1 Key parameters: pH, COD, BOD, TDS, TSS							
	2.2 Effects of pollutants on treatment processes							
<b>3</b>	<b>Overview of Treatment Processes</b>	<b>3</b>	<b>-</b>	<b>3</b>	<b>20%</b>	<b>50%</b>	<b>30%</b>	
	3.1 Physical processes: Screening, sedimentation, and filtration							
	3.2 Chemical processes: Neutralization, coagulation, and flocculation							
	3.3 Biological processes: Aerobic and anaerobic treatments							

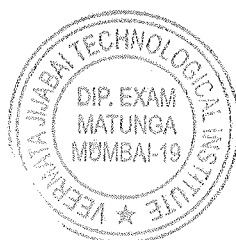
SECTION - II								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level	
<b>4</b>	<b>Industry-Specific Wastewater Treatment</b>	<b>2</b>	<b>-</b>	<b>4</b>	<b>20%</b>	<b>50%</b>	<b>30%</b>	
	4.1 Textile industry: Dye and chemical removal							
	4.2 Food processing industry: Organic load reduction							
	4.3 Chemical industry: Neutralization and heavy metal removal							
	4.4 Case studies for practical understanding							
<b>5</b>	<b>Regulations and Environmental Standards</b>	<b>3</b>	<b>-</b>	<b>5</b>	<b>20%</b>	<b>50%</b>	<b>30%</b>	
	5.1 Local and international discharge standards (e.g., CPCB in India)							



	5.2	Environmental laws and compliance requirements						
	5.3	Importance of monitoring and documentation						
<b>6</b>		<b>Sustainable Practices and New Technologies</b>	<b>3</b>	<b>-</b>	<b>6</b>	<b>20%</b>	<b>50%</b>	<b>30%</b>
	6.1	Basics of water recycling and reuse						
	6.2	Introduction to Zero Liquid Discharge (ZLD)						
	6.3	Emerging technologies: Membrane processes and resource recovery						
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 sources and impacts of industrial wastewater.	2	1
2	Simple calculations of BOD, COD, TSS, and pH from provided sample data.	2	2
3	Draw and label a sedimentation tank.	2	3
4	Calculate alum dosage for coagulation and pH adjustment for neutralization.	2	3
5	Steps of a jar test to determine coagulant dosage.	2	3
6	Advantages and disadvantages of aerobic vs. anaerobic processes.	2	3
7	Discuss the role of microorganisms in reducing organic load in a food industry effluent.	2	3
8	Treatment challenges in the textile industry (dyes) or food industry (organic loads).	2	4
9	Discuss challenges in treating heavy metal-laden effluent from a chemical industry.	2	4
10	Match industries with suitable treatment processes.	2	5
11	Benefits of Zero Liquid Discharge (ZLD) and water reuse.	2	6
12	Suggest sustainable wastewater practices for a local industry.	2	6
11	Suggest sustainable water reuse practices for a nearby industry.	2	6
12	Briefly present a modern technology like Forward Osmosis (FO) or Membrane Bioreactors (MBRs).	2	6



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

### Micro Project (if any)

- **Visit to plant:** Visit nearby industry and prepare report on technologies adopted for energy conservation.
- Identify wastewater characteristics of a selected industry.
- Select appropriate treatment methods for the wastewater based on its characteristics.
- Assess the environmental benefits of the treatment system.

## VII. ASSESSMENT METHODOLOGIES/TOOLS

## 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	-	-	3	-	2	-	3
CO2	3	2	-	-	3	-	2	-	3
CO3	3	2	-	-	3	-	2	-	3
CO4	3	2	-	-	3	-	2	-	3
CO5	3	2	-	-	3	-	2	-	3
CO6	3	2	-	-	3	-	2	-	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	Metcalf & Eddy	Wastewater engineering Treatment disposal reuse	Tata McGraw Hill.
2	Eckenfelder, W.W.	Industrial Water Pollution Control",	McGraw-Hill.

## X. LEARNING WEBSITES & PORTALS

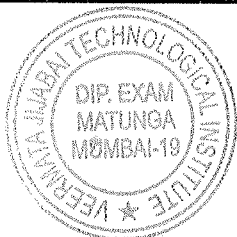
Sr. No	Link / Portal	Description
1	Link	<a href="https://en.wikipedia.org/wiki/Industrial_wastewater_treatment">https://en.wikipedia.org/wiki/Industrial_wastewater_treatment</a>
2	Link	<a href="https://onlinecourses.nptel.ac.in/noc24_ce53/preview">https://onlinecourses.nptel.ac.in/noc24_ce53/preview</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>: FOURTH</b>
<b>COURSE TITLE</b>	<b>: ENVIRONMENTAL SUSTAINABILITY</b>
<b>COURSE CODE</b>	<b>: 235CH47</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 MARKS
							Max	Min	Max	Min	FA-PR (CA)		SA-PR (PR/OR)		SLA		
						Max					Min	Max	Min	Max	Min	Max	
1	2	-	1	2	-	-	-	-	-	-	25	10	-	-	25	10	50

**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

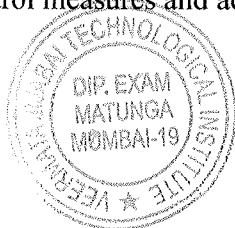
For a country to progress, sustainable development is one of the key factors. Environment conservation and hazard management is of much importance to every citizen of India. Considerable amount of energy is being wasted. Energy saved is energy produced. Environmental pollution is on the rise due to rampant industrial mismanagement and indiscipline. Renewable energy is one of the answers to the energy crisis and also to reduce environmental pollution. Therefore, this course has been designed to develop a general awareness of these and related issues so that every student will start acting as a responsible citizen to make the country and the world a better place to live in.

## III. COURSE OUTCOMES (COS)

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

CO1 - Importance of ecosystem and terminology.

CO2 - The extent of air pollution, effects, control measures and acts.



CO3 - The extent of noise pollution, effects, control measures and acts.

CO4 - The water and soil pollution, effects, control measures and acts

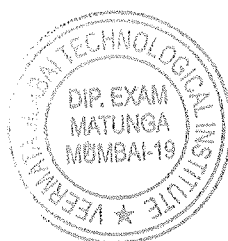
CO5 - Different renewable energy resources and efficient process of harvesting.

CO6 - Solid Waste Management and Environmental acts.

#### IV. COURSE CONTENTS WITH SPECIFICATION TABLE

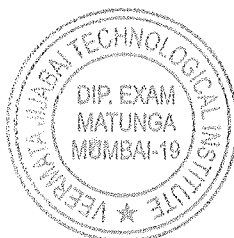
SECTION - I								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	COS	R Level	U Level	A Level	
<b>1</b>	<b>Ecosystem</b>	<b>03</b>		<b>1</b>	<b>30%</b>	<b>30%</b>	<b>40%</b>	
	1.1	Structure of ecosystem						
	1.2	Biotic & Abiotic components, Aquatic (Lentic and Lotic) and terrestrial ecosystem.						
	1.3	Global warming - Causes, effects, Green House Effect, Ozone depletion.						
<b>2</b>	<b>Air Pollution</b>	<b>03</b>		<b>2</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>	
	2.1	Air pollution, Natural and manmade sources of air pollution, Effects of air pollution.						
	2.2	Air Pollutants and Types. Control of air pollutants by Cyclone separator and Electrostatic Precipitator,						
	2.3	Air (prevention and control of pollution) act 1981.						
<b>3</b>	<b>Noise Pollution</b>	<b>02</b>		<b>3</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>	
	3.1	Noise pollution: sources of pollution, measurement of pollution level, Effects and Control of Noise pollution						
	3.2	Noise pollution (Regulation and Control) Rules, 2000.						

SECTION - II								
Unit & Sub-Unit	Topics/Sub-topics	Hours	Marks	CO	R Level	U Level	A Level	
<b>4</b>	<b>Water and Soil Pollution</b>	<b>04</b>		<b>4</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>	
	4.1	Water pollution and Sources of water pollution, Types of water pollutants, Characteristics of						



		water pollutants, control measures of water pollution.						
	4.2	Definition and list unit operations in water and Waste Water Treatment process, Water (prevention and control of pollution) act 1974, Water conservation – Importance of Rain Water Harvesting.						
	4.3	Soil pollution, Causes, Effects and Preventive measures of Soil Pollution due to Excessive use of Fertilizers, Pesticides and Insecticides.						
<b>5</b>		<b>Renewable sources of Energy</b>	<b>02</b>		<b>5</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	5.1	Solar Energy: Basics of Solar energy. Definition and advantages of advanced solar collectors. Solar water heater and Solar stills and their uses.						
	5.2	Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel.						
	5.3	Wind energy: Current status and future prospects of wind energy. Wind energy in India.						
	5.4	Need of new Energy sources, Different type's new energy sources. Environmental benefits of New Energy Sources-Hydrogen energy, Ocean energy resources, Tidal energy conversion.						
<b>6</b>		<b>Solid Waste Management and Environmental Acts</b>	<b>02</b>		<b>6</b>	<b>20%</b>	<b>30%</b>	<b>50%</b>
	6.1	Solid waste generation, Sources and characteristics of Municipal solid waste, Solid Waste Management (SWM) rules 2016- 3R in SWM.						
	6.2	E- Waste generation, Sources and characteristics, E waste management rules 2016						
	6.3	Plastic Waste generation, Sources and characteristics, Recycled plastic rules 2016						
	6.4	Importance of Environment (protection) act 1986 Occupational health and safety measures.						
Legends: R- Remember, U – Understand, A – Apply and above levels (Blooms's Revised Taxonomy).								

**V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES. Not Applicable**



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

### Assignments (if any)

### Micro Project (if any)

- List out the solid, liquid and electronics waste generated in home per week. Prepare plan to reduce it.
- List out the solid, liquid and electronics waste generated in your department per week. Prepare plan to reduce it.
- Prepare a design changes to make your department/institute more environmental friendly.
- List out the daily activities which are responsible for solid waste. Prepare a plan to reduce it.
- Prepare a small compost bin from scratch for your home and department. Prepare a report on “How worms and other decomposers recycle fruits and vegetable scraps into compost”.
- Prepare an ink from waste and paint a posters and decorate bulletin boards or the doors to the cafeteria with waste- free lunch messages to announce or support a waste-free event, and have students vote for their favourite poster.
- Students have to go on field trip nearby home and identify plastic waste spread all over the area. Prepare a plan to reduce it.
- Visit local landfill, recycling centre, or a nearby composing facility. Prepare report on the observation and plan to manage it.

## VII. ASSESSMENT METHODOLOGIES/TOOLS

### Formative Assessment (Assessment of Learning)

- Assignment
- Microproject

### Summative Assessment (Assessment of Learning)

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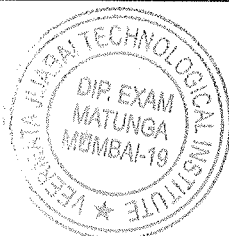
## VIII. SUGGESTED COS - POS MATRIX FORM

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	3	-	3
CO2	-	-	-	-	3	2	3	-	3
CO3	-	-	-	-	3	2	3	-	3
CO4	-	-	-	-	3	2	3	-	3
CO5	-	-	-	-	3	2	3	-	3
CO6	-	-	-	-	3	2	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	Arceivala, Soli Asolekar, Shyam	Waste Water Treatment for Pollution Control and Reuse	Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099
2	O.P. Gupta	Elements of Environmental Pollution Control	Khanna Publishing House, New Delhi
3	Rao, C. S.	Environmental Pollution Control and Engineering	New Age International Publication, 2007, ISBN: 81-224-1835-X.
4	Rao, M. N. Rao, H.V.N	Air Pollution	Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07- 451871-8
5	Frank Kreith, Jan F Kreider	Principles of Solar Engineering	McGraw-Hill, New York ; 1978, ISBN: 9780070354760.

### X. LEARNING WEBSITES & PORTALS

Sr. No	Link / Portal	Description
1	Link	<a href="http://www.eco-prayer.org">www.eco-prayer.org</a>
2	Link	<a href="http://www.indiaenvironmentportal.org.in">www.indiaenvironmentportal.org.in</a>

*[Signature]*

Curriculum Coordinator

*[Signature]*

Head of the Department

*[Signature]*

Dean Diploma

BOS VJTI Approval dated 10/07/2024

