1. COURSE DETAILS

Programme: CE/ME/EE/IE/PL/CH/DE	Semester: III
Course: Applied Mathematics	Group: C*
Course Code: AMT190013	Duration:16 Weeks

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	-	-	1	4	3	70	20	10	70	25	-	-	125

3. COURSE OBJECTIVE:

This Course is being introduced to provide mathematical background needed for any Diploma engineer. It intends to enable the students to apply basic facts, concepts and principles of Differential Equation, Application of derivatives, Probability Distribution and Definite integral with application as a tool to analyze engineering problems.

4. SKILL COMPETENCY

The aim of this course is to help the student to attain the following industry identified

Competency through various teaching learning experiences:

- Solve application-based Engineering problems using the Advanced Knowledge of mathematics

5. COURSE OUTCOMES (COs) at the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
1	Understand the concepts of differential calculus and definite integral and apply to solve engineering related problems.	U,A
2	Study the Concept of differential equation and apply it to solve engineering problems	R, U, A
3	Solve the Problem based on Numerical Method.	U,A
4	Define Laplace transform, study properties of it and apply it to solve numerical	R,U, A

6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Application of Derivatives** 1.1 Tangent and normal line 1.2 Velocity and Acceleration 1.3 Maxima and minima 1.4 Radius of curvature	**04**	**07**	**CO1**

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2	**Differential Equation** 2.1 Introduction and definition 2.2 Concept of order, degree of Differential equation 2.3 Formation of Differential Equation 2.4 Differential Equation of first order and first degree • Method of variable separable • Equation reducible to method of variable separable • Homogeneous Differential equation • Exact Differential equation • Linear Differential equation 2.5 Application of Differential Equation • Geometrical • Growth and Decay • Newton's law of cooling • Electrical circuit	**14**	**19**	**CO2**
3	**Numerical Method** 3.1 Solution of equation of one variable using • Bisection method • Regular falsi method • Newton Raphson method 3.2 Solving simultaneous equation with 2 and 3 variables using • Gauss elimination method, • Iterative methods –Gauss Seidal and Jacobi's methods	**06**	**09**	**CO3**
4	**Integration** Method of integration 4.1 By Substitution – Various Types of Integration 4.2 By Parts 4.3 Mixed Problems	**07**	**10**	**CO1**
5	**Definite Integral & its Applications** 5.1 Definition of Definite Integral 5.2 Properties of Definite Integral 5.3 Reduction Formula 5.4 Area under the curve & Area between curve 5.5 Volume of Solid 5.6 Mean Value, RMS Value 5.7 Centre of Gravity	**05**	**08**	**CO1**
6	**Laplace Transform** 6.1 Introduction 6.2 Definition and Basic Formula 6.3 Properties of Laplace transform' • Linearity property • First shifting • Change of Scale • Multiplication by t^n • Division by t 6.4 Inverse of Laplace Transform 6.5 Properties of Inverse of Laplace Transform 6.6 Methods of Inverse of Laplace Transform • By Partial Fraction	**12**	**17**	**CO4**
	TOTAL	**48**	**70**	

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7. LIST OF ASSIGNMENTS/TUTORIALS

Term Work consists of Journal containing minimum no of 08 tutorials.

Sr. No.	Title of Tutorial	Approx.Hrs required	Cos
1	Assignment on Application of derivatives	2	1
2	Assignment on Differential equation.	3	2
3	Assignment on application of Differential equation	1	2
4	Assignment on Numerical Method.	2	3
5	Assignment on Integration	2	1
6	Assignment on definite integration & its Applications	2	1
7	Assignment on Laplace Transform	2	4
8	Assignment on Inverse Laplace Transform	2	4
	Total	16	

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Assignments
3. Home Work Assignment

9. LEARNING RESOURES

Sr. No.	Title Of Book	Author	Publication
1.	Calculus for Polytechnics	Shri. S.P.Deshpande	Pune Vidyarthi Graha Prakashan Pune-30
2.	Applied Mathematics	Shri. B.M. Patel, Shri J.M. Rawal	Nirali Prakashan Mumbai
3.	Higher Engineering Mathematics	Dr. B.S. Grewal	Khanna Publishers 2/B, Delhi-6
4	Applied Mathematics	G.V.Kumbhojkar	P.Jamnadas LLP

10. WEB REFERENCES.

1. www.mic-mathematics.com
2. www.math.com
3. www.lenerstv.com
4. www.onlinetutorials.com
5. www.archieves.math.utk.edu

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Application of Derivatives			7	07
2	Differential Equation	4	10	5	19
3	Numerical Method	2	5	2	09
4	Integration	6	2	2	10
5	Definite Integral & its Applications	2		6	08
6	Laplace Transform	3	10	4	17
TOTAL		17	27	26	70

R Remembering, U Understanding, A Applying and Above (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	MS.Kavita.K.Dange	
2	Internal	Mr.R.R.Ambade	
3	Internal	Mr.U.J.Patel	
4	External	Ms.Meena Gawas Organisation: Mithibai College Of Arts and Science	

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC ★ MUMBAI 400 056.

1. COURSE DETAILS

Programme: Chemical Engineering	**Semester: III**
Course: Mechanical Operation	**Group:C***
Course Code: MOP190603	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
4	2	-	-	6	3	70	20	10	70	25	50	-	175

3. COURSE OBJECTIVE

The objective of this course is to enable students to understand various mechanical operations used in Chemical Industries with their working principal and construction.

4. SKILL COMPETENCY

The aim of this course is to help students to attend the following industry identified competency through various teaching learning experiences;

Operate Jaw crusher, Sieve shaker, ball mill, Hammer Mill, Froath Floatation Cell, Vacuum Filtration and 'Plate and Frame Filter Press' and Analyze the solid Mixture.

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5. COURSE OUTCOMES (COs): At the end of the semester student will be able to: -

CO.NO.	COURSE OUTCOME	Bloom's LEVEL
CO1	Define the basic principles of size reduction	Remember
CO2	Explain the concepts of various equipment used in chemical and pharmaceutical industry	Understand
CO3	Summarize various separation techniques used in industry	Understand
CO4	Find the power requirement for mixing process	Remember
CO5	Analyze different unit operations like size reduction, Screening, Filtration and Sedimentation	Apply

6. COURSE CONTENTS

Sr.No.	TOPIC/Sub-Topics	Hours	Marks	Cos
1	**Size Reduction** 1.1 Concept of size reduction, Importance of size reduction. 1.2 Energy & Power requirement for size reduction equipments 1.3 Principles involved in crushing and grinding, Crushing efficiency 1.4 Classification and Types of crushing and grinding, Open Circuit and Close circuit operation 1.5 Principles of their working, Rittingers Law, Kick"s law, Bond"s law, and work index. 1.6 Principle, construction, working and application a. Primary crushers : Jaw crusher b. Secondary crushers – Gyratory crusher, Roll crushers c. Grinders – Hammer mill, Ball mill d. Ultrafine Grinders : Fluid energy mill, Selection of crushing rolls & derivation of angle of nip 1.7 Derivation of Critical Speed of ball Mill 1.8 Simple problems	13	14	CO1

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2	**Size Separation of Solid** 2.1 Concept & Importance of screening operation, Types of standard screen series – Tyler standard screen series, Indian standard screen series, 2.2 Effectiveness & capacity of screens – Definition, Derivation of effectiveness. Problems based on it 2.3 Factors affecting the performance of screen – Method of feed, screen surface, Moisture content, Vibration, Screen slope 2.4 Ideal screen, Actual screen 2.5 Types of screen analysis – Differential analysis, cumulative analysis. 2.6 Types of screening equipments a. Grizzlies b. Trommel & Trommel arrangements c. Gyrotary screen d. Shaking & vibrating screen Basic Numerical Problems	09	10	**CO2, CO3, CO5**
3	**Method of Separation of Solids based on Specifics properties** 3.1 Types of size separation based on Density, Specific gravity & surface properties of the materials, Classification – a. Gravity Settling Tank b. Cone Classifier c. Double Cone Classifier d. Rake Classifier e. Spiral Classifier f. Jigging g. Tabling h. Elutriator i. do siphonizer 3.2 Separation solid particles from liquid and gas by Cyclone separator 3.3 Jigging 3.4 Separation of solid particles based on electrical & magnetic properties, Electrostatic separator a. Separation of solid particles based on Magnetic properties b. Magnetic head and pulley separator Magnetic Drum separator	10	11	**CO2, CO3, CO5**
4	**Filtration** 4.1 Types of filtration equipments, a. Primary filter – Sand filter (pressure sand filter and rapid sand filter) b. Pressure filters – Plate & frame filter press (Washing type & Non washing type) c. Vacuum filter – Rotary drum filter d. Centrifugal filter – Basket centrifuge 4.2 Factors affecting the rate of filtration e.g. pressure drop, viscosity, area of filtering surface, Resistance of cake & filter medium 4.3 Type of Filtration - a. Cake filtration and deep bed filtration b. Constant Rate & Constant pressure filtration 4.4 Derivation based on it for batch filter	13	14	**CO2, CO3, CO5**

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5	**Sedimentation** 5.1 Difference between a. Sedimentation & Filtration b. Sedimentation & Classification c. Sedimentation & Centrifugation 5.2 Concept & Principle of sedimentation, 5.3 Types of settling- a. Free settling b. Hindered settling, 5.4 Concept of terminal settling velocity, 5.5 Laboratory batch sedimentation test & setting velocity curve 5.6 Types of thickner- a. Batch thickner, b. continuous thickner (bridge supported), Role of coagulant in filtration & sedimentation	09	10	**CO2, CO3, CO5**
6	**Mixing** 6.1 concept of mixing, homogeneous & heterogeneous mixtures 6.2 Flow patterns in agitated vessels in baffled tank & unbaffled tank, Concept of 'swirling & vortex' & 'methods of prevention of swirling'. 6.3 Types of mixers, Principle, construction, working & applications a. Sigma mixer b. Ribbon blender c. Banbury mixer d. Muller mixer Power number, Power consumption of agitator	10	11	**CO2, CO4, CO5**
	Total	64	70	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 experiments/Assignments

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	Cos
1	Study of Jaw Crusher.	02	CO1
2	Study of ball mill.	04	CO1
3	Study of micron pulveriser/hammer mill.	02	CO1
4	Screen analysis of products from Ball Mill.	04	CO5
5	Study of sigma mixer	02	CO4
6	Experiment based on froath flotation.	04	CO3
7	Experiment on plate and frame filter press.	02	CO3

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8	Experiment on vacuum filtration.	04	CO3
9	To determine settling rate of sedimentation.	04	CO3
10	Assignment 1 – To find the power of the given Crusher.	02	CO1
11	Assignment 2- To find the power requirement for given agitator.	02	CO4
12	Assignment 3- Classify the crushers on the basis of Product size	02	CO2
	TOTAL	32	

8. IMPLEMENTATION STRATEGY (PLANNING)

1.Teaching Plan/Tutorials

2. Minimum no of practical/assignments/drawings etc.

3.Industry visit

4. Guest/Expert lectures

5. Equipment working Animation

6. Self Learning Online Resources

9. LEARNING RESOURSES

Sr. No.	Title Of Book	Author	Publication
1.	Introduction to chemical Engineering	W. L. Badger	Mcgraw Hill International
2.	Unit Operation of Chemical Engineering	McCabe & W.L.Smith	Mcgraw Hill Int. Newyork
3.	Chemical Engineering, Volume II	Coulson & Richardson	Butterworth Heinmann
4	Unit operation – I	K.A. Gawane	Nirali Publication

10. WEB REFERENCES

1. https://m.youtube.com/watch?v=DIwR7BZAnpg
2. https://m.youtube.com/watch?v=tL21JCLG9s8
3. https://nptel.ac.in/courses/103107123/
4. https://www.researchgate.net/publication/318946519_Mechanical_Operations_for_Chemical_Engineers/amp
5. https://onlinecourses.nptel.ac.in/m#/allcourses

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11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Size Reduction	07	07	-	14
2	Size Separation of Solid	06	04	-	10
3	Method of Separation of Solids based on Specifics properties	06	05	-	11
4	Filtration	07	04	3	14
5	Sedimentation	04	06	-	10
6	Mixing	-	05	06	11
	Total	30	31	09	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	FACULTY	NAME	SIGNATURE
1	Internal	Mr. Nilesh R. Nagose	
2	Internal	Mr. Milind M. Belwalker	
3	Internal	Mrs. Jyoti S. Sangle	
4	External	R.O.Narkhede	
		Organisation: Datta Meghe College of Engineering	

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC MUMBAI 400 056.

1. COURSEDETAILS

Programme: Chemical Engineering **Course: Technology of Inorganic and Organic Chemicals** **Course Code: TIC190604**	**Semester: III** **Group: C*** **Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per week					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
04	02	--	--	06	03	70	20	10	70	25	50	--	175

3. COURSE OBJECTIVE

Diploma chemical engineering have to work as plant operator. This course will provide information towards raw material, process and industrial application for manufacturing of Inorganic chemicals like Sulphuric acid, Nitric acid, Phosphoric acid, Nitrogen and phosphorus based fertilizers, Chlor-alkali chemicals, cement , Gypsum and industrial gases as well as Organic chemicals like alcohol, soap, detergents, pulp and paper. This technology will provide necessary skills to perform the job role.

4. SKILL COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through the various teaching learning experiences:

- **Apply the concept of Inorganic and Organic Chemistry in chemical engineering applications**

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5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom LEVEL
CO1	Manufacture Inorganic acids in chemical process industries	Remember, Understand, Apply
CO2	Prepare Nitrogen –based and Phosphate based fertilizers in Chemical process industries	Remember, Understand, Apply
CO3	Prepare Chlor alkali chemicals, industrial gases and calcium compound chemicals in chemical process industry	Remember, Understand, Apply
CO4	Prepare alcohol and its products by using fermentation process and chemicals from petrochemicals	Remember, Understand, Apply
CO5	Prepare Soap and detergent using relevant oil and pulp and paper using sulphate and sulphite process.	Remember, Understand, Apply

6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Manufacturing of Inorganic Acids (Raw material, Chemical Reaction, PFD, Process Description, MOC)** 1.1Sulphuric Acid 1.2Nitric Acid 1.3Phosphoric Acid 1.4Hydrochloric acid	08	08	CO1
2	**Manufacturing of Nitrogen and Phosphate based fertilizers(Raw material, Chemical Reaction, PFD, Process Description)** 2.1 Ammonia 2.2 Urea 2.3Ammonium Nitrate 2.4 Phosphorus	10	12	CO2
3	**Manufacturing of Chlor Alkali and Calcium Compounds(Raw material, Chemical Reaction, PFD, Process Description)** 3.1 Chlorine 3.2 Caustic Soda 3.3 Soda Ash	06	8	CO3

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4	**Manufacturing of Industrial Gases (Raw material, Chemical Reaction, PFD, Process Description)** 4.1 Oxygen and Nitrogen 4.2 Carbon Dioxide 4.3 Hydrogen	08	08	CO3
5.	**Production from Alcohol Based Industry (Raw material, Chemical Reaction, PFD, Process Description)** 5.1 Fermentation process 5.2 Ethyl alcohol 5.3 Acetic acid 5.4 Ethyl Acetate	08	08	CO4
6.	**Manufacturing Chemicals from Petrochemicals** 6.1 Oxidation of Propane 6.2 Chlorination of Propane 6.3 Dehydrogenation of Propane 6.4 Nitration of Propane 6.5 Alkylation of Benzene 6.6 Sweetening and dehydration process	06	06	CO4
7	**Manufacturing of Oil, Soap and Detergent (Raw material, Chemical Reaction, PFD, Process Description)** 7.1 Methods of Extracting Oil 7.2 Hydrogenation of Oil 7.3 Manufacturing of Soap 7.4 Manufacturing of Detergents	10	12	CO5
8	**Production Process in Pulp and Paper Industries (Raw material, Chemical Reaction, PFD, Process Description)** 8.1 Pulp-Method of production 8.2 Comparison of chemical pulping process 8.3 Pulp by Kraft method 8.4 Manufacturing of Paper	08	08	CO5
	TOTAL	64	70	

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7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 experiments.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1.	Analysis of Sulphuric acid	02	CO1
2.	Analysis of Nitric acid	02	CO1
3	Analysis of Hydrochloric acid	02	CO1
4	Analysis of Nitrogen Content in given Fertilizer	02	CO2
5	Analysis of Soda Ash	02	CO3
6	Analysis of Bleaching Powder	02	CO3
7	Estimate the strength of glacial acetic acid	02	CO4
8	Determination of Iodine Value of Oil	02	CO5
9	Determination of Saponification Value of Oil	02	CO5
10	Determination of Acid Value of Oil	02	CO5
11	Analysis of soap for moisture content and acidity/alkalinity.	02	CO5
12	Determination of total fatty matter of soap	02	CO5
13	Industrial Visit	06	All

8. IMPLEMENTATION STRATEGY (PLANNING)

1.Teaching Plan/Tutorials
2. Minimum no of practical/assignments/drawings etc.
3.Industry visit
4.Guest/Expert lectures

9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Dryden"s Outlines of Chemical Technology	M. Gopala Rao Marshall Sittig	East West Publishers, New Delhi
2	Shreve"s Chemical Process Industries	George T. Austin	Tata Mc Graw Hill
3	Handbook of Industrial Chemistry Vol – I &II	Davis K.H.	C.B.S. Publishers, New Delhi

10. WEB REFERENCES:

https://nptel.ac.in/courses/103107082
https://nptel.ac.in/courses/103103029

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11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Inorganic Acids	02	02	04	08
2	Nitrogen and Phosphate based fertilizers	02	02	08	12
3	Chlor Alkali and Calcium Compounds	02	02	04	08
4	Industrial Gases	02	02	04	08
5	Alcohol Based Industry	02	02	04	08
6	Chemicals from Petrochemicals	02	02	02	06
7	Oil, Soap and Detergent	02	02	08	12
8	Pulp and Paper Industries	02	02	04	08
	Total	16	16	38	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	FACULTY	NAME	SIGNATURE
1	Internal	Mr. Nilesh R. Nagose	
2	Internal	Mr. Milind M. Belwalker	
3	Internal	Mrs. Jyoti S. Sangle	
4	External	R.O. Narkhede	
		Organisation: Datta Meghe College of Engineering	

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1. COURSEDETAILS

Programme: Chemical Engineering	**Semester:III**
Course: Fluid Flow Operation	**Group: A***
Course Code: FFO190605	**Duration:16 Weeks**

2. TEACHINGAND EXAMINATIONSCHEME

Scheme of Instructions and Periods per					ExaminationSchemeandMaximumMarks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D +T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
2	2	-	1	05	03	70	20	10	70	25	50	-	175

3. COURSE OBJECTIVE

The objective of this course is to enable students to understand different principles of fluid flow, know flow measuring instruments and their uses, Know about different pumps and their uses.

4. SKILL COMPETENCY

The aim of this course is to help students to attend the following industry identified competency through various teaching learning experiences:

Maintain flow of different fluids in the chemical plants according to process requirement.

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to:

-

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Remember the fluid parameter in chemical process	Remember
CO2	Calculate the pressure drop in piping system	Understand
CO3	Check the flow rate of incompressible fluid	Remember
CO4	Select the flow Meter.	Remember
CO5	Classify liquid and gas pumping devices	Understand

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Fluid flow Properties** 1.1. Fluid– Definition, Pressure Gradient, Velocity Gradient. 1.2. Fluid Statics and Dynamics – Concept 1.3. Viscosity – Definition, Kinetic Viscosity and Dynamic Viscosity, unit and numerical. 1.4. Newton's Law of Viscosity. 1.5. Types of fluids– Ideal and Real Fluid, Compressible and Incompressible, Newtonian and Non-Newtonian 1.6. Rheologicalbehavior for Newtonian and non-Newtonian fluids 1.7. Hydrostatic Equilibrium – Derivation for condition for hydrostatic equilibrium. Derivation for pressure drop for U tube manometer, inclined manometer	05	11	CO1
2	**Fluid flow Parameters** 2.1. Concept of average point and mass velocity, volumetric and mass flowrate of fluid, units and interconversion 2.2. Equation of continuity - Derivation and application (Numerical Problems) 2.3. Type of Flow, Reynolds number Experiment (Numerical Problems). 2.4. Concept of lower and upper Critical Velocity. 2.5. Type of Friction, definition of Fanning and Darcy Weisbatch friction factor, derivation of friction factor, Relation between friction factor and Reynolds number 2.6. Velocity distribution across the pipe, relation between point velocity, average velocity and maximum velocity and its derivation 2.7. Derivation of Hagen Poiseuille equation and its application 2.8. Head and Energy loss due to pipe fitting, concept of equivalent length of pipe fittings and Valves, Numerical Problems.	08	18	CO1(2.1, 2.2), CO2(remaining)
3	**Bernoulli's Equation** 3.1. Different types of Energy associated with flowing fluid such kinetic energy, potential energy and Pressure energy. 3.2. Statement, Assumption and derivation of Bernoulli's equation for incompressible fluids. 3.3. Bernoulli's Equation – Significance and application, Graphical representation of energy variation 3.4. Problem based on Bernoulli's Equation.	03	06	CO3

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4	**Different types of flow meter** 4.1. Variable area and variable head flow meter principle, 4.2. Construction, working, application and calibration of orifice meter, Venturimeter, pitot tube and Rotameter. 4.3. Derivation of equation for rate of flow through venturi meter, orifice meter and pitot tube. 4.4. Problems based on orificemeter and venturi meter.	07	14	CO4
5	**Liquid Pumping Devices** 5.1. Importance of pumping 5.2. Classification of pump – Centrifugal and positive displacement pump, 5.3. Principle, construction, working and application of centrifugal pump, reciprocating pump (piston, plunger and diaphragm pump), Rotary pump (Gear pump), dosing pump (piston and peristaltic pump). 5.4. Different losses in centrifugal pump. 5.5. Power requirement of centrifugal pump and reciprocating pump (derivation) 5.6. Head – concept and derivation, Net positive suction head (NPSH), air binding, priming and cavitation (Numerical Problems). 5.7. Characteristic curve of centrifugal pump	07	14	CO5
6	**Gas pumping Devices** 6.1. Device for transportation of Gas/Air (Fan, Blower and compressor) 6.2. Fan(induced draft and force draft) – Principle, construction and working, 6.3. Centrifugal Blower – principle, construction and working. 6.4. Centrifugal and reciprocating compressor – principle construction and working, 6.5. Vacuum Generation device – principle, constriction and working of steam jet ejector, oil ring and water ring vacuum pump.	02	07	CO5
	TOTAL	32	70	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 experiments/Assignments.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Reynold's Experiment – To study the different types of flow	4	CO2
2	To find the coefficient of discharge for orifice meter.	2	CO4
3	To find the coefficient of discharge for Venturi meter	4	CO4
4	To verify the Bernoulli's theorem	4	CO3
5	To find the pressure drop across different pipe fitting.	4	CO1, CO2
6	To study the different types Valve	2	CO2
7	To study the pipe fitting	2	CO2
8	To find the pressure drop across different size pipe.	4	CO2

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9	To study the calibration of rotameter	4	CO4
10	Assignment 1 – Problem on Head calculation of Centrifugal Pump	2	CO5
11	Assignment 2 – Problem on NPSH Calculation of Centrifugal Pump	2	CO5
	TOTAL	32	

8. IMPLEMENTATION STRATEGY (PLANNING)

1.Teaching Plan/Tutorials
2. Minimum no of practical/assignments/drawings etc.
3. Simulations using Excel
4.Slides
5.Animation Videos

9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Unit operations of Chemical Engineering	Warren L. Mccabe and Julian C. Smith	Mcgraw Hill Inc, Newyork
2	Introduction to chemical Engineering	Walter L. Badger, Julius T Banchero	Mcgraw Hill Inc, Auckland
3	Fluid Mechanics	R. K. Bansal	Laxmi Publication Pvt. Ltd

10. WEB REFERENCES

- www.vlab.com
- www.nptel.ac.in/fluidflowoperation
- www.pumpsindia.com
- https://www.myodesie.com/wiki/index/returnEntry/id/3006

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Fluid flow Properties		05	06	11
2	Fluid flow Parameters	06	02	10	18
3	Bernoulli's Equation	04	02	-	06
4	Different types of flow meter	-	06	08	14
5	Liquid Pumping Devices	-	07	07	14
6	Gas pumping Devices	-	03	04	07
	Total	10	25	35	70

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R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	FACULTY	NAME	SIGNATURE
1	Internal	Mr. Nilesh R. Nagose	
2	Internal	Mr. Milind M. Belwalker	
3	Internal	Mrs. Jyoti S. Sangle	
4	External	Dr. Manish Tiwari and Rahul Paliwal	
		Organisation: MPSTME	

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1. COURSEDETAILS

Programme: Chemical Engineering	**Semester:III**
Course: Heat Transfer Operation	**Group: A***
Course Code: HTO190606	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
					Theory Paper Duration and marks(ESE)								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Hours	Marks	SSL	TA	TH	TW	PR	OR	TOTAL
2	2	-	1	5	03	70	20	10	70	25	50	-	175

3. COURSE OBJECTIVE

The objective of this course is to enable students to understand different modes of heat transfer., Know different heat transfer equipment and their uses, know about principle of crystallization and equipment used.

4. SKILL COMPETENCY

he aim of this course is to help students to attend the following industry identified competency through various teaching learning experiences:

Maintain the Temperature of different fluids in the chemical plants according to process requirement

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Interpret the temperature of the wall involving conduction process	Understand
CO2	Interpret the temperature of fluid during heating or cooling process	Understand
CO3	Interpret the temperature of fluid during radiation heat transfer	Understand
CO4	Select & Design the required Heat exchanger in chemical Process.	Remember
CO5	Calculate the temperature of fluid during Evaporation	Understand

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Modes of heat transfer** : Introduction to modes of heat transfer- Conduction, Convection, Radiation 1. Conduction:- 1.1. Steady state conduction, Fourier's law, Conduction through single and multiple layers of different systems like rectangular slab, cylinder along with concept of log mean radius in thick walled and sphere. Problems based on rate of heat loss and finding interface temperature in composite layers. 1.2. Variation of thermal conductivity in solids with temperature also in fluids with temperature and pressure. 1.3. Concept of critical radius of insulation and it's significance.	07	15	CO1
2	**Convection:** 2.1. Forced Convection and Natural convection, 2.2. Concept of overall heat transfer coefficient along with film heat transfer coefficient and it's derivation. 2.3. Governing equation for forced convection obtained by dimension analysis to understand Prandtl number, Reynolds's number, Nusselt number, Grashoff's number and with it' physical significance. 2.4. Use of empirical equation for calculation of heat transfer coefficient in laminar, turbulent and transition region in forced convection. Problems based on calculation of heat transfer Coefficient by providing empirical equations. 2.5. Comparison of concurrent, counter current and cross current flows through heat exchangers, with derivation of log mean temp. difference and problems. 2.6. Heat transfer in condensation of vapor : Filmwise and dropwise condensation (only concepts) 2.7. Heat transfer in boiling liquids: Nucleate and film boiling region (only concepts)	07	15	CO2
3	**Radiation** 3.1. Stefan Boltzman's law, Kichoff's law, Wien's Displacement Law 3.2. Concept of Absorptivity, Reflectivity, Transmissivity Grey body, Black body and Emissivity	04	08	CO3
4	**Heat transfer equipment** Construction and working of: - Double pipe heat exchanger, shell and tube heat exchanger, single pass and multipass, graphite heat exchanger, jacketed vessel, plate type, finned tube exchanger.	04	08	CO4

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5	**Evaporation** 5.1. Comparison of evaporation with distillation and drying, factors affecting evaporation. 5.2. Capacity and economy of evaporator, methods to increase economy- multiple effect, mechanical and thermal recompression. 5.3. Construction and working of pan evaporator, horizontal tube, calendria evaporator, long tube evaporator. Equipment used for evaporation, evaporators,	05	12	CO5
6	**Design of heat exchanger** 6.1. Calculation of film heat transfer coefficient, Overall heat transfer coefficient, Log mean temperature difference, Dirt factor, Area of heat transfer and number of tubes. 6.2. Numerical on "Process design of Shell and tube heat Exchanger - For term work and assignment only.	05	12	CO4
	TOTAL	32	70	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of 10 experiments/Assignments

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Study of different types of Heat Exchangers	02	CO4
2	Study of Heat transfer phenomena in parallel/Counter current Flow arrangement	04	CO4
3	Study of Plate type heat exchanger	02	CO4
4	Heat transfer through conduction in composite wall	04	CO1
5	Study of Heat transfer in shell and tube Heat exchanger	04	CO4
6	To find the capacity and economy of single tube evaporator	04	CO5
7	Study the Stefan Boltzmann apparatus and find the value of its constant.	04	CO3
8	To study the heat transfer in Natural convection	04	CO2
9	Assignment 1 – To design the heat shell and tube heat exchanger	02	CO4
10	Assignment 2 – To Find the capacity and Economy of Evaporator	02	CO5
11	Assignment 3- To find Heat loss through composite Wall.	02	CO1
	TOTAL	32	

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8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Minimum no of practical/assignments/drawings etc.
3. Demonstrations/Simulations
4. Slides
5. Animation Videos

9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Unit operations of Chemical Engineering	Warren L. Mecabe and Julian C. Smith	Mcgraw Hill Inc, Newyork
2	Introduction to chemical Engineering	Walter L. Badger, Julius T Banchero	Mcgraw Hill Inc, Auckland
3	Process Heat Trasfer	D.Q. Kern	Mcgraw Hill Inc, Auckland

10. WEB REFERENCES

1. https://www.usna.edu/Users/mecheng/adams/index2.htm
2. https://swayam.gov.in/

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Modes of heat transfer	08	07		15
2	Convection:		07	08	15
3	Radiation		04	04	08
4	Heat transfer equipment	04	04		08
5	Evaporation		04	08	12
6	Design of heat exchanger		02	10	12
	Total	12	28	30	70

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Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

OTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	FACULTY	NAME	SIGNATURE
1	Internal	Mr. Nilesh R. Nagose	
2	Internal	Mr. Milind M. Belwalker	
3	Internal	Mrs. Jyoti S. Sangle	
4	External	Rahul Paliwal / Manish Tiwari	
		Organisation: MPSTME	

1. COURSEDETAILS

Programme: Plastic Engineering/Chemical Engineering	**Semester: III**
Course: Technology of Plastics	**Group: C*/C**
Course Code: TOP 190503	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks (ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	2	--	--	5	03	70	20	10	70	25	50		175

3. COURSE OBJECTIVE:

Different plastic materials are being invented and used for various applications in industry. This course is a prerequisite course for higher semester courses and imparts appreciation of plastic materials their grades and end applications. The course summarizes the preparation, properties and applications of thermoplastic and thermosetting materials and will also be beneficial to plastics technology diploma engineers (also called technologist) interested to become entrepreneurs by establishing raw materials and additives material supply firms.

4. SKILL COMPETENCY:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences.

Use different types of relevant plastic materials to produce specified products.

5. COURSE OUTCOMES (COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Select relevant plastics materials for manufacturing of commodity product.	Remembering, Understanding
CO2	Use relevant plastics materials for manufacturing of engineering products.	Remembering, Understanding, Applying
CO3	Select appropriate specialty plastic materials for different end applications	Applying
CO4	. Use relevant additives for plastic materials processing requirements	Understanding, Applying

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6. COURSE CONTENTS

Sr.No.	Topic/Sub-Topics	Hours	Marks	COs
1	**1.0 Commodity Plastics: Principles of Manufacturing, properties and applications:** 1.1 Polymethyl methacrylate, Polyacrylamides, Polyacrylonitrile. 1.2 Polyvinyl alcohol by Hydrolysis process, Poly vinyl acetate, Poly vinyl chloride by cracking process. 1.3 Polyesters: Polyethylene terephthalate, poly butylene terephthalate. 1.4 Cellulosic- sources, cellulose nitrate, cellulose acetate and cellulose acetate butyrate. (Detail description of manufacturing and flow sheet not expected)	15	18	CO1, CO2
2	**2.0Engineering Plastics: Principles of manufacturing, properties and Applications:** 2.1Acrylonitrile Butadiene Styrene, Polycarbonate, Polyacetals 2.2Polyamides such as Nylon-6, Nylon-66 2.3Polyphenyleneoxide, Polytetrafluoroethylene	08	15	CO2, CO3
3	**3.0 Thermosetting Plastics: Preparation, Properties and Applications:** 3.1 Phenol formaldehyde, Urea formaldehyde 3.2 Melamine formaldehyde 3.3 Polyurethane 3.4 Silicone, Epoxy (Details description of manufacturing and flow sheet not expected)	10	13	CO2
4	**4.0 Specialty Plastics: Principle of Manufacturing, Properties and Applications:** 4.1Ethylene vinyl acetate, Styrene acrylonitrile 4.2 PPS, PEEK 4.3 Polyamide-imide 4.4 Liquid crystal polymer, conducting polymers	05	08	CO4
5	**5.0 Additives: Functions, examples and selection criteria for following additives.** 5.1 Plasticizers 5.2 Heat and Light stabilizers 5.3 Fillers 5.4 Colorants 5.5 Lubricants, Extenders 5.6 Flame retardants 5.7 Impact Modifiers, Blowing agents	05	08	CO3,CO4
6	**6.0 Compounding:** 6.1 Need of compounding, Equipment's of compounding such as 6.2 Tumbler mixer 6.3 High Speed mixer 6.4 Ribbon blender 6.5 Banbury Mixer, Two roll mill	05	08	CO4
	TOTAL	48	70	

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7. LIST OF PRACTICALS/ASSIGNMENTS

Term Work consists of Journal containing minimum no of 08 Experiments/ 02 Assignments

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	COs
1	To compute density of plastics.	02	CO1 CO4
2	To determine the melting point of given polymer.	02	CO1, CO2
3	To determine the bulk factor of the resin.	02	CO4
4	To Prepare the Novolac resin.	02	CO1, CO4
5	To Prepare the Resol resin.	02	CO2
6	Preparation of Polystyrene by bulk polymerization	04	CO1
7	To Prepare Urea Formaldehyde Resin	04	CO4
8	To determine Hydroxyl value of Resins	02	CO4
9	To measure solution viscosity of polymeric material	02	CO1
10	To identify common commodity plastics by flame & solvent test.	04	CO3
11	To determine percentage of filler in to the polymer by using muffle furnace.	02	CO3
12	Assignment on Raw materials, preparation, properties and uses for polymers and resins	02	CO2
13	Assignment on Polymerization Reactions	02	CO3
14	Assignment on Polymerization Techniques	02	CO4
	TOTAL	**32**	

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum no of practical/assignments.
3. Demonstrations

9. LEARNING RESOURSES

Sr. No.	Title Of Book	Author	Publication
1.	Text Book of Polymer Science ByClinds Billmeyer (Willey)(Interscience)	By Clindsivy	Willey Interscience
2.	Polymer Science	V. R. Gowarikar	New Age International, New Delhi
3.	Text Book of Polymer Science	By Ghosh	Multitask Publishing Co. Ghatk
4	Plastic Materials	J. A. Brydson	Butterworth
5	Properties and Structure of Polymers	A. V. Tobol sky	John Will's & Sons

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10. WEB REFERENCES

1. https://files.eric.ed.gov/fulltext/ED529370.pdf
2. https://pslc.ws/macrog/weight.htm
3. https://en.wikipedia.org/wiki/Polymer_degradation
4. www.sciencedirect.com

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Commodity Plastics	08	05	05	18
2	Engineering Plastics	05	07	03	15
3	Thermosetting Plastics	05	05	03	13
4	Speciality Plastics	-	03	05	08
5	Additives	-	04	04	08
6	Compounding of plastics and Compounding Equipment	-	05	03	08
TOTAL		**18**	**30**	**22**	**70**

R Remembering, U Understanding, A Applying, (Bloom's revised taxonomy levels)
NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of Cos. actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	**Internal**	Meghna Humbal	
2	**Internal**	Mr.D.M.karad	
3	**Internal**	Mrs.Rameshwari Bawankar	
4	**External**	Mr.Ninad Hule Organisation: Vijaya Engineering Works	

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1. COURSE DETAILS

Programme: Chemical Engineering	**Semester:III**
Course: Material of Construction	**Group:C**
Course Code: MOC190607	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per week					Examination Scheme and Maximum Marks							
Theory Hrs. L	Practical Hrs. P	Drawing Hrs. D	Tutorial Hrs. T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	--	--	05	03	70	20	10	70	25	-	-	125

3. COURSE OBJECTIVE

The objective of this course is to enable students to select the relevant ferrous and non-ferrous industrial materials and alloys for different equipments in chemical plant.

4. SKILL COMPETENCY

Aim of this course is to help the students to attain following industry identified competency through various teaching learning experiences:

Apply principles of chemistry of materials to chemical engineering applications.

5. COURSE OUTCOMES(COs)

At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO 1	Interdentify the material structure	Remember
CO 2	Test physical, chemical, mechanical, properties of material.	Remember, Understand
CO 3	Select the relevant industrial materials for different applications.	Understand, Apply
CO 4	Identify the type of corrosion in industrial environments.	Understand, Apply
CO 5	Select the relevant ferrous metals for the different applications.	Apply

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Structure of material and Insulations** 1.1 Crystal Structure; Types of structure; Atomic structure, Nano structure, Micro structure, Chemical Bonding, Fundamental laws of crystal structure, Bragg's Law. 1.2 Materials in research: Biomaterials, Nanomaterial, Electronic, optical and Magnetic Materials. 1.3 Insulating Materials: Heat/Thermal insulations. Sound insulations, Electrical insulation. 1.4 Heat/Thermal Insulation: General aspects, requirements, classifications, Organic insulation,(e.g. wool, cotton wool, saw dust, corkboard) and Inorganic insulation (e.g. Slag wool, Glass wool, Charcoal, Asbestos, Gypsum powder)	05	08	CO1
2	**Properties of Engineering Materials:** 2.1 Chemical Properties: Composition Chemical reactivity with air, And acid 2.2 Physical Properties: Dimension, Colour, Appearance, Density, Porosity 2.3 Thermal Properties: Melting point, Specific Heat , Heat Capacity Thermal expansion, Thermal conductivity, Thermal stability, thermal shock resistance, heat resistance 2.4 Electrical Properties resistivity and conductivity, Dielectric Constant , Dielectric strength , Thermo electricity 2.5 Mechanical properties: Tensile strength, yield strength, Impact Strength, compressive strength Hardness, Malleability, Ductility, Brittleness, Fatigue, Creep, Elasticity, Plasticity, ,Toughness	12	16	CO2,

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3	**Ferrous metals and Alloys** 3.1 Types of Iron: Pig iron, cast iron wrought iron. 3.2 Effects of chemicals elements of Iron: Chromium, Copper, manganese, Nickel, Silicon, Phosphorus. 3.3 Steel; Classification of steel Based on carbon content, based on deoxidation practice. 3.4 Alloy Steels: Purpose of alloying Preparation of alloys, Classification of alloy, chemical composition, purpose structural class. 3.5 Special alloy steels: Heat resisting steel, Stainless Steel. 3.6 Heat treatment. Iron-carbon system. Annealing, Normalising, hardening, Critical cooling rate, Hardenability, age hardening, surface hardening, tempering. 3.7 Use of IS code for selection of alloys	12	16	CO5
4	**Non Metallic Materials and material testing** 4.1 Ceramics: Classification, Clay, Silica, Feldspar, Properties of ceramics: Mechanical, Electrical, Chemical, Thermal, Important Engineering ceramics, silicon carbide aluminium, engineering application of ceramics. 4.2 Composites: Particle reinforced composites. Fiber Reinforced composites. Structural composites 4.3 Rubbers and plastics 4.4 polymeric material : thermoplastic and thermosetting polymers , polymerisation reaction : Addition ,condensation , Co polymerisation. **Testing of Materials** 4.5 Conventional tests 4.6 Non Destructive testing principles 4.7 Industrial applications of non-destructive testing	12	16	CO3
5	**Corrosion and its Prevention** 5.1 Nature of corrosion 5.2 Mechanical of corrosion 5.3 Types of corrosion 5.4 Prevention of corrosion 5.5 Corrosion Testing 5.6 Stress corrosion, Cracking corrosion, Corrosion allowance 5.7 Corrosion monitoring.	07	14	CO4
	TOTAL	**48**	**70**	

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7 LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum eight no of experiments and minimum two assignments.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Identify the material from given crystal structure	04	CO1
2	Determine thermal and electrical conductivity of a given metal	04	CO2
3	Determine tensile strength, Yield strength and Impact strength of given material	04	CO2
4	Determine melting point of given material	04	CO2
5	Prepare the thermoplastic/ thermosetting plastic material	04	CO3
6	Determine the rate of corrosion in acidic medium	04	CO4
7	Determine the rate of corrosion in alkaline medium	04	CO4
8	Determine composition of given alloy steel	04	CO5
9	Determine copper content in cu alloy metal	04	CO5
10	Determine manganese in steel	04	CO5
	TOTAL	40	

8 IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Minimum 8 no of practicals and minimum two assignments.
3. Slides
4. Self-Learning Online Resources

9 LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Engineering Chemistry	Dr. Dara S.S. Dr. Umare S.S.	S Chand and Company Ltd, New delhi
2	Materials Science and Metallurgy	Daniel c Yesudian, D.G. Harris	SCITECH Publications (India) pvt ltd,chennai
3	Materials Science & Metarllurgy	Dr. O.P Khanna	Dhanpat rai publications Ltd,New Delhi
4	Material Science	Narang B.S	CBS Publishers and distributers,Delhi

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5	Material Science and Proceses	Chaoudhary Hajra S K	Indian Book Distributing company,Mumbai1985

10 WEB REFERENCES

- https:// en.wikipededia.org/wiki/materials science
- https:// mse.stanford.edu
- https://ocw.mit.edu/courses/material.scienceandengineering
- https://nptel.ac.in/course.html

11 SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Structure of material and Insulations	02	02	04	08
2	Properties of Engineering Materials	04	06	06	16
3	Ferrous metals and Alloys	04	06	06	16
4	Non Metallic Materials and material testing	04	06	06	16
5	Corrosion and its Prevention	04	04	06	14
	Total	18	24	28	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS:

SR.NO		NAME	SIGNATURE
1.	Internal	R.D. Shimpi	
2.	Internal	M. M. Belwalkar	
3.	internal	N.R.Nagose	
4.	External	R.O.Narkhede	
		Organization:MPSTME	

1. COURSE DETAILS

Programme: Chemical Engineering **Course: #Chemical Reaction Engineering** **Course Code: CRE190608**	**Semester: IV** **Group: C*** **Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
04	02	--	--	06	03	70	20	10	70	50	50	--	200

3. COURSE OBJECTIVE

The objective of this course is to enable students, to understand principles and kinetic tools, useful in analyzing the rate of chemical reactions for homogeneous reactions, to operate the reactor and to do basic design of the reactor.

4. SKILL COMPETENCY

Aim of this course is to help the students to attain following industry identified competency through various teaching learning experiences:

Apply the concept of chemical reaction engineering in reactor design and applications.

5. COURSE OUTCOMES(COs)

At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Apply basic concepts of thermodynamics and kinetics parameters of various reactions.	Remember, Understand, Apply
CO2	Interpret batch reactor data to determine order of reactions.	Remember, Understand, Apply
CO3	Calculate size of reactor, applying design equation	Understand, Apply
CO4	Select suitable reactor for various applications.	Understand, Apply
CO5	Use proper catalyst for various chemical reactions.	Remember, Understand, Apply

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Thermodynamics :** 1.1 Thermodynamics, system, surroundings, open system, closed system, isolated system, state and path functions, intensive and extensive properties, reversible and irreversible process. 1.2 Laws of thermodynamics : First law, second law & third law 1.3 Chemical equilibrium- Laws of chemical equilibrium, equilibrium constant, relationship between free energy change and equilibrium constant, feasibility of chemical reaction from the free energy change, equilibrium conversion and problems.	08	08	CO1
2	**Kinetics of Homogeneous Reactions :** 2.1 Concept of rate of reaction, Factors affecting rate of reaction, rate constant, classification of chemical reactions. 2.2 Concentration dependent term of a rate equation, elementary and non-elementary reactions, molecularity and order of reaction, single and multiple reactions, series and parallel reactions.	09	10	CO1
3	**Interpretation of Batch Reactor Data :** 3.1 Integral and differential method for analyzing kinetic data, concept of constant volume batch reactor and variable volume batch reactor. 3.2 Constant volume batch reactor- Analysis of total pressure data obtained in a constant volume system. Integral method of analysis of data- Irreversible first order, second order, zero order reactions, over all order of irrreversible reactions from the half life, parallel, series and autocatalytic reactions and reversible reactions. 3.3 Differential Method of analysis of data. 3.4 Variable volume batch reactor- Integral method of analysis –Zero order, first order, second order reactions, problems	15	16	CO2
4	**4.0 Introduction to Reactor Design :** 4.1 Types of Chemical Reactors, material balance, energy balance. 4.2 Single ideal reactors-performance equations for ideal batch reactor, steady state mixed flow reactor and plug flow reactor, space time, space velocity and holding time, problems	13	14	CO3

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5	**Design for single reactions :** 5.1 Size comparison of single reactors 5.2 Multiple reactor system- Plug Flow Reactors in series in parallel, Equal size Mixed Reactors in series, Mixed flow reactors of different sizes in series, Reactors of different types in series, problems	12	12	CO4
6	**Catalysis :** 6.1 Nature of Catalytic reactions, classification of catalytic reactions, catalyst preparation and general behavior, catalyst deactivation and regeneration. 6.2 Introduction to packed and Fluidized bed reactors.	07	10	CO5
	TOTAL	64	70	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum eight no of experiments and minimum two assignment.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1.	Saponification of Ethyl Acetate-Second order rate determination.	04	CO2
2	Hydrolysis of Methyl Acetate-First order rate determination.	04	CO2
3	Hydrolysis of Methyl acetate at higher temperature.	04	CO2, CO1
4	Determination of order of reaction – Part –I. Order with respect to H_2O_2 in a reaction between H_2O_2 and HI.	04	CO2
5	Determination of order of reaction – Part – II i) Order with respect to HI in a reaction between H_2O_2 and HI. ii) Overall order	04	CO2
6	Second order reaction in CSTR	02	CO3
7	Second order reaction in CSTR with unequal flow rate	02	CO3
8	Second order reaction in PFR	02	CO3
9	Second order reaction in PFR with unequal flow rate	02	CO3
10	Second order reaction in PFR-CSTR combination.	02	CO4
11	Study on selection of catalyst for given chemical process	02	CO5

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Minimum 8 no of practical/assignments/drawings etc
3. Slides
4. Self-Learning Online Resources

9. LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Chemical Reaction Engg	Octave Levenspiel	Wiley Eastern Ltd; New Delhi
2	Chemical Engg Kinetics	J.M.Smith	McGraw Hill International, Newyork

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3	Element of chemical Reaction Engg	H. Scott Fogler	Pearson New Delhi
4	Element of chemical Reaction Engg	Srivastav R P S	Khanna Publishers, New Delhi

10. WEB REFERENCES :

1. www.nptel.ac.in
2. www.che.utah.edu
3. www.chemguide.co.uk>physical>basicrates>orders
4. www.chemguide.co.uk/physical/catalysis/introduction.html
5. https://www.britannica.com/science>catalyst

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Thermodynamics	04	04	00	08
2	Kinetics of Homogeneous Reactions	02	02	06	10
3	Interpretation of Batch Reactor Data	00	08	08	16
4	Introduction to Reactor Design	00	07	07	14
5	Design for single reactions	00	06	06	12
6	Catalysis	02	02	06	10
	Total	08	29	33	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	R.D.Shimpi	
2	Internal	M.M.Belwalkar	
3	Internal	Jyoti Sangle	
4	External	Dr. Manish Tiwari Organisation: Mukesh Patel School Of Technology Management & Engineering	

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1. COURSE DETAILS

Programme: Chemical Engineering **Course: Principles of Stoichiometry** **Course Code: POS190609**	**Semester: IV** **Group: C*** **Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D +T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
4	-	-	1	5	3	70	20	10	70	50	-	-	150

3. COURSE OBJECTIVE

The objective of this course is to enable students, to apply stoichiometric principles, material balance and energy balance, to industrial problems, to analyze a particular problem in whole or in part and also in evaluating the requirement of raw materials for various processes.

4. SKILL COMPETENCY

Aim of this course is to help the students to attain following industry identified competency through various teaching learning experiences:

Apply unit operation and unit process in chemical industries.

5. COURSE OUTCOMES(COs)

At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Use system of units in chemical process industries	Remember
CO2	Use the gas law in various chemical engineering process.	Remember
CO3	Estimate the basic calculation of material balance across various unit operation	Understand
CO4	Calculate the amount of raw material and product for chemical process	Apply
CO5	Apply the law of conservation of energy in chemical engineering applications.	Apply

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Dimensions and Units:** 1.1 Dimension and system of units. 1.2 Fundamental quantities and derived quantities. 1.3 Use of force, Volume, Pressure, work, energy, heat and power. 1.4 Units conversion, SI,MKS,CGS and FPS	04	04	CO1
2	**Chemical and physical principles:** 2.1 Atomic Weight, Molecular Weight, Mole 2.2 Mole% , Weight % , ppm 2.3 Solute, Solvent and solution 2.4 Normality, Molarity and molality	04	04	CO1
3	**Laws of gases and Gas mixtures:** 3.1 Ideal gas law, Dalton's law, Amagat law, Boyle's law and Charles law, Van der waal equation. 3.2 Density, Sp. Gravity, Average molecular Weight, Partial Pressure, Pure component volume of gaseous Mixture. 3.3 Raoult's law and Henry's law	08	10	CO2
4	**Material balance without chemical reaction:** 4.1 Law of conservation of mass. 4.2 Steady state and unsteady state 4.3 Material balance equations for unit operations: definition, block diagram, numerical based on unit operations evaporation, filtration, blending, distillation, extraction, absorption, crystallization, drying.	16	18	CO3
5	**Material balance with chemical reaction:** 5.1 Chemical reaction terms: stoichiometric equation, stoichiometric coefficient, stoichiometric ratio. 5.2 Material balance with chemical reaction: Calculation of % Conversion, %yield, % excess reactant, composition of Product and reactant.	16	18	CO4
6	**Energy balance :** 6.1 Law of conservation of energy 6.2 Heat: Latent heat and sensible heat, heat capacity 6.3 Use of specific heat and mean specific heat data for calculation of heat required 6.4 Heat of combustion, heat of formation and Hess's Law of constant heat of Summation, standard heat of reaction. 6.5 Adiabatic reaction temperature	16	16	CO5
	TOTAL	**64**	**70**	

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7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of tutorial book (200 page Notebook) separate to practice the numerical on given following topics:

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Solve numerical based on conversion of units of physical quantity among SI, MKS, CGS and FPS system	02	CO1
2	Solve numerical using Ideal gas law, Dalton's Law, Amagat's Law. Raoult's Law	02	CO2
3	Solve numerical on calculation of average molecular weight, average density and composition of gas in mole% and weight%	02	CO1
4	Solve numerical on material balance at steady state with unit operations like evaporation, filtration, blending, distillation, extraction, absorption, crystallization, drying.	04	CO3
5	Solve numerical on material balance involving at steady state with chemical reactions to calculate stoichiometric ratio, limiting reactants, excess reactants, % excess reactant, composition of product & reactant.	04	CO4
6	Solve numerical on heat capacities calculation for pure component and mixture, heat of formation using given data, standard heat of reaction using heat of formation and heat of combustion data.	02	CO5

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Tutorials
3. Self-Learning Online Resources

9. LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Stoichiometry	Bhatt B.I. & Vora S.M	McGraw Hill Education, New Delhi,2004
2	Basic Principles and Calculations in chemical engineering	Himmelblau David M. & Riggs	Prentice Hall of India Pvt. Ltd, New York, 2004
3	Chemical Process Principles	Hougen & Watson	Wiley Eastern Ltd, New Delhi, 2004
4	Stoichiometry & Process Calculations	K.V.Narayanan & B. Lakshmikutty	PHI learning Pvt. Ltd, New Delhi 2012

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10. WEB REFERENCES

1. www.unitoperation.com
2. www.dplot.com /-Dplot
3. Video lectures from NPTEL website
4. Massive open online courses (MOOCs)

11.SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Dimensions and Units	04	-	-	04
2	Chemical and physical principles	-	04	-	04
3	Laws of gases and Gas mixtures	03	03	04	10
4	Material balance without chemical reaction	04	04	10	18
5	Material balance with chemical reaction	04	04	10	18
6	Energy balance	04	04	08	16
	Total	19	19	32	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	R.D.Shimpi	
2	Internal	Jyoti Sangle	
3	Internal	M.M.Belwalkar	
4	External	Prof.Vishal Shah	
		Organisation: D.J.Sanghvi College of Engineering	

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1. COURSEDETAILS

Programme: Chemical Engineering **Course: Process Equipment Drawing** **Course Code: PED 190610**	**Semester: IV** **Group: C*** **Duration:16 Weeks**

2. TEACHINGAND EXAMINATIONSCHEME

Scheme of Instructions and Periods per					Examination Scheme and Maximum Marks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
2	-	4	-	6	-	-	-	-	-	50	50		100

3. COURSE OBJECTIVE

The objective of this course is to enable students to visualize views of assembled parts and get acquainted with function selection and operation of different chemical equipment.

4. SKILL COMPETENCY

The aim of this course is to help students to attend the following industry identified competency through various teaching learning experiences

Apply the principles of Process Equipment Drawing in Chemical Process Industry

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Interpret the welding drawing as per I.S.Code (I.S.813-1986)	Understand
CO2	Preparing drawing for interpenetration of surfaces of solids.	Apply
CO3	Develop assembly drawing of various types of valves, pipe joints, reaction vessel, and pressure vessel.	Apply
CO4	Select the support for different type of vessels	Remember
CO5	Select the type of valves	Remember

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	COs
1	Intersection of surfaces 1.1. Intersections of surfaces of the solids with axis perpendicular or parallel to reference planes. 1.2. Intersection of two prisms 1.3. Intersection of two cylinders 1.4. Intersection of prism and cylinder 1.5. Intersection of pyramid and prism 1.6. Intersection of cone and cylinder	5	CO2
2	Pipe joints 2.1. Threaded, welded and flanged pipe fittings 2.2. I.S. standard, pipe supports & piping layout	2	CO3
3	Detail of reaction vessel 3.1. Types of agitators 3.2. Jackets and different types of coils (batch reactors) 3.3. Types of batch reactors	2	CO3
4	Valves 4.1. Different types of valve and their selection such as globe valve, gate valve, ball valve, needle valve, non-return valve, diaphragm type valve, Safety valve, automatic control valve, steam traps.	2	CO5
5	Details and Assembly of 5.1. Valves- Gate valve, globe valve, Ball valve, Relief valve, non-return valve. 5.2. Oil fuel burner.	5	CO3
6	Welding Joints 6.1. Symbols I.S.Code (I.S.813-1986) 6.2. Its use and method of showing its use on actual Drawing.	2	CO1
7	Heat Exchangers and Evaporators 7.1. Different types of heat exchangers Double pipe, 1-1 shell & tube, plate type heat exchangers 7.2. Different types of evaporators: horizontal tube, calendria, long tube evaporators.	4	CO3
8	Pressure Vessel 8.1. Different types of heads , nozzles 8.2. Types of supports for horizontal vessel, short and tall vessels.	5	CO4
9	Details and assembly of 9.1. Pressure vessel 9.2. Reaction vessel 9.3. Stuffing box 9.4. Pipe joint- expansion joint	5	CO3
	TOTAL	32	

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7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no. of 10 drawings.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	A drawing sheet on four problems of Intersection of surfaces of solids.	08	CO2
2	A drawing sheet on four problems of Intersection of surfaces of solids	08	CO2
3	One sheet half imperial size on pipe joints	04	CO3
4	One sheet half imperial size on types of agitators, jackets, coils and different types of batch reactors.	04	CO3
5	One sheet half imperial size showing assembly and details of any valve mentioned above.	08	CO5
6	One sheet half imperial based on assembly and details of any valves.	08	CO5
7	One half imperial sheet on sectional representation & symbols of welding	04	CO1
8	One sheet half imperial size on heat exchangers and evaporators.	08	CO3
9	One sheet half imperial size on pressure vessel.	08	CO4
10	One sheet details of any of the following equipment: Pressure vessel, Reaction vessel, Stuffing box, Pipe joint- expansion joint.	04	CO3
11	One sheet half imperial based on assembly and details of any valves.	04	CO3

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Drawing sheets
2. Demonstrations
3. Slides

9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Machine Drawing	N.D. Bhatt	Charotar Publishing House Anand
2	Process Equipment Design	M.V. Joshi	Macmillan India Ltd.New Delhi
3	Engineering Drawing	N.D. Bhatt	Charotar Publishing House Anand

10. WEB REFERENCES

1. http://www-mdp.eng.cam.ac.uk/web/library/enginfo/drawings/index.html
2. http://www.lntvalves.com/media/37280/lt-gate-globe-check-valves-api-600.pdf
3. https://www.academia.edu/5733625/Chemical_Engineering_Drawing_Symbols

11. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	FACULTY	NAME	SIGNATURE
1	Internal	Mr. Nilesh R. Nagose	
2	Internal	Mr. Milind M. Belwalker	
3	Internal	Mrs. Jyoti S. Sangle	Sangle
4	External	Dr. Manish Tiwari	Tiwari
		Organisation MPSTME	

1. COURSE DETAILS

Programme: Chemical Engineering	**Semester: IV**
Course: #Plant Utilities	**Group: A***
Course Code: PUT190611	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D +T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	2	-	-	5	3	70	20	10	70	50	50	-	200

3. COURSE OBJECTIVE :

The objective of this course is to enable students to understand the principle involved during water treatment, generation of steam and its uses, refrigeration cycles, to learn the different equipment used to run the process plant with different utilities, to acquire the knowledge for selection of different utilities, to understand basic calculation involved in steam generation, psychometric operation and refrigeration.

4. SKILL COMPETENCY:

Aim of this course is to help the students to attain following industry identified competency through various teaching learning experiences:

Use different utilities in chemical process plants for various application.

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Understand the requisites of boiler feed water.	Understand
CO2	Use steam generators & non steam heating systems in chemical process plants.	Remember
CO3	Understand basic principles involved in refrigeration cycles and its application.	Understand, Apply
CO4	Use Humidification and dehumidification processes for air in chemical industries	Apply
CO5	Select the fuel for combustion process in chemical process industries.	Understand,Apply

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Industrial water :** 1.1 Hard and soft water, Units of hardness. 1.2 Permanent hardness, temporary hardness. Numericals. 1.3 Scale and sludge, corrosion, priming and foaming, Caustic Embrittlement 1.4 Methods of water treatment :Lime soda, Zeolite and Ion exchange process. 1.5 Ultra filtration, Reverse osmosis and membrane separation 1.6 Block flow diagram of Industrial water.	09	14	CO1
2	**Steam and steam generator :** 2.1 Properties of steam 2.2 Problems based on enthalpy calculation for wet steam, dry saturated steam, superheated steam 2.3 Types of steam generator / boilers 2.4 Problems based on performance of boilers for equivalent evaporation, actual evaporation, thermal efficiency of boilers. 2.5 Preparing boiler for inspection 2.6 Boiler mountings and accessories: Safety valve, Steam trap, Air pre heater, Super heater, Economizer Non steam heating system: 2.7 Thermic fluid and its properties 2.8 Types of thermic fluid and temperature ranges	15	21	CO1 & CO2
3	**Refrigeration :** 3.1 Refrigeration :Unit of refrigeration, coefficient of performance 3.2 Reversed Carnot cycle on P-V and T-S diagram 3.3 Air refrigeration cycle: Bell Coleman air refrigeration cycle 3.4 Vapour compression and vapour absorption cycle. 3.5 Refrigerants: Classification, Selection criteria and applications.	09	14	CO3
4	**Psychrometry :** 4.1 Different terminologies used in humidification operation such as wet bulb temperature, humidity, %RH, %Saturation, humid heat, humid volume. 4.2 Use of humidity chart wet bulb temperature, humidity, %R H, %Saturation, humid heat, humid volume. 4.3 Problems based on calculation of humidity, %RH, %Saturation, humid heat, humid volume knowing vapour pressure at dew point temperature & dry bulb temperature. 4.4 Equipment used for humidification, dehumidification 4.5 Cooling towers : Natural Draft, Forced Draft	07	10	CO4

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5	**Industrial fuel :** 5.1 Salient features of common solid , liquid and gaseous fuels. 5.2 Classification, common properties and uses. 5.3 Calorific value NCV and GCV. 5.4 Combustion process: Complete and incomplete combustion Composition of flue gases and air requirement	06	08	CO5
6	**Air :** 6.1 Compressed air, process air and instrument air	02	03	CO5
	TOTAL	48	70	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum ten no of experiments.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	To determine the Total solids content in water	04	CO1
2	To determine the alkalinity of water	04	CO1
3	To determine the hardness of water by E.D.T.A.	04	CO1
4	To determine the permanent hardness of water	04	CO1
5	Determination of humidity and use of humidity chart	04	CO4
6	Study of Ion exchanger	02	CO1
7	Study of different types of boilers	02	CO2
8	Study of mechanism and working of steam traps	02	CO2
9	Study of natural draught and induced draught cooling towers	02	CO4
10	Study of mountings and accessories	02	CO2
11	Performance of refrigeration cycle	02	CO3
12	Proximate analysis or Ultimate analysis of Fuel	02	CO5

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum no of practical/assignments/drawings etc.
3. Industry visit
4. Guest/Expert lectures

9. LEARNING RESOURCES

Sr.No.	Title of Book	Author	Publication
1	Thermal Engineering	P. L. Balleney	Khanna Publisher New Delhi 1987
2	Industrial water treatment	S.T. Powel	McGraw Hill, New York 2009
3	Boiler operations	P. Chattopadhay	Tata McGraw Hill, New Delhi 1995
4	Elements of Heat Engines Vol – II,III	R.C. Patel C.J. Karmchandani	Acharya Book Depot. Vadodara 1986

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5	Engineering Chemistry	Jain and Jain	Dhanpatria Publications New Delhi 2008
6	A Text Book of Refrigeration & Air Conditioning	R.K.Rajput	S.K.Kataria and Sons, New Delhi,2003

10 WEB REFERENCES

1. www.aqascience.net
2. www.boiler.guide
3. www.idc-online.com/technical references/pdfs
4. Video lectures from NPTEL website
5. Massive open online courses (MOOCs)
6. https://www.sciencedirect.com/topics/earth-and-planetary-sciences/water-treatment-plant

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Industrial water	04	06	04	14
2	Steam and steam generator	04	07	10	21
3	Refrigeration	04	04	06	14
4	Psychrometry	00	04	06	10
5	Industrial fuel	00	04	04	08
6	Air	-	03	-	03
	Total	12	28	30	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS:

Sr. No.		NAME	SIGNATURE
1	Internal	R.D.Shimpi	
2	Internal	M.M.Belwalkar	
3	Internal	Jyoti Sangle	
4	External	Shri.R.O.Narkhede Organisation: Datta Meghe College Of Engineering	

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1. COURSE DETAILS

Programme: CH/EE/IE/DE	**Semester: IV/VI/VI/VI**
Course: Industrial Management	**Group: M***
Course Code:IMG190014	**Duration:16 Weeks**

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks								
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+ D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	----	----	----	03	03	70	20	10	70	-----	-----	-----	100

3. COURSE OBJECTIVE

Engineering professional is responsible for a wide variety of tasks, requiring strong technical knowledge and managerial skills . This course provides broad knowledge about different managerial skills, managerial skills are essential for enhancing their employability and career growth. This course is therefore designed to provide the basic concepts in management principles, safety aspects and Industrial Acts.

4. SKILL COMPETENCY:

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use relevant managerial skills for ensuring efficient and effective management.**

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	Course Outcome	Bloom's level
CO 1	Understand the importance of Indian industry.	I – Remembering II - Understanding
CO 2	Use principles of planning and organizing for accomplishment of tasks.	I – Remembering II - Understanding
CO 3	Use principles of directing and controlling for implementing the plans.	II - Understanding III - Apply
CO 4	Apply principles of safety management in all activities.	I – Apply
CO 5	Understand financial management	I - Remembering II - Understanding

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6. COURSE CONTENTS

Sr. No.	Topic/Sub-topic	Hours	Marks	COs
1	**Introduction to Indian Industry** 1.1 Meaning - Definition 1.2 Classification of Industry 1.3 Infrastructure and Location of Industry 1.4 Importance of Industry 1.5 Types of required in industries.	06	10	CO1
2	**Types of Ownership of Industry** 2.1 Proprietorship 2.2 Partnership 2.3 Private Ltd Company 2.4 Public Ltd Company 2.5 Co-operative Enterprises 2.6 Public Sector Enterprises	10	14	CO1
3	**Supervisor & Supervision** 3.1 Meaning and definition 3.2 Role and Responsibilities of supervisor 3.3 Qualities of Supervisor 3.4 Skills of Supervisor 3.5 Functions of Supervisor	06	10	CO2 CO3
4	**Management** 4.1Introduction to management 4.2Meaning, definition and importance. 4.3Relevance of management to engineers. 4.4Principles of management. 4.5Resorces of management 4.6 Recruitment, selecting and placement of man-power	10	14	CO2 CO3 CO4
5	**Industrial Relations** 5.1 Meaning and Importance. 5.2 Types of Industrial Relations. 5.3 Industrial disputes – Causes. 5.4 Methods and machinery for resolving industrial disputes. 5.5 Trade union – Its role in maintaining industrial peace. 5.6 Industrial safety 5.7 Industrial Acts	10	14	CO4
6	**Finance** 6.1 Sources of finance. 6.2 Working capital and fixed capital. 6.3 Financial statements of a company. 6.4 Financial ratios. 6.5 Budgets and budgetary control.	06	08	CO5
	Total	**48**	**70**	

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7. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. PPT

8. LEARNING RESOURCES

Sr. No.	Title of book	Author	Publication
1.	Industrial Organisation and Management	T.R Banga S.C Sharma	Khanna Publication
2.	Industrial Management	O.P Khanna	Dhanpat Rai and Sons
3.	Industrial organization and engineering economics	T.R Banga S.C Sharma	Khanna Publication

9. WEB REFERENCES

a. http://nptel.ac.in /course (NPTEL)

10. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	Topic	Distribution of theory marks			
		R level	U level	A level	TOTAL Marks
1	Introduction to Indian Industry	02	04	04	10
2	Types of Ownership of Industry	02	06	06	14
3	Supervisor & Supervision	02	02	06	10
4	Management	02	06	06	14
5	Industrial Relations	04	06	04	14
6	Finance	---	04	04	08
TOTAL		12	28	30	70

11. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		Name	Signature
1	Internal	Shri A.S Shukla	
2	Internal	Shri G.J.Badwe	
3	Internal	Shri Pratik Sawant	
4	External	Shri Mangesh Mohan Organization:-Father Agnel Polytechnic, Bandra	

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC
MUMBAI 400 056.

1. COURSE DETAILS

Program: Chemical Engineering	Semester: IV
Course: #Plant Safety and Loss Prevention	Group:M*
Code:PSL190612	Duration:16 Weeks

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks							
Theory Hrs. L	Practical Hrs. P	Drawing Hrs. D	Tutorial Hrs. T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	2	-	-	5	3	70	20	10	70	50	-	50	200

3. COURSE OBJECTIVE

The objective of this course is to enable students to create safety awareness and identify various hazards in chemical plant and its prevention.

4. SKILL COMPETENCY:

Aim of this course is to help the students to attain following industry identified competency through various teaching learning experiences:

Apply safety and Loss prevention measures in chemical plant.

5. COURSE OUTCOMES (COs)

At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO 1	Understand basic principles, theories of plant safety and loss prevention.	Remember
CO 2	Prepare guidelines for safety precautions to be followed for various safety practices.	Understand, Apply
CO 3	Identify class of fire and select proper extinguisher to extinguish fire.	Understand, Apply
CO 4	Take precautions during storage, transportation and maintenance work	Remember, Understand
CO 5	Analyze hazards and hazard assessment techniques.	Remember, understand, Apply
CO 6	Understand various promotional aspects of safety	Remember, Understand

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6. COURSE CONTENTS

Chapter	Contents	Hours	Marks	CO
1.	**DEVELOPMENT OF PLANT SAFETY & LOSS PREVENTION** 1.1 Importance and objectives of safety 1.2 Introduction, principle of total loss control and risk management 1.3 Accidents – definition, Hazard, Causes of accident, Theori of accident, Heinrich theory, Frank Bird theory, Domino's theory, Multiple causation theory 1.4 Role of management in safety.	08	12	CO1
2.	**PERSONEL PROTECTIVE EQUIPMENTS & SAFETY PRACTICES** **PERSONEL PROTECTIVE EQUIPMENTS** 2.1 Respiratory equipment 2.2 Non-respiratory equipment **SAFETY PRACTICES** 2.3 Handling of Tools, Static Electricity, welding, Machine guards, Noise.	08	12	CO2
3.	**FIRE PREVENTION** 3.1 Classes of fire, Stages of fire 3.2 Causes of fire, Fire Detection Instruments 3.3 Fixed and portable fire extinguishers, Preventive measures	08	12	CO3
4.	**STORAGE , TRANSPOTATION and WORK PERMITS** 4.1 Different methods of storage, Governing factors of storage, Characteristics of chemicals for storage 4.2 Definition of hazardous chemicals, U.N. Classification, Class labels, MSDS, Emergency information panel, tremcar instruction in writing booklet , Colour codes 4.3 Safety precaution in transportation of different types of chemicals 4.4 WORK PERMITS Importance, Vessel entry , hot work , line work, electrical, engineering contract, excavation	08	12	CO4

Chapter	Contents	Hours	Marks	CO
5.	**INDUSTRIAL HAZARD & HAZARD ANALYSIS** 5.1 Hazard associated with heat transfer and mass transfer 5.2 Hazard associate with momentum transfer and material handling 5.3 Hazard and Operability study(HAZOP) 5.4 Accident Consequence Analysis, Event Tree Analysis, Fault tree Analysis, Failure Modes Effects and Criticality analysis(FMECA)	08	10	CO5
6.	**PROMOTIONAL ASPECTS OF SAFETY** 6.1 On site emergency plan 6.2 Introduction to factory act 1948 6.3 Safety Health and environmental standards 6.4 Case studies of accidents	08	12	CO6
	Total	**48**	**70**	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum eight no of experiments and minimum two assignments.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx.Hrs required	COs
1	Study of non-respiratory personal protective equipment's	02	CO2
2	Study of respiratory personal protective equipments	04	CO2
3	Demonstration and study of fire extinguishers	04	CO3
4	Study of multigas detectors or dragger tube	02	CO5
5	Study and Experiment based on Sound level meter	02	CO3
6	Visit to safety museum of Central Labor Institute, sion.	08	CO6
7	Classification of hazardous chemicals	02	CO4
8	Study and Demonstration of Gas monitor	02	CO6
9	Study and demonstration of Explosimeter	02	CO4
10	Mock fire drill using fire extinguisher	04	CO3
	Total	32	

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8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan
2. Minimum eight no of practicals and minimum two assignments.
3. Industry visit
4. Guest/Expert lectures
5. Demonstrations/Simulations
6. Self-Learning Online Resources

9 LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Losprevention in process industries (Vol.I & II)	Frank P. Lees	Butter worth Heinemann
2	Safe handling of hazardous chemicals	A.K. Rohatge	Bombay, J.K. Enterprises
3	Safety & accident prevention in chemical operation	H.H. Faucet & W.S. Wood	Inter-science Publishers of John Wiley & Sons New Yark
4	Industrial safety handbook	William & Handley	McGraw Hill,London

10. WEB REFERENCES

1. https://nptel.ac.in/courses/103/106/103106071/
2. https://labour.gov.in/
3. http://www.dgfasli.nic.in/
4. http://www.nsc.org.in/
5. www.myodesie.com

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Development Of Plant Safety & Loss Prevention	6	6	-	12
2	Personnel Protective Equipments & Safety Practices	3	3	6	12
3	Fire Prevention	4	4	4	12
4	Storage, Transportation And Work Permits	4	4	4	12
5	Industrial Hazard & Hazard Analysis	2	4	4	10
6	Promotional Aspects Of Safety	4	6	2	12
		23	27	20	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)
NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS:

SR.NO		NAME	SIGNATURE
1.	Internal	M. M. Belwalkar	
2.	Internal	R.D. Shimpi	
3.	internal	N.R.Nagose	
4.	External	Manish Tiwari	
		Organization: MPSTME	

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC MUMBAI 400 056

1. COURSEDETAILS

Programme: CH Course: #Pollution Control and Waste Disposal Course Code: **PCW 190613**	Semester: IV Group: M* Duration:16 Weeks

2. TEACHINGAND EXAMINATIONSCHEME

Scheme of Instructions and Periods per Week					ExaminationSchemeandMaximumMarks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
03	02	--	--	05	03	100	20	10	70	50	--	50	200

3. COURSE OBJECTIVE

Pollution Control and waste disposal is the application of environmental science, environmental monitoring and electronic devices used for monitoring and analysis of environmental pollutants. Environmental technology is used to control air pollution, water pollution. Content to this course include working of different equipments for controlling air pollution, waste water treatment methods and solid waste management.

4. SKILL COMPETENCY

The aim of this course is to help the students to attained the following industry identified competency through various teaching learning experiences

- **Use of proper equipment to collect and control the pollution.**
- **Identify the pollutants emitted from various industries which affects environment.**

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Identify the environmental issue based on air and water pollution	Understand, Remember
CO2	Know the impact health, vegetation, animals and materials by air as well as water pollutants	Remember
CO3	Select the methods of sampling for analysis of pollutants.	Understand, Remember, Apply
CO4	Use the various equipment used for control the pollution	Understand, Remember, Apply
CO5	Identify the various disposal method for solid waste	Understand, Remember, Apply

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	**Air Pollution**: 1.1 Natural and manmade sources 1.1.1 Classification of sources 1.1.2Natural Sources 1.1.3 Manmade sources- Industrial and Automobile 1.2 Greenhouse gases 1.2.1 working 1.2.2 Global warming 1.2.3 Cause and effect 1.3 Ozone 1.3.1 working 1.3.2 Ozone layer depletion with case study 1.3.3cause and effect • Sampling Techniques 1.4 Particulate Sampling 1.4.1 Dust fall jar 1.4.2 high volume sampler 1.4.3 Electrostatic precipitator 1.4.4 Thermal Precipitator Effects of air pollution 1.5Effect on health 1.5.1basic concept 1.5..2 Effect of air and particulate pollutants 1.5.3Case study (Recent) 1.6 Effect on vegetation and animals 1.6.1Basic concept 1.6.2Case Study (Recent) 1.7 Effect on materials and structure 1.7.1 Basic concept 1.7.2 Case Study (Recent)	14	20	CO1 CO2
2	**Sample Collection Equipment for particulate matter** 2.1 Gravity Settling Chamber 2.2 Cyclone Separator 2.3 Fabric Filter 2.4 Wet Scrubber 2.5 Electrostatic precipitator • Collection Equipments for gaseous pollutants 2.6 Absorption 2.7 Adsorption 2.8 Condensation 2.9 Incineration	10	15	CO4

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3	• **Water Pollution** 3.1 Sources 3.2 Types of Pollutants • Sampling techniques 3.3 Grab Sampling 3.4 Composite Sampling • Analytical Methods 3. 5 DO – Definition 3.6 BOD-Definition and Calculation 3.7 COD- Definition and Calculation 3.8 TOC-Definition • Treatment Methods 3.9 Physical Treatment-sedimentation and Froth Floatation 3.10 Secondary Method – Activated Sludge Method, Trickling Filter 3.11 Tertiary Method – Membrane Separation technology, Application of RO in Waste water treatment. • Zero liquid discharge configuration (ZLD)	14	20	CO2, CO3
4	• **Solid Waste Management** 4.1 types of Solid Waste and segregation. 4.2 Solid waste treatment methods 4.3 Solid waste handling process 4.3.1 open dumping 4.3.2 Sanitary Land filling 4.3.3 Composting 4.3.4 Incineration	10	15	CO5
	TOTAL	48	70	

7. LIST OF PRACTICALS/ASSIGNMENTS/EXERCISES/TUTORIALS/DRAWINGS

Term Work consists of Journal containing minimum no of -10 experiments/exercises/tutorials/drawings with approx.no of hours required and corresponding CO attained specified here.

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	Approx. Hrs required	COs
1.	Collection of particulate matter from atmosphere by High Volume Sampler	02	CO2
2.	Determination of particulate matter from atmosphere	02	CO3
3.	Determination of Dissolved Oxygen (DO) from given sample 1(Effluent)	02	CO3
4	Determination of Dissolved Oxygen (DO) from given sample - 2(Sewage)	02	CO3
5.	Determination of Dissolved Oxygen (COD) from given sample-1	02	CO3
6	Determination of Dissolved Oxygen (COD) from given sample-2	02	CO3
7	Determination of Dissolved Oxygen (BOD) from given sample-1	02	CO3

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8	Determination of Dissolved Oxygen (BOD) from given sample-2	02	CO3
9	To estimate chloride content of the given sample.	02	CO3
10	To measure the amount of suspended particles in the liquid by the Nephelo turbidity meter.(Sample 1)	02	CO3
11	To measure the amount of suspended particles in the liquid by the Nephelo turbidity meter.(Sample 2)	02	CO3
12	Determination of concentration of sodium ion in the given sample by flame photometer.	02	CO3
13	Industrial Visit (Air Pollution)	04	All
14	Industrial visit (Water Pollution)	04	All
	Total	32	

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Minimum no of practical/assignments/drawings etc.
3. Industry visit
4. Guest/Expert lecture
5. Presentation
6. Case Study

9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Environmental Pollution Control	C.S.Rao	New age International publication
2	Waste Water Treatment	M.N. Rao	Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
3	Pollution Control in Process Industry	S.P. Mahajan	Tata McGraw Hill, New Delhi

10. WEB REFERENCES

https://www.mpcb.gov.in/water-quality/standards-protocols/water-quality-standards
https://www.nrdc.org/stories/air-pollution-everything-you-need-know
https://www.who.int/water_sanitation_health/resourcesquality/watpolcontrol.pdf

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11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Air Pollution	4	6	10	20
2	Collection Equipments	4	4	7	15
3	Water Pollution	4	6	10	20
4	Solid Waste Management	4	6	7	15
	Total				70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.		NAME	SIGNATURE
1	Internal	Ms Jyoti Sangle	
2	Internal	Shri R.D.Shimpi	
3	Internal	Shri Nilesh Nagose	
4	External	Dr. Manish Tiwari	
		Organisation: MPSTME	

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC ★ MUMBAI 400 056.

1. COURSEDETAILS

Programme:Chemical Engineering	Semester:IV
Course: Chemical Engineering Thermodynamics	Group: C
Course Code: CET190614	Duration:16 Weeks

2. TEACHINGAND EXAMINATIONSCHEME

Scheme of Instructions and Periods per					ExaminationSchemeandMaximumMarks							
Theory Hrs L	Practical Hrs P	Drawing Hrs D	Tutorial Hrs T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	-	-	-	3	03	70	20	10	70	25	-	-	125

3. COURSE OBJECTIVE

3.1. To study basic concepts of thermodynamics.
3.2. To know laws of thermodynamics and their applications.
3.3. To study applications of thermodynamics.
3.4. Knowledge of chemical equilibrium phase equilibria and partial molar properties.

4. SKILL COMPETENCY

The aim of this course is to help students to attend the following industry identified competency through various teaching learning experiences:

Apply the principles of chemical engineering thermodynamics in Chemical Process Industry.

5. COURSE OUTCOMES(COs) At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Explain concept of equilibrium in chemical Thermodynamic Process	Remember
CO2	Apply First law of thermodynamics in chemical process industry	Apply
CO3	Analyze basic thermodynamic quantity	Understand
CO4	Use second law of thermodynamics in process industry	Apply
CO5	Use concept of chemical equilibrium in chemical process	Apply

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6. COURSE CONTENTS

Sr. No.	TOPIC/Sub-topic	Hours	Marks	COs
1	Introduction to Thermodynamics 1.1. Scope and limitations of thermodynamics, basic concepts, system, surrounding, boundary, process, thermodynamics properties, open system, closed system and isolated system, homogeneousand heterogeneous system. 1.2. Extensive properties, intensive properties 1.3. Thermodynamics process, isothermal process, adiabatic process, isochoric process, isobaric process, cyclic process, reversible and Irreversible process 1.4. Types of equilibrium:Thermal, chemical, mechanical. 1.5. Thermodynamic functions:State function and path function.Macroscopic versus Microscopic view	03	03	CO3

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2	First law of thermodynamics 2.1. First law of thermodynamics: law of conservation of energy, mathematical statement, concepts of different forms of energy such as Heat, Work, changing the internal Energy of an object or of system, Changing the potential Energy of an object. 2.2. Various form of First law-Isolated system, closed or Batch System, Open or flow System. 2.3. Work and heat is a path function, sign convention used for work and heat, different form of work – Push pull work, pV work, Electrical Work, Surface tension work, Elastic Work, Other form of work. 2.4. Potential Energy – Constant Gravity, changing gravity, within a spherical body of constant density 2.5. Kinetic Energy – Linear motion at not very high velocity, Rotation motion at very high velocity, at a very high velocity approaching speed of light. 2.6. enthalpy, heat capacity, specific heat, heat capacity at constant volume, heat capacity at constant pressure,Temperature dependence of heat capacity, relation between C_P and C_V, Numerical for calculating enthalpy. 2.7. Equation of state and concepts of ideal gas, process involving ideal gases, constant volume process, constant pressure process, constant temperature process, adiabatic process (Determining$\Delta U, Q, W$ for above process), numerical. 2.8. zeroth law of thermodynamics: statement	06	10	**CO2**
3.	Internal Energy (U) and Enthalpy (H) 3.1. Internal Energy, Enthalpy, First law Equation for Batch system, significance of ΔU and ΔH, Standard states for U and H. 3.2. ΔU and ΔH for temperature change, ΔU and ΔH for phase change. 3.3. Reaction at constant Volume system, Reaction at constant pressure system, Reaction network at standard condition, Reactions at other than standard conditions, ΔU due to mass change.	07	12	**CO2**

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4.	Ideal Gas and First law 4.1. The Joule Experiment, Constant Volume process, Constant pressure process, Constant Temperature process, Adiabatic process, Compression and expansion process in practice,	06	10	**CO2**
5	Engineering Fluids 5.1. Mixture of Ideal Gas, Pure material going from solid to liquid to gas (P-T diagram, P-V diagram), Two important Engineering fluid (water and HFC-134a) Mixture of phase and thermo tables, High pressure and non-ideal behavior. 5.2. Numerical problem on steady state and unsteady state system.	08	08	**CO1**
6	Second Law of Thermodynamics 6.1. Statement of second law of thermodynamics, Measuring ΔS, Heat flow for reversible and irreversible reaction. 6.2. Entropy change – Constant Volume process, Constant Pressure Process, Constant Temperature process, Going from $P_1V_1T_1$ to $P_2V_2T_2$, Reversible Work, Adiabatic Reversible Process, 6.3. Entropy of Pure substance, Gibb's Phase Rule, Simple application of Entropy,	07	09	**CO4**
7	Work from Heat 7.1. Carnot Heat engine, The Kelvin Temperature Scale, The Ideal or Reversible Heat Pump, The T-S diagram for the Carnot cycle, Non-Ideal Heat Engine.	05	08	**CO4**
8	Chemical equilibrium in a mixture of ideal gases and real gases 8.1 The equilibrium constants Mathematical derivations of Kp and Kc of a chemical reaction Relationship between Kp, Kc, and Ka. 8.2 Effect of Temperature Pressure and concentration on the equilibrium constant, Le chatelier`s principle 8.3 Determination of equilibrium constant 8.4 Problems on chemical equilibrium	06	10	**CO5**
	TOTAL	**48**	**70**	

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7. LIST OFASSIGNMENTS:

Assignments will be given to students on following topics

Sr. No.	Title of Experiment/Assignment/Exercise/Tutorial/Drawings	COs
1	Explain concept of equilibrium in chemical Thermodynamic Process	CO1
2	Apply First law of thermodynamics in chemical process industry	CO2
3	Analyze basic thermodynamic quantity	CO3
4	Use second law of thermodynamics in process industry	CO4
5	Use concept of chemical equilibrium in chemical process	CO5

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Assignments
3. Slides

9. LEARNING RESOURCES

Sr. No.	Title of Book	Author	Publication
1	Introduction to Chemical Engineering Thermodynamics	J.M. Smith H.C. Vanness	McGraw Hill, New Delhi
2	Engineering Thermodynamics	P.K. Nag	Tata McGraw Hill, New Delhi
3	Chemical Engineering Thermodynamics	Y.V.C. Rao	University Press, Hydrabad
4	Chemical and Engineering Thermodynamics	Stanley. I. Sandler	Wiley publication, New Jersey, 1998, ISBN 13:9780471182108
5	Understanding Engineering Thermo	Octave Levenspiel	OSU publication, ISBN-13:978-0135312032,ISBN-10: 0135312035

10. WEB REFERENCES

1. www.nptel.ac.in
2. www.msubbu.in
3. http://ocw.mit.edu
4. http://freevideolectures.com

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11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Introduction to Thermodynamics	03			**03**
2	First law of thermodynamics		**04**	**06**	**10**
3	Internal Energy (U) and Enthalpy (H)		**06**	**06**	**12**
4	Ideal Gas and First law		**04**	**06**	**10**
5	Engineering Fluids			**08**	**08**
6	Second Law of Thermodynamics		**03**	**06**	**09**
7	Work from Heat		**04**	**04**	**08**
8	Chemical equilibrium in a mixture of ideal gases		**04**	**06**	**10**
	TOTAL	03	25	42	**70**

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)
NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS

Sr. No.	FACULTY	NAME	SIGNATURE
1	Internal	Mr. Nilesh R. Nagose	
2	Internal	Mr. Milind M. Belwalkar	
3	Internal	Mrs. Jyoti S. Sangle	
4	External	Prof. Vishal Shah	
		Organisation DJSCE	

SHRI BHAGUBHAI MAFATLAL POLYTECHNIC ★ MUMBAI 400 056

1. COURSE DETAILS

Programme: **Chemical Engineering**	Semester:IV
Course: **Introduction to Energy Systems**	Group:C
Course Code: IES 190615	Duration:16 Weeks

2. TEACHING AND EXAMINATION SCHEME

Scheme of Instructions and Periods per Week					Examination Scheme and Maximum Marks							
Theory Hrs. L	Practical Hrs. P	Drawing Hrs. D	Tutorial Hrs. T	Credits (L+P+D+T)	Theory Paper Duration and marks(ESE)		SSL	TA	TH	TW	PR	OR	TOTAL
					Hours	Marks							
3	-	-	-	3	03	70	20	10	70	25	-	-	125

3. COURSE OBJECTIVE

The objective of this course is to enable students to understand basic nonconventional energy resources and judiciously select application equipment from energy efficiency perspective.

4. SKILL COMPETENCY

Aim of this course is to help the students to attain following industry identified competency through various teaching learning experiences:

Use of renewable energy technologies as applicable in chemical industry.

5. COURSE OUTCOMES(COs)

At the end of the semester student will be able to: -

CO No.	COURSE OUTCOME	Bloom's LEVEL
CO1	Interpret importance of renewable energy	Remember
CO2	Select the basics of solar thermal photovoltaic technology and its applications	Understand, Apply
CO3	Use wind power technology wherever feasible	Understand, Apply
CO4	Use biomass and biodiesel wherever feasible	Remember, understand
CO5	Compare ocean, geothermal and nuclear energy.	Remember, Apply

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6. COURSE CONTENTS

Sr. no	TOPIC Sub topic	Hours	Marks	COs
1.	**Energy Scenario** 1.1 Resources and Reserves 1.2 Indian Energy Scenario 1.3 Energy Security, Energy Conservation and it's …..importance. 1.4Energy conservation Act, 2001.	06	10	CO1
2.	**Solar Radiation** 2.1 Types Of Solar radiation (a) Direct or Beam (b) Diffuse (c) Global 2.2 Solar Radiation Geometry 2.3 Empirical Equation for predicting the availability of solar radiation 2.4 Instruments for Measuring solar radiation	07	10	CO2
3.	**Devices For Thermal Collection** 3.1 Flat-plat collector 3.2 Cylindrical parabolic concentrating collector 3.3 Parabolic concentrating collector 3.4 Solar Thermal Technologies Application - water heating - space heating - power generation - refrigeration - distillation – -cooling -water pump	07	10	CO2
4.	**Biomass and biodiesel** 4.1 Sources , energy content, 4.2 conversion process of biomass to biogas, biogas plant, 4.3 Biodiesel manufacturing process.	07	10	CO4

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5.	**Ocean energy: -** 5.1 Ocean thermal energy 5.2 Conversion, energy from tides, waves **Geothermal energy: -** 5.3 Geothermal energy sources& systems 5.4 Application of geothermal energy	07	10	CO5
6.	**Wind energy** 6.1Wind flow-motion of wind of wind power, conversion (COP) 6.2Types of wind turbines a. Lift force machine b. Drag force machine c. horizontal and vertical axis machine d. Constant speed or variable speed machine 6.3Components of wind turbines	07	10	CO3
7.	**Nuclear energy & Energy Audit** 7.1 Concept of nuclear energy ,nuclear reactor 7.2 Types of Energy audit. 7.3 Understanding Energy Costs saving techniques .	07	10	CO5
	Total	**48**	**70**	

7. LIST OF ASSIGNMENT:

Students will submit research study report based on solar energy/ wind energy/ biomass/ bio fuel /energy audit etc carrying 25 marks.

8. IMPLEMENTATION STRATEGY (PLANNING)

1. Teaching Plan/Tutorials
2. Minimum no of assignments.
3. Guest/Expert lectures

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9. LEARNING RESOURCES

Sr. No	Title of Book	Author	Publication
1	Renewable Energy Technologies	Chetan Singh Solanki	PHI, New Delhi
2	Solar Photovoltaic	Chetan Singh Solanki	PHI, New Delhi
3	Non-conventional Energy Sources	G.D.Rai	Khanna Publication

10. WEB REFERENCES

1. www.bp.com/centres/enrgy.
2. www.epa.org
3. www.calculator.org/properties.html
4. www.eeca.govt.nz
5. www.energyusernews.com/
6. www.bce-india.nic.in

11. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Sr. No.	TOPIC	Distribution of Theory Marks			
		R Level	U Level	A Level	Total Marks
1	Energy scenario	4	6	-	10
2	Solar radiation	2	2	6	10
3	Devices for thermal collection	2	2	6	10
4	Biomass and biodiesel	2	4	4	10
5	Ocean and geothermal energy	4	6		10
6	Wind energy	2	2	6	10
7	Nuclear energy and energy audit	2	4	4	10
8	Total	18	26	26	70

R Remember, U Understand, A Apply and above, (Bloom's revised taxonomy levels)

NOTE: This specification table provides general guidelines to assist students for their learning and to teachers to teach and assess students with respect to attainment of COs. The actual distribution of marks at different taxonomy levels (R, U, A) in the question paper may vary from above table.

12. COURSE EXPERT COMMITTEE MEMBERS:

SR.NO		NAME	SIGNATURE
1.	Internal	M. M. Belwalkar	
2.	Internal	R.D. Shimpi	
3.	internal	J. S. Sangle	
4.	External	Dr. Manish Tiwari	
		Organization: MPSTME