Three-Year Undergraduate Program

Diploma Petro-Chemical Engineering

Faculty of Engineering & Technology

Parul University Vadodara, Gujarat, India

Faculty of Engineering & Technology

Diploma in Petro-Chemical Engineering

1. Vision of the Department

To be an eminent Petro-chemical Engineering Department enhancing excellence in academics and research in Petro-chemical and allied sectors for developing sustainable resources as well as imparting solutions for industries and society.

2. Mission of the Department

M1 To provide students with current scientific and technological information to become competent in this field without compromising moral values and professional ethics.

M2 To develop an effective platform to disseminate research culture among students as well as teachers.

M3 To establish a connection with the industry and society at large for promoting creativity, innovations and an entrepreneurial culture thereby addressing their needs efficaciously.

3. Program Educational Objectives

Diploma in Chemical Engineering typically reflect the broad goals that the program aims to achieve in preparing its graduates.

PEO 1	Excel in the application of technical skills and hands-on techniques acquired through rigorous training, effectively operating and troubleshooting chemical engineering equipment and systems.
PEO 2	Uphold high ethical standards and demonstrate professionalism in all aspects of their work, contributing responsibly to their field and ensuring compliance with industry regulations and safety practices.
PEO 3	Proficient in conveying technical information clearly and effectively, collaborating with peers and stakeholders to achieve successful outcomes in both team-based and independent projects.

4. Program Learning Outcomes

Program Learning outcomes are statements conveying the intent of a program of study.

PLO 1	**Engineering knowledge:**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering Specialization to the solution of complex engineering problems.
PLO 2	**Problem analysis:**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using the first principles of mathematics, natural sciences, and engineering sciences.
PLO 3	**Design/ development of solutions:**	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for

		Public health and safety, and cultural, societal, and environmental considerations.
PLO 4	**Conduct investigations of complex problems:**	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information To provide valid conclusions.
PLO 5	**Modern tool usage:**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex Engineering activities with an understanding of the limitations.
PLO 6	**The engineer and society:**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the Professional engineering practice.
PLO 7	**Environment and sustainability:**	Interpret the impact of professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable Development.
PLO 8	**Ethics:**	Apply ethical principles and commit to professional Ethics and responsibilities and norms of the engineering practice.
PLO 9	**Individual and team work:**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PLO 10	**Communication:**	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear Instructions.
PLO 11	**Project management and finance:**	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a Team, to manage projects and in multidisciplinary environments.
PLO 12	**Life-long learning:**	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

5. Program Specific Learning Outcomes

PSO 1	**Petro-Chemical Engineering Principles**	Demonstrate a deep understanding of advanced chemical engineering concepts, including specialized areas such as chemical reaction engineering, process control, and industrial catalysis. They will adeptly apply these principles to tackle complex problems and devise innovative solutions.

PSO 2	**Process Design and Optimization**	Designing and optimizing intricate chemical processes. They will utilize advanced simulation and modeling tools to enhance process performance, efficiency, and safety, addressing challenges with advanced analytical techniques.
PSO 3	**Sustainability and Environmental Stewardship**	In-depth knowledge of sustainability practices and environmental management. They will design and implement processes that reduce environmental impact, improve resource efficiency, and adhere to stringent regulatory requirements.

6. Credit Framework

Semester wise Credit distribution of the Program	
Semester-1	17
Semester-2	18
Semester-3	20
Semester-4	24
Semester-5	24
Semester-6	24
Total Credits:	**127**

Category wise Credit distribution of the Program	
Category	**Credit**
Major Core	68
Minor Stream	18
Multidisciplinary	20
Ability Enhancement Course	2
Skill Enhancement Courses	2
Value added Courses	6
Summer Internship	2
Research Project/Dissertation	9
Total Credits:	**127**

7. Program Curriculum

Semester 1						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
1	3602107	Applied Chemistry	3	3	0	0
2	3602108	Applied Chemistry Lab	1	0	2	0
3	3602110	Physical Analytical and Inorganic Chemistry Lab	1	0	2	0
4	3602111	Physical Analytical and Inorganic Chemistry	3	3	0	0
5	3605101	Environmental Science	Audit Course	2	0	0
6	3606102	Introduction to IT Systems Lab	2	0	4	0
7	3609101	Engineering Graphics	1	1	0	0
8	3609102	Engineering Graphics Lab	2	0	4	0
9	3691101	Mathematics - I	3	2	0	1
10	3693103	Communication Skills - I	1	1	0	0
Total			**17**	**12**	**12**	**1**
Semester 2						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
11	3602152	Organic Chemistry lab	1	0	2	0

12	3602153	Introduction to Chemical Engineering	2	2	0	0
13	3602155	Organic Chemistry	4	4	0	0
14	3609154	Engineering Workshop Practice	2	0	4	0
15	3691151	Mathematics-II	4	3	0	1
16	3692103	Applied Physics	3	3	0	0
17	3692104	Applied Physics Lab	1	0	2	0
18	3693153	Communication Skills - II	1	1	0	0
Total			**18**	**13**	**8**	**1**
Semester 3						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
19	3600201	Entrepreneurship and Start-ups	1	1	0	0
20	3602208	Mechanical Operations Lab	1	0	2	0
21	3602210	Fluid Flow Operation Lab	1	0	2	0
22	3602215	Chemical Engineering Materials	3	3	0	0
23	3602217	Chemical Technology -I	3	3	0	0
24	3602219	Fluid Flow Operation	3	3	0	0
25	3602221	Mechanical Operations	3	3	0	0
26	3602223	Chemical Process Calculation	4	3	0	1
27	3693203	Professional Communication and Critical Thinking	1	1	0	0
Total			**20**	**17**	**4**	**1**
Semester 4						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
28	3600251	Essence of Indian Knowledge and Tradition	0	2	0	0
29	3602264	Process Heat Transfer Lab	1	0	2	0
30	3602266	Mass Transfer - I Lab	1	0	2	0
31	3602267	Pollution Control and Effluent treatment	3	3	0	0
32	3602268	Pollution Control and Effluent treatment Lab	1	0	2	0
33	03628251	Basics of Petroleum and Petrochemical	3	3	0	0
34	03628232	Minor Project	1	0	2	0
35	3602272	Chemical Technology -II lab	1	0	2	0
36	3602273	Chemical Technology -II	4	4	0	0
37	3602277	Mass Transfer - I	4	3	0	1

38	3602279	Process Heat Transfer	4	3	0	1
39	3693251	Employability Skills	1	1	0	0
Total			**24**	**19**	**10**	**2**

Semester 5

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
40	3602308	Mass Transfer - II Lab	1	0	2	0
41	3602310	Petroleum Refining and Petrochemical Technology Lab	1	0	2	0
42	03628310	Summer Internship	2	0	0	0
43	03628308	Major Project - I	4	0	8	0
44	03628307	Plant Design and Economics	4	3	0	1
45	3602323	Mass Transfer - I	3	3	0	0
46	03628309	Health Environment and Safety	3	3	0	0
47	3602327	Petroleum Refining and Petrochemical Technology	3	3	0	0
48		Program Elective - I (Compulsory Subjects :1)	3	3	0	0
Total			**24**	**15**	**14**	**1**

PEC 01

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
49	3602331	Polymer Science and Compounding	3	3	0	0
50	3602333	Polymer Technology	3	3	0	0

Semester 6

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut
51	3600351	Indian Constitution	0	2	0	0
52	03628352	Utilities and Instrumentation Lab	1	0	0	1
53	03628353	Utilities and Instrumentation	3	3	0	0
54	03628354	Major Project -II	4	0	8	0
55	3602364	Chemical Reaction Engineering Lab	1	0	2	0
56	3602369	Chemical Reaction Engineering	5	4	0	1
57	03628355	Chemical Engineering Thermodynamics	4	3	0	1
58		Open Elective-I (Compulsory Subjects :1)	3	3	0	0
59		Program Elective - II (Compulsory Subjects :1)	3	3	0	0
Total			**24**	**18**	**10**	**3**

PEC 02

Sr. No.	Subject Code	Subject Name	Credit	Lect	Lab	Tut

60	3602387	Pharmaceutical Technology	3	3	0	0
61	3602389	Rubber Processing Technology and tire Manufacturing	3	3	0	0
62	3602391	Modern Separation Techniques	3	3	0	0
Open Elective 01						
Sr. No.	**Subject Code**	**Subject Name**	**Credit**	**Lect**	**Lab**	**Tut**
63	3600381	Industrial Management	3	3	0	0
64	3600383	Project Management	3	3	0	0
65	3607343	Energy Conservation and Audit	3	3	0	0
Total			**127**			

Detailed Syllabus
Semester 1

(1)

a) Course Name: Applied Chemistry

b) Course Code: 0362107

c) Prerequisite: Understanding of Basic knowledge of science for the application.

d) Rationale: The study of basic concepts of chemistry like chemical bonding, corrosion, water treatment, Organic chemistry and different engineering materials like polymers, adhesives, paints, lubricants, etc. will help the students understanding engineering subjects.

e) Course Learning Objective:

CLOBJ 1	Evaluate the chemical properties and performance of various fuels, including fossil fuels and alternative energy sources. Understand the environmental and economic implications of fuel use.
CLOBJ 2	Relate the chemical principles behind adhesive formulations and their applications. Analyze factors affecting adhesive strength and durability.
CLOBJ 3	Demonstrate a comprehensive understanding of electrochemical concepts, including redox reactions, electrochemical cells, and applications in energy storage and conversion technologies.
CLOBJ 4	Explain the types and nature of chemical bonds (ionic, covalent, metallic) and their effects on the physical and chemical properties of materials. Apply this knowledge to predict molecular behavior and interactions.

f) Course Learning Outcomes:

CLO 1	Summarize the concept of Existence of material in nature.
CLO 2	Plan with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.

f. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	0	0	3	20	20		60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

g. Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit – I Chemical Bonding and Catalysis** Rutherford model of atom, Bohr's theory, Heisenberg uncertainty principle, Quantum numbers – orbital concept. 2. Shapes of sap and d orbitals, Pauli's exclusion principle, Hund's rule of maximum multiplicity Aufbau rule, electronic configuration, Theory Of Valency , Electronic Configuration , Types of chemical bonds - Electrovalent bond, & its characteristics ,Covalent bond & its characteristics ,Co-ordinate bond , Hydrogen bond, its types and Significance , Metallic bond, Explanation of Metallic properties, Electron Sea Model , Intermolecular force of attraction ,Vander Waals force of attraction ,Catalysis, Types of catalysis , Theory of Catalysis , Characteristics of Catalyst , Types of Catalyst , Positive Catalyst ,Negative Catalyst , Auto-catalyst Catalytic Promoter and Catalytic inhibitor Industrial Application of Catalyst.	10%	6
2	**Unit– II Concepts of Electrochemistry** Introduction, Arrhenius theory of ionization., Degree of ionization, Factors affecting the degree of ionization, Definition of pH, pH of acid, base and neutral solution, pH calculations of acid, base and salt solution at different concentration, Importance of pH in various fields, Definition of buffer solution, Buffer Action & Types of buffer Solution, Application of buffer solutions, Electrolytes and Non-electrolytes, Types of electrolytes Definition the term ` Electrode ' the Types of Electrodes Inert electrode, Working electrode & Reference electrode; with suitable Illustrations. Construction & working of reference electrode, Hydrogen electrode, Calomel electrode, Quinhydrone electrode, Glass electrode, Ag/ Agcl/ Kcl electrode • Kohlrausch Law of independent, Migration of ions, Construction and working of electrochemical cell, Standard conditions, Standard hydrogen electrodes, Nernst theory of single electrode potential & Nernst equation, Electrochemical series, galvanic series, Electrolysis, Faradays laws of electrolysis, Industrial application of Electrolysis,	20%	8

3	**Unit– III Corrosion of metals & its prevention** Definition of corrosion, Types of corrosion, Dry corrosion: Oxidation corrosion mechanism corrosion-mechanism, Nature of oxide film, Wet corrosion-mechanism, Concentration cell corrosion, Pitting corrosion, Waterline corrosion, Crevice corrosion, Stress Corrosion, Erosion Corrosion, Factors affecting the rate of corrosion, - Nature of film, Nature of Environment of Solution, Area of cathode anode and, Temperature, Moisture, Purity of metal, Methods of prevention of corrosion, Modification of environment, Modification of the properties of metal, Use of protective coatings., Anodic and cathodic protection, Modification in design and choice of material	**10%**	**5**
4	**Unit– IV Water Treatment** Graphical presentation of water distribution on Earth (pie or bar diagram). Hard water and soft water. Types of hardness of water, Salts producing hardness of water, Method to express the hardness of water, Estimation of total hardness by EDTA Method, Examples to calculate the hardness, Effect of hard water in Boiler operation I. Scale and sludge formation and its Prevention, Priming and foaming and its prevention, Caustic embrittlement and its prevention. Corrosion and its prevention, Softening of Water, Soda-Lime process, Permuted process, Ion Exchange process, Reverse Osmosis process, Treatment of Drinking water, Sedimentation, Coagulation, Filtration, Sterilization of water by chlorination Break-point chlorination-Graph., enlist Indian standard specification of drinking water	**20%**	**8**
5	**Jnit– V Lubricants** ntroduction and definition of lubricants and lubrication, function of lubricants, Types of lubrication, Fluid film lubrication, Boundary lubrication, Classification of lubricants, Solid lubricants, Semi-solid lubricants, Liquid lubricants, Synthetic oils, Physical Properties of lubricants and their significance like. Viscosity and viscosity index, Flash point and fire point, Pour point and cloud point, oiliness Chemical Properties of lubricants like I. Saponification value ii. Neutralization number iii. Emulsification number, Selection of lubricants for, Gears, Cutting tools, Steam turbine.	**10%**	**5**
6	**Unit– VI Polymer, Elastomers & Adhesives** Introduction and Definition of Polymer and Monomer, Classification of Polymer on basis of Molecular structure as Linear, Branch and Cross-linked polymers, Classification on basis of monomers (photopolymer and copolymer) Classification of Polymers on basis of Thermal behavior	**20%**	**7**

	(Thermoplastics& Thermosetting), Types polymerization Reaction, Addition Polymerization, Condensation Polymerization, Synthesis, properties and application of I. Polyethylene, Polypropylene iii. Polyvinyl chloride iv. Teflon v. Polystyrene vi. Phenol formaldehyde vii. Acrylonitrile viii. Epoxy Resin, Define the term: - elastomer Natural rubber and its properties 5. Vulcanization of rubber 6. Synthetic rubber, Synthesis, properties and uses, Buna-S Rubber ii. Buna-N Rubber, Neoprene Rubber, Definition of adhesives and Examples, Characteristics of adhesives Classification of adhesives and their uses.		
7	**Unit-VII Chemistry of Fuel.** Definition of fuel and combustion of fuel, classification of fuels, calorific values (HCV and LCV), Bomb Calorimeter, calculation of HCV and LCV using Delong's formula, Proximate analysis of coal, solid fuel petrol and diesel - fuel rating (octane and Cetane numbers), Chemical composition, calorific values and, applications of LPG, CNG, water gas, coal gas, producer gas and biogas.	**10%**	**6**
	Total	**100%**	**45**

h. Text Book and Reference Book:

1. A Text Book of Polytechnic Chemistry by V.P. Mehta | Jain Brothers
2. A Text Book of Applied Chemistry by J. Raja ram
3. ENGINEERING CHEMISTRY By B. SIVSANKAR | TATA MACGRAWHILL
4. Engineering Chemistry by Shashi Chawla | Dhanpati Rai and Co.

2)

a) Course Name: Applied Chemistry Lab

b) Course Code: 03602108

c) Prerequisite: Understanding of Basic knowledge of science for the application.

g) Rationale: Science is the foundation for all technician courses. The basic aim of teaching science is to develop in the students the habit of scientific inquiry, ability to establish the cause and effect, relationship. Chemistry forms the part of applied science. The study of basic concepts of chemistry like chemical bonding, corrosion, water treatment, Organic chemistry and different engineering materials like polymers, adhesives, paints, lubricants, etc. will help the students understanding engineering subjects where the emphasis is laid on the application of these concepts Chemistry is concerned with the changes in structure and properties of matter. Many of the process which are involved to bring out this change forms the basis of engineering activities. Teaching of chemistry should be aimed at developing the right type of aptitude in the students and the ability to predict the result under given condition thus good foundation in basic science will help the students in their self-development.

d) Course Learning Objective:

CLOBJ 1	Demonstrate a comprehensive understanding of electrochemical concepts, including redox reactions, electrochemical cells, and applications in energy storage and conversion technologies.
CLOBJ 2	Rephrase the impact of corrosion on materials and structures, and evaluate strategies for mitigation.
CLOBJ 3	Analyze the chemical processes involved in water treatment, including purification, disinfection, and waste water management. Understand the role of chemistry in ensuring safe and clean water supplies
CLOBJ 4	Describe the synthesis, properties, and applications of various polymers. Understand the relationship between polymer structure and performance, including aspects of polymerization techniques and material characteristics.
CLOBJ 5	Assess the chemical composition and performance of different lubricants. Understand their role in reducing friction and wear in mechanical systems, and analyze their environmental and economic impacts.

f. Course Learning Outcomes:

CLO 1	Compare the concept of Existence of material in nature.
CLO 2	Match with the various Mechanism of natural phenomenon.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Develop skills to do experiments.
CLO 5	Apply analytical techniques to solve the engineering problem and performance analysis of material.

g. Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	

-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Experiment List:

Exp. No.	**Name of the Experiment**
1	Determine the strength of given acidic solution using standard solution of base.
2	Standardize KMnO4 solution by preparing standard oxalic acid and to estimate ferrous ions.
3	Standardize Na2S2O3 solution by preparing standard potassium dichromate and to estimate percentage of copper from brass.
4	Determine the viscosity of given lubricating oil by using Red-wood Viscometer.
5	Determine PH-Values of given samples of Solution by using Universal Indicator and PH-meter.
6	To Determine molecular weight of a polymer using Ostwald viscometer.
7	Preparation of (any one) polystyrene, urea formaldehyde, phenol formaldehyde and its Characterization.
8	To Determine Acid Value of given lubricating Oil.
9	Determine of the percentage of moisture in a given sample of coal by proximate analysis.
10	To Determine of saponification value of a lubricating oil.
11	Study of corrosion of metals in medium of different ph.
12	To Determine the COD of given water sample.
13	Determine Flash & Fire point of given lubricating oil.
14	Study of Corrosion of Metals in the different Mediums.

f. Text Book and Reference Book:

1. A Text Book of Polytechnic Chemistry by V.P. Mehta | Jain Brothers
2. A Text Book of Applied Chemistry by J. Raja ram
3. ENGINEERING CHEMISTRY By B. SIVSANKAR | TATA MACGRAWHILL
4. Engineering Chemistry by Shashi Chawla | Dhanpati Rai and Co.

3)

a) **Course Name:** Physical Analytical and Inorganic Chemistry

b) **Course Code:** 03602109

c) **Prerequisite:** For a course in Physical, Analytical, and Inorganic Chemistry, the primary prerequisite is General Chemistry. This foundational course provides essential knowledge of chemical principles, including atomic structure, chemical bonding, and reaction mechanisms.

d) **Rationale:** Analytical Chemistry focuses on techniques for identifying and quantifying chemical substances, which is essential for practical applications in research and industry.

e) **Course Learning Objective:**

CLOBJ 1	Demonstrate and apply principles of thermodynamics, kinetics, and quantum mechanics to chemical systems.
CLOBJ 2	Develop analytical techniques for qualitative and quantitative chemical analysis.
CLOBJ 3	Invent the structure, bonding, and reactivity of inorganic compounds, including coordination complexes.
CLOBJ 4	Utilize spectroscopic and electrochemical methods to study and interpret chemical phenomena.

f) **Course Learning Outcomes:**

CLO 1	**Physical Chemistry**: Apply thermodynamic and kinetic principles to understand chemical systems and reactions.
CLO2	**Analytical Chemistry**: Utilize quantitative and qualitative techniques for the identification and analysis of chemical substances.
CLO 3	**Inorganic Chemistry**: Understand the structure, bonding, and reactivity of inorganic compounds and coordination complexes.
CLO 4	**Lab Skills**: Develop practical laboratory skills to conduct experiments, analyze data, and interpret results in various branches of chemistry.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Topics**	**Weightage (%)**	**Teaching**
1	CHEMICAL KINETICS: 1. Define the terms: I. Rate of reaction ii. Specific reaction rate iii. Velocity constant 2. Molecularity and order of reaction 3. Definition the terms: I. First order reaction ii. Half concentration period 4. Derivation equation for first order reaction.	**10%**	**5**

	5. Derivation of equation for second order reaction. Half-life period for first & second order reaction. Problems related chemical kinetics		
2	CHEMICAL THERMODYNAMICS: 1. System and surroundings, Types of System and suitable illus trations 2. Thermodynamic property- extensive and intensive 3. First law of thermodynamics. 4. Function, Internal energy, Enthalpy 5. Rule of assigning sign to work done (W) and heat transferred (Q) as positive and negative. 6. Molar heat capacity- at constant volume (Cv) and at Constan t pressure (Cp). The relationship Cp - Cv = R 1. Adiabatic chan ge, Isothermal change, Reversible process, Irreversible process 2. Derivation equation for Adiabatic Expansion of an Ideal gas. PVr =Constant 1. Second law of thermodynamics 2. Aspects of thermo- chemistry & Phenomenon of heat of reaction. Types of heat of reactions – Exothermic and endothermic processes with examples State Hess's law of constant heat Summation	**15%**	**7**
3	BASIC CONCEPTS OF CHEMICAL ANALYSIS: Basic Concepts: Common ion Effect, Solubility Product, Ionic product, Salt hydrolysis, State conditions for precipitation Considering I and KS Application of H2S and NH4CL in inorganic qualitative analysis Volumetric analysis I. Acid-base titration ii. Complex metric titration iii. Oxidation-reduction titration iv. Precipitation titration 2. Chromatography I. Classification of chromatography	**15%**	**7**
4	SURFACE CHEMISTRY: - Adsorption- Adsorbate, Adsorbent- Classification of adsorption: Physical ad sorption and Chemisorption- Types of solution: True solution, S uspension and colloidal solution- Classification of colloidal solu tion -Lyophobic and Lyophilic sol. 1. Methods of preparing colloidal Solutions. I. Condensation methods ii. Dispersion methods 2. Purification of colloidal solutions I. Dialysis ii. Ultra filtration 3. Important properties of colloidal solution and explain the fol lowing in details I. Scattering of light (Tyndall effect) 1. Brownian movement 2. Electrophoresis 3. Electro osmosis 4. Emulsion & Gels. I. Types of emulsion ii. Cleansing action of soap 5. Application of colloids Smoke precipitation, Purification of water, Sewage treatment, Leather tanning etc.	**15%**	**7**
5	Radioactivity and Nuclear Chemistry Radioactivity -Radioactivity	**10%**	**5**

	Definition, Natural & Artificial radioactivity, Units and Laws of Radioactivity, Half Life, Average Life & Decay Constant. Radioactive Rays Properties and uses of alpha particles, beta particles and gamma rays, Nuclear Fission and Nuclear Fusion, Application of Nuclear Chemistry Introduction to the Nuclear radiation detectors (Numerical on Above topics)		
6	PREPARATION OF STANDARD SOLUTION: Different methods of expressing concentration. 1. Weight/Weight method (W/W) 2. Weight/Volume method (W/V) I. Types of W/W Methods- Molality (M), -Mole fraction (X), -Parts per million (PPM) 1. Different types of W/Methods. I. gems/liter ii. Normality (N) iii. Molarity (M) iv) Formality (F) v) P.P.M. / mg/liter 3 and Problems on them. Types of different s tandards i) Primary standards II) Secondary standards 1. Conditions for primary standard Procedure for preparing primary standard Solution	**10%**	**5**
7	Phase rule Phase rule, phase, component, degrees of freedom, One compone nt system and two component system, Phase diagram of Water with explanation	**10%**	**4**
8	Physical Properties Physical properties of liquid 1.2 Types of physical properties and Characteristics of each property. 1.3 Definition of the Surface tension, Preacher, Refractive index, Molar refraction, Specific refraction, Viscosity. 1.4 Surface tension and viscosity 1.5 Drop pipette method (Stalagmometer) to determine the Surface tension. 1.6 Ostwald's viscometer to determine viscosity of liquids. 1.7 Refractometer to determine refractive Index of liquid.	**10%**	**4**
	Total	**100**	**45**

i) Text Book and Reference Book:

Physical Chemistry: *Physical Chemistry* by Peter Atkins – A comprehensive guide to the principles and applications of physical chemistry.
Analytical Chemistry: *Quantitative Chemical Analysis* by Daniel C. Harris – A detailed reference for understanding and performing chemical analyses.
Inorganic Chemistry: *Inorganic Chemistry* by J.D. Lee – An essential textbook for inorganic chemistry covering theoretical and descriptive topics.
Advanced Inorganic Chemistry: *Advanced Inorganic Chemistry* by F. Albert Cotton and Geoffrey Wilkinson – A detailed reference for advanced concepts in inorganic chemistry.

4)

a) **Course Name:** Physical Analytical and Inorganic Chemistry- lab

b) **Course Code:** 03602110

c) **Prerequisite:** Understanding of general chemistry concepts, such as atomic structure, bonding, and thermodynamics. Basic laboratory skills, including proficiency in handling equipment.

d) **Rationale:** The rationale for combining Physical, Analytical, and Inorganic Chemistry in a lab setting is to provide students with a comprehensive understanding of key chemical principles through hands-on experimentation.

e) **Course Learning Objective:**

CLOBJ 1	Master essential lab techniques for synthesis, titration, and analysis of chemical compounds.
CLOBJ 2	Apply physical and inorganic chemistry principles to design and conduct experiments.
CLOBJ 3	Develop analytical and problem-solving skills for accurate chemical analysis.
CLOBJ 4	Strengthen data analysis, interpretation, and professional lab reporting skills

f) **Course Learning Outcomes:**

CLO 1	Demonstrate how to follow standard operating procedures (SOPs) when using specific laboratory instruments to ensure consistent and reproducible results.
CLO2	Apply theoretical concepts to practical experiments.
CLO 3	Develop problem-solving and critical thinking skills.
CLO 4	Communicate experimental results clearly and effectively.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**3**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**
1	Acid-Base titration- Strong acid Vs Strong base using Phenolphthalein as an indicator. Prepare of standard solution.
2	Acid-Base titration- Strong acid Vs weak base using methyl orange as an indicator.
3	Determine viscosity by Oswald's Viscometer
4	Determine of surface tension by Stalagmometer.
5	Determine Refractive Index Using Abbes Refractometer

6	Determine the first order reaction.
7	Determine the second order reaction.
8	Titrate Hall NaOH by conduct meter and explain nature of graph.
9	Redox titration
10	Chromatography
11	Determine the amount of Hall in the given solution by using NaOH solution by pH metrically
12	Titrate Nalco AgNO3 Potentiometric ally and explain the nature of graph
13	Titrate Hall NaOH by conduct meter and explain nature of graph

5)

a) **Course Name:** Environmental Science

b) **Course Code:** 03605101

c) **Prerequisite:** Understanding of subjects like biology, chemistry, physics, and earth science.

d) **Rationale:** The course is designed to give developers a general awareness of these and related issues so that every student will start acting as a responsible citizen to make the country and the world a better place to live in.

e) Course Learning Objective:

CLOBJ 1	Develop a strong foundation in ecological principles, including ecosystem dynamics, biodiversity, energy flow, and biogeochemical cycles.
CLOBJ 2	Construct and propose sustainable practices in areas such as energy consumption, waste management, water conservation, and resource use.
CLOBJ 3	Gain practical experience in fieldwork, including sample collection, environmental monitoring, and laboratory techniques for analyzing environmental data.
CLOBJ 4	Organize the science behind climate change, including greenhouse gas emissions, global warming, and the role of natural and human-induced factors in changing the Earth's climate.

f) Course Learning Outcomes:

CLO 1	Classify the ecosystem and terminology and solve various engineering problems applying
CLO2	Ecosystem knowledge to produce eco – friendly products.
CLO 3	Infer the suitable air, the extent of noise pollution, and control measures and acts.
CLO 4	Utilize the water and soil pollution, and control measures and acts.
CLO 5	Simplify different renewable energy resources and efficient process of harvesting.
CLO 6	Makeup solid Waste Management, ISO 14000 & Environmental Management.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**20**	**20**	**-**	**-**	**-**	**40**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Topics**	**Weightage (%)**	**Teaching Hours**
1	**Ecosystem** Structure of ecosystem, Biotic & Abiotic components, Food chain and food web Carbon, Nitrogen, Sulphur, Phosphorus cycle. Global warming -Causes, effects, process, Green House	**15%**	**4**

	Effect, Ozone depletion.		
2	**Air and Noise Pollution** Definition of pollution and pollutant, Natural and manmade sources of air pollution (Refrigerants, I.C., Boiler). Air Pollutants: Types, Particulate Pollutants: Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator). Gaseous Pollution Control: Absorber, Catalytic Converter, And Effects of air pollution due to Refrigerants, I.C., Boiler, Noise pollution: sources of pollution, measurement of pollution level, Effects of Noise pollution, Noise pollution (Regulation and Control) Rules, 2000.	**22%**	**6**
3	**Water and Soil Pollution** Sources of water pollution, Types of water pollutants, Characteristics of water pollutants Turbidity, pH, total suspended solids, total solids BOD and COD: Definition, calculation. Waste Water Treatment: Primary methods: sedimentation, froth floatation, Secondary methods: Activated sludge treatment, Trickling filter, Bioreactor, Tertiary Method: Membrane separation technology, RO (reverse osmosis), Causes, Effects and Preventive measures of Soil Pollution: Causes-Excessive use of Fertilizers, Pesticides and Insecticides, Irrigation, E-Waste.	**24%**	**8**
4	**Renewable Sources of energy** Solar Energy: Basics of Solar energy. Flat plate collector (Liquid & Air). Theory of flat plate collector. Importance of coating. Advanced collector. Solar pond. Solar water heater, solar dryer. Solar stills. Biomass: Overview of biomass as energy source. Thermal characteristics of biomass as fuel. Anaerobic digestion. Biogas production mechanism. Utilization and storage of biogas. Wind energy: Current status and future prospects of wind energy. Wind energy in India. Environmental benefits and problem of wind energy. New Energy Sources: Need of new sources. Different types new energy sources. Applications of (Hydrogen energy, Ocean energy resources, Tidal energy conversion.) Concept, origin and power plants of geothermal energy.	**24%**	**8**
5	**Solid Waste management** Solid waste generation- Sources and characteristics of: Municipal solid waste, E- waste, biomedical waste. Metallic wastes and Non-Metallic wastes (lubricants, plastics, rubber) from industries. Collection and disposal: MSW (3R, principles, energy recovery, sanitary landfill), Hazardous waste.	**15%**	**4**
	Total	**100%**	**30**

i) Text Book and Reference Book:

1. **Principles of Solar Engineering**
   By Yogi Goswami D., Frank Keith, Jan F. Kreider | Taylor & Francis, 2003 | Second
2. **Environmental Studies**
   By M.P. Paonia, S.C. Sharma | Khanna Publishing House, New Delhi | 2017
3. **Renewable Energy Sources**
   By Twaddell J.W. and Weir. A | EFN Spon Ltd
4. **Environmental Sciences**
   By Daniel B Botkin & Edward A Keller, | John Wiley & Sons
5. **Air Pollution**
   By M. N. Rao and H. V. N. Rao | Tata McGraw-Hill Publishing Company
6. **Environmental Pollution Control Engineering**
   By Rao C.S | 2nd edition
7. **Solid Waste Treatment and Disposal**
   By G. Charangoes | McGraw Hill Pub.

6)

a) **Course Name:** Introduction to IT Systems Lab

b) **Course Code:** 03606102

c) **Prerequisite:** Basic understanding of how to use Windows, Linux, or macOS, including file management, command line usage, and basic system settings.

d) **Rationale:** This course aims to teach students basics of computer including hardware and software.

e) **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to install, configure, and navigate different operating systems (Windows, Linux, etc.), understanding their core functions and interfaces.
CLOBJ 2	Execute tasks such as system booting, user account management, file permissions, and basic troubleshooting using command-line tools and graphical interfaces.
CLOBJ 3	Identify common IT system issues, such as hardware malfunctions, software conflicts, and network outages, and apply appropriate troubleshooting methods to resolve them.
CLOBJ 4	Survey system performance metrics such as CPU usage, memory utilization, and network traffic, and generate reports that document findings and suggest improvements.

f) **Course Learning Outcomes:**

CLO 1	Take part in the ecosystem and terminology and solve various engineering problems applying
CLO2	Mark excels sheet, power point, word, access database etc.
CLO 3	Adapt internet effectively
CLO 4	Function dynamic webpages including style sheet
CLO 5	Comfortably work on computer, install and configure OS, assemble a PC and connect it to external devices, write documents, Create excel sheet, power point, word, access database etc.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**
1.	**Study practical of computer components** Study practical of computer components
2.	**Study practical of different OS installation (Windows, Linux, Ubuntu)** Study practical of different OS installation (Windows, Linux, Ubuntu)

3.	**Write a script for basic OS commands** Write a script for basic OS commands
4.	**Write a script for basic operators in OS** Write a script for basic operators in OS
5.	**Study practical of Internal structure and components of storage devices (Hard disk components)** Study practical of Internal structure and components of storage devices (Hard disk components)
6.	**Study practical of input working devices (Keyboard, Mouse, scanner)** Study practical of input working devices (Keyboard, Mouse, scanner)
7.	**Study practical of output working devices (Monitor, Printer)** Study practical of output working devices (Monitor, Printer)
8.	**Write a HTML code to display "hello world"** Write a HTML code to display "hello world"
9.	**Write a HTML code to create a table for student marksheet.** Write a HTML code to create a table for student marksheet.
10.	**Write a HTML code to create a simple registration form** Write a HTML code to create a simple registration form
11.	**Write a CSS to create user define tag** Write a CSS to create user define tag
12.	**Write an HTML code to create static website using CSS** Write an HTML code to create static website using CSS
13.	**Study practical of evolution and working of internet** Study practical of evolution and working of internet
14.	**Study practical of surfing techniques in internet** Study practical of surfing techniques in internet
15.	**Create your Gmail account and use different services provided by Google like Google drive, sharable sheet etc.** Create your Gmail account and use different services provided by Google like Google drive, sharable sheet etc.
16.	**Perform various DOS commands** Perform various DOS commands
17.	**Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis 1) Fetch the data of the student who has distinction 2) Fetch the data of students with minimum marks in each subject. 3) Sort the data based on percentage** Develop an excel sheet which has record of 50 students result of 5 subjects and make following analysis Fetch the data of the student who has distinction Fetch the data of students with minimum marks in each subject. Sort the data based on percentage
18.	**Create a presentation of your favorite movie using animation** Create a presentation of your favorite movie using animation
19.	**Create a word file for your resume** Create a word file for your resume
20.	**Create library management database in access with minimum 5 tables in it.** Create library management database in access with minimum 5 tables in it.

i) Text Book and Reference Book:

1. **Basic Computer Course Made Simple**
   By Satish Jain | BPB Publication
2. **Basic Computer Engineering**
   By Sanjay SilkAir and Rajesh K Shukla | Wiley India Pvt. Limited, Pub. Year 2011
3. **Computer Fundamentals**
   By P.K. Sinha | BPB Publications
4. **HTML & CSS: The Complete Reference**
   By Thomas A. Powell | McGraw Hill

7)

a) **Course Name:** Engineering Graphics

b) **Course Code:** 03609101

c) **Prerequisite:** Drawing basic knowledge

d) **Rationale:** Engineering drawing is an effective language of engineers. It is the foundation block which strengthens the engineering & technological structure.

e) **Course Learning Objective:**

CLOBJ 1	Develop the ability to read and interpret technical drawings and blueprints, understanding scales, symbols, dimensions, and tolerances.
CLOBJ 2	Gain skills in constructing geometric shapes such as lines, circles, polygons, and curves using precise methods and tools.
CLOBJ 3	Extend isometric projection and create isometric drawings of complex parts and assemblies, ensuring correct proportions and perspectives.
CLOBJ 4	Interpret and create sectional views to show the interior features of objects, learning different types of sections (full, half, offset, etc.).

f) **Course Learning Outcomes:**

CLO 1	It is the foundation block which strengthens the engineering & technological structure. Moreover, it is the transmitting link between ideas and realization.
CLO2	It is an attempt to develop fundamental understanding and application of engineering drawing.
CLO 3	It covers Knowledge & application of drawing instruments & also familiarizes the learner about Bureau of Indian Standards.
CLO 4	The curriculum aims at developing the ability to draw and read various drawings, curves & Projections.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Topics**	**Weightage (%)**	**Teaching Hours**
1	**Drawing equipment's, instruments and materials.** Equipment's- types, specifications, method to use them, applications. Instruments- types, specifications, methods to use them and applications. Pencils- grades, applications, types of points and applications. Other materials- types and applications.	**4%**	**1**
2	**Planning, Layout and Scaling of Drawing** Follow and apply standard	**4%**	**1**

	practice as per bureau of I.S. for planning and layout, Choose appropriate scale factor for the drawing as per given situation		
3	**Lines, Lettering and dimensioning** Different types of lines. Vertical capital and lower-case letters. Inclined capital and lower-case letters. Numerals and Greek alphabets. Dimensioning methods. Aligned method. Unilateral with chain, parallel, progressive and combined dimensioning.	**4%**	**1**
4	**Geometric Construction** Geometric construction related with line like bisecting a line, to draw perpendicular with a given line, divide a line, etc. Geometric construction related with angle like bisect an angle, trisect an angle, etc. To Construct polygon. Triangle, Square / Rectangle, Pentagon with special method. D: Hexagon with special method. To draw tangents. Geometric construction related with circle & arc.	**7%**	**2**
5	**Engineering Curves** Conic sections: Concept and understanding of focus, directory, vertex and eccentricity and drawing of conic sections. Using various methods, understand construction of: Ellipse. Parabola. Hyperbola. Cycloidal Curves (Cycloid, Epicycloid, Hypocycloid) Involutes. Involutes of a circle, Involutes of a polygon, Spiral (Archimedean spiral only).	**22%**	**2**
6	**Projection Of Points, Lines and Planes** Reference planes, orthographic projections. Concept of quadrant.1st angle and 3rd angle projection and their symbols. Projection of points. Projection of lines – determination of true length and inclinations for following cases. Line parallel to one or both the plane. Line perpendicular to one of the planes. Line inclined to one plane and parallel to another. Line inclined to both the planes. **Projection of Planes:** Types of planes, Projection of planes parallel to one of the reference planes, Projection of plane inclined to one reference plane and perpendicular to another, Projection of planes inclined to both reference planes.	**25%**	**2**
7	**Orthographic Projections** Types of projections-orthographic, perspective, isometric and oblique: concept and applications. Various term associated with orthographic projections. Theory of projection, Methods of projection, Orthographic projection, Planes of projection. Conversion of simple pictorial views into Orthographic views. Illustrative problems on orthographic projection B.I.S. code of practice.	**22%**	**3**
8	**Isometric Projections** Isometric axis, lines and planes. Isometric scales. Isometric view and isometric drawing. Difference between isometric projection and isometric drawing. Illustrative problems limited to objects containing lines, circles and arcs shape only.	**12%**	**3**
	Total	**100%**	**15**

i) Text Book and Reference Book:

1. **ENGINEERING GRAPHICS**
   By P. J. Shah | S. Chand & Co., New Delhi Publications.
2. **A Text Book of Engineering Graphics**
   By B.S.Ch. | Shand & Company Ltd., New Delhi
3. **Engineering Drawing**
   By B.S.Ch. | S. Chand, New Delhi

8)

a) **Course Name:** Engineering Graphics Lab

b) **Course Code:** 03609102

c) **Prerequisite:** Knowledge of trigonometric functions to understand projections, angles, and 3D modeling.

d) **Rationale:** Engineering graphics relies heavily on precise geometric shapes and angles. Students must be comfortable calculating angles, distances, and using geometric transformations.

e) **Course Learning Objective**:

CLOBJ 1	Make use of and interpret orthographic projections of 3D objects by representing them in 2D, including front, top, and side views, according to industry standards.
CLOBJ 2	Develop skills in drawing isometric projections of objects, allowing students to visualize and create 3D representations from 2D drawings.
CLOBJ 3	Gain proficiency in industry-standard CAD software (such as AutoCAD, SolidWorks, or similar) to produce accurate 2D drawings and 3D models, enhancing both visualization and technical drawing skills.

f) **Course Learning Outcomes:**

CLO 1	Select and construct appropriate drawing scales, use drawing equipment's, and understand Indian Standards of engineering drawing
CLO2	Draw views of given object and components 3) Sketch orthographic projections into isometric projections and vice versa.
CLO 3	Apply computer aided drafting tools to create 2D engineering drawings

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**
1.	**USE OF DRAWING INSTRUMENTS** Teacher will demonstrate: Use of drawing instruments, Planning and layout as per IS, Scaling technique. Draw following: - Drawing horizontal, vertical, 30-degree, 45 degrees, 60- & 75-degrees lines using Tee and Set squares/ drafter, Types of lines, Types of dimensioning. Alphabets & numerical (Vertical& inclined as Per I.S.).

2.	**GEOMETRIC CONSTRUCTION** Drawing of set of lines with different conditions (Two problems). Drawing Polygons (Three Problems). Drawing circles and arcs with different geometric. Conditions and with line constraints (Three problems).
3.	**ENGINEERING CURVES – I** Construction of ellipse using any two methods from arc of circle method, four center method, rectangular method, eccentricity method and concentric circle method. Construction of parabola with any one method from rectangular method, tangent method and eccentricity method. Construction of hyperbola with any one method from eccentricity method and rectangular method. Construction of spiral.
4.	**ENGINEERING CURVES – II** Construction of cycloid. Construction of hypocycloid & epicycloids. Construction of involute (circle). Construction of involute (polygon).
5.	**PROJECTIONS OF POINTS AND LINE** Draw projection of points-For 10 various conditions (One problem). Draw projection of lines with different conditions (Four problems).
6.	**PROJECTIONS OF PLANE** Draw projection of different planes with different conditions (triangle, square / rectangular, pentagonal / hexagonal, and circular -one for each) (Four problems).
7.	**ORTHOGRAPHIC PROJECTIONS** Draw Orthographic projections of different objects (Two problems) (Draw four views of each object).
8.	**ISOMETRIC DRAWINGS** Draw isometric drawings from given orthographic views (Three problems).

i) Text Book and Reference Book:

1. **Engineering Drawing Practice for Schools and Colleges**
   By Bureau of Indian Standards | Government of India, Pub. Year 1998
2. **Engineering Drawing**
   By N. D. Bhatt | Charter Publishing House, Pub. Year 2010
3. **Engineering Graphics & Design**
   By Jain & Gautam | Khanna Publishing House
4. **Engineering Drawing**
   By D. A. Jolie | Tata McGraw Hill Edu
5. **Engineering Drawing**
   By R. K. Dhawan | S. Chand and Company

9)

a) **Course Name:** Mathematics – I

b) **Course Code:** 03691101

c) **Prerequisite:** Knowledge of basic concept studied till 10th std.

d) **Rationale:** The purpose of teaching mathematics to diploma engineering students is to impart them basic knowledge of mathematics which is needed for full understanding and study of engineering subjects.

e) **Course Learning Objective:**

CLOBJ 1	Develop a strong foundation in essential mathematical concepts, including algebra, calculus, geometry, trigonometry, and statistics, to solve real-world and theoretical problems.
CLOBJ 2	Suppose accurate and efficient computations, both manually and using mathematical software tools, to solve algebraic equations, differential equations, and integrals.
CLOBJ 3	Prove mathematical ideas clearly and effectively in both written and oral forms, using appropriate notation, language, and logical structure to communicate solutions and reasoning.

f) **Course Learning Outcomes:**

CLO 1	Resolve Rational Fraction into sum of Partial Fractions in engineering problems.
CLO2	Omit Trigonometric Ratios and solve problems using the formulae for Multiple and Sub multiple Angles.
CLO 3	Represent Complex numbers in various forms like modulus-amplitude (polar) form, Exponential (Euler) form – illustrate with examples.
CLO 4	Choose the concepts of Limit and Continuity for solving the problems
CLO 5	Appreciate Differentiation and its meaning in engineering situations.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**1**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

W - Weightage (%), T - Teaching hour

Sr.	Topics	Weightage (%)	Teaching Hours
1	**UNIT I LOGARITHM** Definition, Logarithm as a transformation, Antilogarithm, Rules of Logarithms and examples, use logarithmic functions for simplifying arithmetic computations. Partial fractions: Definition of partial fractions. Types of partial fraction (Denominator containing non-repeated linear factors, repeated linear factors and irreducible non- repeated quadratic factors).	17%	4
2	**UNIT II Trigonometry** Concept of angles, measurement of angles in degrees, grades and radians and their conversions, T-Ratios of Allied angles (without proof), Trigonometric identities, Sum, difference formulae and their applications (without proof). Product formulae (Transformation of product to sum, difference and vice versa). T- Ratios of multiple angles, sub-multiple angles (2A, 3A, A/2). Graphs of all trigonometric functions	23%	7
3	**Unit III: Complex Numbers** Definition of a complex number, real and imaginary parts of a complex number, Polar and Cartesian representation of complex number, Conjugate of complex number, Geometric representation of complex numbers and their operations, Modules and Amplitude form, De Moivre's Theorem, Root of Complex Number, Use of De Moivre's Theorem to simplify mathematical expressions	17%	4
4	**Unit IV: Function and Limit** Function and Limit Definition and concept of function, Concept of limits and standard forms of limits (limit of (an - an / x - a) when x tends to a, limit of (six / x) when x tends to 0, limit of (ax - 1 / x) when x tends to a, limit of (1 + x) 1/x when x tends to a)	9%	3
5	**Unit V: Calculus** Differentiation: Definition of derivative, differentiation of standard function by first principle, Rule of Differentiation, Differentiation of algebraic, trigonometric, Exponential, Logarithmic, Implicit functions and Composite functions, Higher order derivatives.	34%	10
	Total	100%	45

i) Text Book and Reference Book:

1. **Advanced Mathematics for Polytechnic**
   By Pandya N R | Macmillan Publishers India Ltd.,2012
2. **A textbook of Engineering Mathematics by N.P. Bali, Laxmi Publication.**
3. **Polytechnic Mathematics**
   By S P Deshpande | Pune Vidyarthi Groh Prakashan
4. **Applied Mathematics**
   By H.K. Das | S. Chand Publication

10)

a) **Course Name:** Communication Skills – I

b) **Course Code:** 03693103

c) **Prerequisite:** Knowledge of English Language.

d) **Rationale:** Communication confidence laced with knowledge of English grammar is essential for all engineers

e) **Course Learning Objective:**

CLOBJ 1	Encourage students to analyze information, evaluate arguments, and develop reasoned conclusions.
CLOBJ 2	Foster the ability to identify and solve complex problems through logical reasoning and creativity.
CLOBJ 3	Develop effective written, verbal, and non-verbal communication skills to express ideas clearly and persuasively.
CLOBJ 4	Teach students to work effectively in teams, valuing diverse perspectives and contributing positively to group efforts.
CLOBJ 5	Cultivate imaginative thinking and the ability to generate original ideas and solutions.

f) **Course Learning Outcomes:**

CLO 1	Analyze complex issues, evaluate evidence, and develop reasoned arguments to support their conclusions.
CLO 2	Identify problems, explore potential solutions, and implement strategies to address challenges effectively.
CLO 3	Articulate ideas clearly and persuasively in written, verbal, and non-verbal forms, adapting their communication style to different audiences and purposes.
CLO 4	Locate and critically evaluate information from various sources, demonstrating information literacy skills to support their learning and decision-making.
CLO 5	Create coherent and persuasive written and oral messages.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**		**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

W - Weightage (%), T - Teaching hours

Sr.	Topics	Weightage (%)	Teaching Hours
1	**IceBreaker + Introducing your Friend** This is one activity which will build the bond between the students in the class and work as a team in the task given to them. The students will be asked to introduce their new best friend in the class. This will ensure that the bond being created here will stay strong and also break the ice between them.	5%	01
2	**Picture Connector** In this class the students will be trained to form a logical connection between a set of pictures which will be shared with This geared towards building creativity and presentation skills.	5%	01
3	**Crazy Scientist** The students will be taught the importance of invention and innovation using some examples that changed the world the way it worked.	5%	01
4	**Shopping Role Play** This activity topic gears towards making students do role play based on shopping scenarios. It involves giving them a scenario and asking them to further develop the idea in a very interesting manner, then going on to enact it.	5%	01
5	**Grammar** Parts of speech, Active and Passive voice, Tenses.	20%	10
6	**Communication: Theory & Practice** Basics of communication: Introduction, meaning, definition, Process of communication. Types of communication: Formal, Informal, Verbal/Non verbal and Written barriers to effective communication. 7 Cs of effective communication: (considerate, concrete concise, clear, complete, correct and courteous). Technical Communication	12%	05
7	**Soft Skills for Professional Excellence** Introduction: Soft skills and hard skills, Importance of soft skills.	12%	02
8	**Debate** Students are trained to let go of inhibitions and come forward and speak openly on passionate topics. The students will be divided into teams and made to share their ideas and views on the topics.	5%	01
9	**Extempore** To change the average speakers in the class to some of the best Orators. This will be done by making the students give a variety of impromptu speeches in front of the class.	5%	01
10	**Letter Writing** Types of letters-Inquiry letter, Order letter, Complaint letter, Adjustment, Request letter, Recommendation letter. Format of letters.	12%	02
11	**Reading Comprehension** Dabbawallas, A Snake in the grass, Internet – Dr. Jagdish Joshi	14%	5
	Total	100%	30

i) Text Book and Reference Book:

1. **Technical Communication: Principles And Practice**
   By Sangeetha Sharma, Meenakshi Raman | Oxford University Press
2. **An An English grammar: comprehending the principles and rules of the language, illustrated by appropriate Englis grammar: comprehending the principles and rules of the language, illustrated by appropriate exercises, and a key to the exercises (v.1)**
   By Murray, Lindley | York England: Printed by Thomas Wilson & Sons, for Longman, Hurst, Rees, Orme, and Brown; and Dart Fourth edition
3. **Active English**
   By Juneja & Qureshi | Macmillan

SEMESTER 2

1)

a) Course Name: Organic Chemistry

b) Course Code: 0362155

c) Prerequisite: Reaction Condition and Mechanism along with Nomenclature and isomerism are important to understand because it helps you to understand and recognize the organic compounds that will be studied in organic chemistry chapters.

d) Rationale: Organic Chemistry is the foundation for Chemical Engineering, Textile Processing, Textile Manu., Plastic Engineering courses. This course provides the basic knowledge of organic compounds and their chemical behavior.

e) Course Learning Objective:

CLOBJ 1	Describe the structure of organic molecules, including the types of bonds (single, double, triple), hybridization, and molecular geometry. They should understand concepts like resonance and aromaticity.
CLOBJ 2	Classify different functional groups (e.g., alcohols, aldehydes, ketones, carboxylic acids, amines) and understand their chemical properties and reactivity patterns.
CLOBJ 3	Visualize Organic compounds systematically according to IUPAC rules, including complex molecules with multiple functional groups and stereoisomers.
CLOBJ 4	Apply knowledge of reactions and mechanisms to design synthesis routes for target molecules. This includes selecting appropriate reagents and conditions to achieve the desired transformation.

f) Course Learning Outcomes:

CLO 1	Draw and interpret the structure of organic molecules, including the ability to recognize and represent various types of bonding and hybridization.
CLO 2	Predict the mechanisms of organic reactions, including identifying intermediates and transition states.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Decide Name organic molecules based on their functional groups, and predict their reactivity and physical properties.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
4	0	0	4	20	20		60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit– I Concept of Organic Chemistry** Introduction -Classification of Hydrocarbons, Functional group classification of organic compound, IUPAC system of nomenclature. Structural Isomerism -Position Isomerism, Chain Isomerism, Mesmerism Isomerism, Functional Isomerism Stereo Isomerism- Optical isomerism, Geometrical Isomerism	10%	8
2	**:– II Purification of Organic Compounds** :tallization, Sublimation, Distillation-Simple distillation, Fractional distillation, Distillation under reduced pressure, Steam distillation, Tests of purification- M.P. & B.P. of organic compounds.	10%	7
3	**Unit– III Detection & Estimation of Elements** Detection of C, H, N, halogens, S & P., Lasagna's Test for detection of N, Cl, Br, I & S., Estimation of C & H., Estimation of Nitrogen by Duma's method. Estimation of Nitrogen by Kjeldahl's method, Estimation of halogens, Sulphur and Phosphorous by Cariu'sMethod. Problems based on methods of estimation.	15%	8
4	**Unit– IV Study of Aliphatic Compounds** Preparation, Properties (Physical and Chemical) & Uses of following Compounds. Alcohol, Aldehyde & Ketone (Methanol, Ethanol, Acetaldehyde & Acetone.) Carboxylic Acid (Acetic Acid & Oxalic), Esters and ether (Methyl& Ethyl Acetate & Diethyl ether), Amines (Methylamine, Ethyl Amine).	20%	12
5	**Unit– V Study of Aromatic Compounds** Preparation, Properties (Physical and Chemical) & Uses of following Compounds. Benzene & Toluene, Nitrobenzene & Aniline., Phenol & Benzaldehyde, Benzoic Acid & Salicylic Acid., Styrene. & Naphthalene, Anthracene and Urea, Benzamide	20%	12
6	**Unit– VI Carbohydrates, Soaps & Detergent** Introduction**:** Carbohydrates and its classification with Suitable Examples and functions of carbohydrates Explain soaps and Detergent, Classification of soaps and detergent with suitable example of each class Mechanism of cleansing action	10%	5

7	**Unit-VII Chemistry of Dyes** Define Dye, Difference between dye and color, Explain Chromogens, Chromophore, and Auxochrome, Classification of Dyes based on structure, Classification of Dyes based on method of application. Introduction to the Dyes, Natural to synthetic dyes, Classification of Dyes on the basis of structure and the mode of application to the fibers and Chemical constitution of dyes. Azo dyes, Mordant dyes. Anthraquinone (VAT) dyes, Indigoid dyes. Reactive dyes and Disperse dye: Introduction Classification and applications.	**15%**	**8**
	Total	**100%**	**60**

i) Text Book and Reference Book:

A Text Book of Organic Chemistry by Arun Bahl and B.S. Bahl | Sultan Chand & Sons, New Delhi
Text Book Of Organic Chemistry by P. L. Soni | Sultan Chand & Sons, New Delhi
ENGINEERING CHEMISTRY By O.P AGRAWAL | KHANNA
ENGINEERING CHEMISTRY By JAIN & JAIN | DHANPAT RAI
Organic Chemistry by Finar, I. L. | Dorling Kindersley (India) Pvt. Ltd. | Volume 1
Organic Chemistry by By Morrison and Boyd

2)

a) **Course Name:** Organic Chemistry Lab

b) **Course Code:** 03602152

c) **Prerequisite:** Reaction Condition and Mechanism along with Nomenclature and isomerism are important to understand because it helps you to understand and recognize the organic compounds that will be studied in organic chemistry chapters.

d) **Rationale:** Organic Chemistry is the foundation for Chemical Engineering, Textile Processing, Textile Manu., Plastic Engineering courses. This course provides the basic knowledge of organic compounds and their chemical behavior.

e) **Course Learning Objective:**

CLOBJ 1	Classify different functional groups (e.g., alcohols, aldehydes, ketones, carboxylic acids, amines) and understand their chemical properties and reactivity patterns.
CLOBJ 2	Decide according to IUPAC rules, including complex molecules with multiple functional groups and stereoisomers.
CLOBJ 3	Knowledge of reactions and mechanisms to design synthesis routes for target molecules.
CLOBJ 4	Critically analyze and evaluate experimental data, draw conclusions, and solve complex problems using their understanding of organic chemistry principles.
CLOBJ 5	Apply laboratory safety protocols and be aware of the environmental impact of chemical processes and waste disposal.

f) **Course Learning Outcomes:**

CLO 1	Identify and name organic molecules based on their functional groups, and predict their reactivity and physical properties.
CLO 2	Apply principles of laboratory safety and environmental impact, including proper waste disposal and risk management.
CLO 3	Explain the characteristic of Material, Substances and Compounds.
CLO 4	Examine skills to do experiments.
CLO 5	Perform organic laboratory techniques safely and effectively, including setting up reactions, purifying products, and analyzing results.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Experiment List:

Exp. No.	Name of the Experiment
1	All Physically Observing of Organic Acid, Base, Phenol & Neutral Compounds. (Their physical state, Structural formula & Solubility).
2	Purification of a given organic compound by crystallization.
3	Purification of a given organic compound by Solvent Treatment method.
4	Detection of Melting point and Boiling point of some Organic Solids by Thiele's Method.
5	Separation of some Organic Compounds (Acid + Phenol + Base) using solvent treatment method.
6	Preparation of some compounds such as I) Nitrobenzene from Benzene.
7	Purification of some organic compounds by Sublimation method.
8	Detection of some Elements by Lasagna's test.
9	Practical are to be performed based on the organic spotting of the following compounds. Organic Qualitative Analysis I) Acetic Acid & Benzoic Acid (ii) Aniline & Nitrobenzene iii) Benzene & Acetone (iv) Chloroform & Phenol.

i) Text Book and Reference Book:

1. A Text Book of Organic Chemistry by Arun Bahl and B.S. Bahl | Sultan Chand & Sons, New Delhi
2. Text Book Of Organic Chemistry by P. L. Soni | Sultan Chand & Sons, New Delhi
3. ENGINEERING CHEMISTRY By O.P AGRAWAL | KHANNA
4. ENGINEERING CHEMISTRY By JAIN & JAIN | DHANPAT RAI
5. Organic Chemistry by Finar, I. L. | Dorling Kindersley (India) Pvt. Ltd. | Volume 1
6. Organic Chemistry by Morrison and Boyd

3)

a) Course Name: Introduction to Chemical Engineering

b) Course Code: 03602153

c) Prerequisite: Basic understanding of chemistry principles

d) Rationale: The course serves as the foundational entry point for students to understand the basic concepts and principles that form the backbone of chemical engineering. It introduces topics like mass and energy balances, thermodynamics, fluid mechanics, and heat and mass transfer that are critical to solving engineering problems.

e) Course Learning Objective:

CLOBJ 1	Contrast the basic principles of chemical engineering, including material and energy balances, thermodynamics, fluid mechanics, heat transfer, and mass transfer.
CLOBJ 2	Develop problem-solving abilities to approach and analyze chemical engineering problems using systematic methods, including process diagrams and calculations.
CLOBJ 3	Apply the principles of conservation of mass and energy to solve steady-state and transient material and energy balance problems for various chemical processes.

CLOBJ 4	Keen of common unit operations such as distillation, filtration, evaporation, heat exchange, and chemical reaction processes.
CLOBJ 5	Explore the real-world applications of chemical engineering in industries such as petrochemical, pharmaceutical, environmental, and food processing.

f) Course Learning Outcomes:

CLO 1	Demonstrate an understanding of the basic principles of chemical engineering, including mass and energy balances, thermodynamics, and fluid dynamics.
CLO 2	Apply mathematical and engineering principles to solve chemical engineering problems, including material and energy balance calculations in steady-state and transient systems.
CLO 3	Identify and describe common unit operations (such as distillation, filtration, and heat exchange) and their applications in chemical engineering processes.
CLO 4	List teams to address chemical engineering problems and communicate technical information clearly through written reports and oral presentations.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**2**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Topics**	**Weightage (%)**	**Teaching hours**
1	**Introduction to the Subject** Chemistry, Chemical Engineering and Chemical Technology; Chemical process industries: History and their role in Society; Role of Chemical Engineer; History and Personalities of Chemical Engineering; Greatest achievements of Chemical Engineering	**15%**	**5**
2	**Components of Chemical Engineering** Role of Mathematics, Physics, Chemistry and Biology; Thermodynamics, Transport Phenomena, Chemical Kinetics and Process dynamics, design and control. Opportunities for Chemical Engineers; Future of Chemical Engineering.	**18%**	**6**
3	**Draw Symbols of Various Equipment and Devices** Draw symbols of various equipment and devices for heat exchange, mass transfer and mechanical operations for example crusher, filter press, rotary filter, conveyors, screen, distillation and absorption columns, scrubbers, dryers, condenser, heat exchanger, jacketed vessel, cyclone, ESP, pump etc. in sketch book.	**22%**	**8**
4	**Concept of Unit Processes and Unit Operations** Concept of Unit Processes and Unit Operations; Description of	**20%**	**5**

	different Unit Processes and Unit Operations; Designing of equipment's; Flowsheet representation of process plants, Overview of Block diagram, Flow diagram.		
5	**Role of Computer in Chemical Engineering** Role of Computer in Chemical Engineering; Chemical Engineering Software; Relation between Chemical Engineering and other engineering disciplines; Traditional vs. modern Chemical Engineering; Versatility of Chemical Engineering: Role of Chemical Engineers in the area of Food, Medical, Energy, Environmental, Biochemical, Electronics etc.	**25%**	**6**
	Total	**100%**	**30**

i) Text Book and Reference Book:

1. Introduction to chemical engineering By Ghosal Salil k. | Tata McGraw Hill Publication, New Delhi, (Reprint 2006)
2. Badger and Bencher, "Introduction to Chemical Engineering". Tata McGraw hill.

4)

a) **Course Name:** Engineering Workshop Practice

b) **Course Code:** 03609154

c) **Prerequisite:** Learn about fundamentals of mechanical and electrical engineering.

d) **Rationale:** Workshop practice is the backbone of the real industrial environment which helps to develop and enhance relevant technical hand skills required by the technician working in the various engineering industries and workshops.

e) **Course Learning Objective**

CLOBJ 1	Develop a thorough understanding of workshop safety procedures, including the proper use of personal protective equipment (PPE), safe operation of machinery, and adherence to safety regulations.
CLOBJ 2	Motive hand tools, power tools, and workshop machinery, including lathes, milling machines, drills, and grinders, to perform precise engineering tasks.
CLOBJ 3	Accurately measure and mark materials using various measurement tools (calipers, micrometers, rulers) and techniques to ensure precision in engineering projects.
CLOBJ 4	Relate and interpret technical drawings and blueprints to guide the construction and assembly of engineering components and projects.
CLOBJ 5	Apply techniques for cutting, shaping, and finishing materials (metal, wood, plastic) using appropriate workshop methods and tools to achieve desired specifications.

f) **Course Learning Outcomes:**

CLO 1	Basic engineering practice to identify, select and use various marking, measuring, and holding, striking and cutting tools & equipment's and machines
CLO 2	Job drawing and complete jobs as per specifications in allotted time. Inspect the job for the desired dimensions and shape. Operate, control different machines and equipment's adopting safety practices.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**4**	**2**	**-**	**-**	**100**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Exp. No.	**Name of the Experiment**
1.	**To A Perform a Job in Carpentry Shop.** Types, sketch, specification, material, applications and methods of using of carpentry tools- saws, planner, chisels, hammers, pallet, marking gauge, vice, try square, rule, etc., Types of woods and their applications., Types of carpentry hardware 's and their uses., Demonstration of carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, etc., Preparation of wooden joints., Safety precautions.

2.	**To A Perform a Job in Tim Smithy.** Concept and conversions of SWG and other gauges in use., Use of wire gauge., Types of sheet metal joints and application., Types, sketch, specification, material, applications and methods of using tin smithy tools-hammers, stakes, scissors/snips, etc., Demonstration of various tin smithy tools and sheet metal operations such as shearing, bending and joining., Preparation of tin smithy job., Safety precautions
3.	**To Perform a Job on Fitting Practice.** Sketch, specification and applications of fitting work holding tools-bench vise, V-block with clamp and C-clamp., Sketch, specification , material ,applications and methods of using fitting marking and measuring tools-marking table, surface plate, angle plate, universal cribbing block, try-square, scriber, divider, center punch, letter punch, calipers, Vernier caliper, etc., Types, sketch, specification , material , applications and methods of using of fitting cutting tools hacksaw, chisels, twist drill, taps, files, dies., Types, sketch, specification, material, applications and methods of using of fitting finishing tools-files, reamers., Sketch, specification and applications of miscellaneous tools-hammer, spanners, screw drivers sliding screw wrench., Demonstration of various fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping., Preparation of simple and male- female joints., Safety precautions.
4.	**To Perform a Job on Soldering.**
5.	**To Perform a Job on Welding.** Demonstration of different welding tools / machines., Demonstration on Arc Welding, Gas Welding, MIG, MAG welding, gas cutting and rebuilding of broken parts with welding., One simple job involving butt and lap joint., Safety precautions.
6.	**To Perform a Job on plumbing.** Types, specification, material and applications of pipes., Types, specification, material and applications of pipe fittings., Types, specifications, material, applications and demonstration of pipe fitting tools., Demonstration of pipe fitting operations such as marking, cutting, bending, threading, assembling, dismantling, etc., Types and application of various spanners such as flat, fix, ring, box, adjustable, etc., Preparation of pipe fitting jobs., Safety precautions.
7.	**To Perform a Job on Sheet Metal Practice.**
8.	**Identify Different symbol used in electrical installation and prepare sheet.** Demonstration of electrical symbol used in domestic or industrial wiring., Demonstration of electrical wiring tools and accessories., Demonstration of electrical measuring instruments like voltmeter, Ammeter, Wattmeter., Demonstration of advanced tools used in testing of electrical installation like Multi meter, Clip-on meter, Megger, Tachometer, Tester etc.
9.	**Identify the different tools used in electrical installation.** Demonstration of electrical wiring tools and accessories.
10.	**Demonstration of measuring instrument Voltmeter, Ammeter, Wattmeter.** Demonstration of electrical measuring instruments like voltmeter, Ammeter, Wattmeter.
11.	**Demonstration of testing instruments: Multi meter, Clip-on meter, Megger, Line tester.** Demonstration of advanced tools used in testing of electrical installation like Multi meter, Clip-on meter, Megger, Tachometer, Tester etc.
12.	**Demonstration of different cables used in electrical installation.** Single core cable, multicore cable, single strand wire, multi strand wire, shielded wire
13.	**Demonstration of different switches used in electrical installation.** Demonstration of different switches like Toggle switch, Rotary switches, Push button switch etc.

14.	**Demonstration of protective devices: fuse, MCB, ELCB.** Demonstration of protective devices like fuse, MCB, ELCB.

i) Text Book and Reference Book:

1. **Mechanical workshop practice**
   By K.C. John
2. **A Textbook of Electrical Workshop Practices**
   By Dr. Umesh Rathore | S.K. Kataria & Sons
3. **A Course in Workshop Technology**
   By Raghuvamsa B S | Dhanpati Rai and Sons, 1682 Nai Darak, New Delhi. Pub. Year 1982
4. **Workshop Practice Manual**
   By K. Venkat Reddy | BS Publications
5. **Elements of Workshop Technology Vol. I**
   By Hajra Chaudhary S.K. | Asia Publishing House
6. **Comprehensive Workshop Technology**
   By S.K. Garg | Laxmi publications

5)

a) **Course Name:** Mathematics-II

b) **Course Code:** 03691151

c) **Prerequisite:** Knowledge of Basic concept of mathematics studied till semester

d) **Rationale:** This course is designed to give a comprehensive coverage at an introductory level to the subject of matrices, Integral Calculus coordinate geometry, Basic elements of vector algebra and First Order Differential Equations.

e) **Course Learning Objective:**

CLOBJ 1	Develop a strong foundation in essential mathematical concepts, including algebra, calculus, geometry, trigonometry, and statistics, to solve real-world and theoretical problems.
CLOBJ 2	Accurate and efficient computations, both manually and using mathematical software tools, to solve algebraic equations, differential equations, and integrals.
CLOBJ 3	Recall mathematical ideas clearly and effectively in both written and oral forms, using appropriate notation, language, and logical structure to communicate solutions and reasoning.

f) **Course Learning Outcomes:**

CLO 1	Inspect algebraic operations on matrices and Analysis solution of systems of linear equations
CLO2	Definite Integration to solve engineering problems
CLO 3	Defend algebra of vectors in finding work done, moment, velocity
CLO 4	Solve differential equation arising in different Engineering branch and able to form mathematical & physical interpretation of its solution which place important role in all branches of Engineering

g) **Teaching & Examination Scheme:**

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	-	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Unit I: Determinants and Matrices** Elementary properties of determinants up to 3rd order, consistency of equations, Crammer's rule. Algebra of matrices, Inverse of a matrix, matrix inverse method to solve a system of linear equations in 3 variables.	**22%**	**12**

2	**Unit II: Vector Algebra** Definition notation and rectangular resolution of a vector. Addition and subtraction of vectors. Scalar and vector products of 2 vectors. Simple problems related to work, moment and angular velocity.	**13%**	**6**
3	**Unit III: Co-Ordinate Geometry** Straight line Inclination and slope of a line, different forms of equations to a straight line, Slope-intercept form, and Point slope form, Two-point form, Intercept form. General equation of a Straight line, Family of lines. Conditions for concurrency of lines. Circle Definition, Equation of a circle with given center and radius, General form of equation of circle, Equation of a circle when intercepts are given, circle passing through three points, Equation of chord, Equations of tangents and normal at a point on a circle.	**15%**	**10**
4	**Unit IV: Integral Calculus** Integration as inverse operation of differentiation, Integration of simple functions, Integration by substitution, by parts and by partial fractions (for linear factors only). Definite integral: Definition, Properties of Definite integral, Odd and Even functions, Use of formulas, and for solving problems Where m and n are positive integers. Applications of integration for I. Simple problem on evaluation of area bounded by a curve and axes. ii. Calculation of Volume of a solid formed by revolution of an area about axes. (Simple problems)	**37%**	**10**
5	**Unit V: Differential Equations** Solution of first order and first-degree differential equation by variable separation method (simple problems), Exact differential equations (simple problems), Linear differential equations (simple problems), MATLAB – Simple Introduction.	**13%**	**7**
	Total	**100%**	**45**

6)

a) Course Name: Applied Physics

b) Course Code: 03692103

c) Prerequisite: High School Level Physics

d) Rationale: Applied Physics aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology.

e) Course Learning Objective:

CLO 1	Make use of concepts of physics, including mechanics, thermodynamics, electromagnetism, optics, and modern physics, and their relevance to real-world applications.
CLO2	Learn physics principles to solve practical engineering problems, including analyzing forces, energy transformations, and motion in various contexts.
CLO 3	Prove experiments in the laboratory to investigate physical phenomena, collect data, and analyze results using scientific methods and statistical tools.
CLO 4	Justify mathematical techniques such as calculus, algebra, and differential equations to perform calculations and model physical systems.

f) Course Learning Outcomes:

CLO 1	Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy by minimizing different types of errors.
CLO2	Analyze type of motions and apply the formulation to understand banking of roads/railway tracks and conservation of momentum principle to describe rocket propulsion, recoil of gun etc.
CLO 3	Define scientific work, energy and power and their units. State the principle of conservation of energy.
CLO 4	Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
CLO 5	Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces. Describe the viscosity of liquids, coefficient of viscosity and the various factors affecting its value

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Unit 1: Physical world, Units and Measurements** Physical quantities; fundamental and derived, Units and systems of units (FPS, CGS and SI units), Dimensions and dimensional formulae of physical quantities, Principle of homogeneity of dimensions, Dimensional equations and their applications (conversion from one system of units to other, checking of dimensional equations and derivation of simple equations), Limitations of dimensional analysis. Measurements: Need, measuring instruments, least count, types of measurement (direct, indirect), Errors in measurements (systematic and random), absolute error, relative error, error propagation, error estimation and significant figures	15%	10
2	**Unit 2: Force and Motion** Scalar and Vector quantities – examples, representation of vector, types of vectors. Addition and Subtraction of Vectors, Triangle and Parallelogram law (Statement only), Scalar and Vector Product, Resolution of a Vector and its application to inclined plane and lawn roller. Force, Momentum, Statement and derivation of conservation of linear momentum, its applications such as recoil of gun, rockets, Impulse and its applications. Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period, Relation between linear and angular velocity, linear acceleration and angular acceleration (related numerical), Centripetal and Centrifugal forces with live examples, Expression and applications such as banking of roads and bending of cyclist.	20%	9
3	**Unit 3: Work, Power and Energy** Work: Concept and units, examples of zero work, positive work and negative work Friction: concept, types, laws of limiting friction, coefficient of friction, reducing friction and its engineering applications, Work done in moving an object on horizontal and inclined plane for rough and plane surfaces and related applications. Energy and its units, kinetic energy, gravitational potential energy with examples and derivations, mechanical energy, conservation of mechanical energy for freely falling bodies, transformation of energy (examples). Power and its units, power and work relationship, calculation of power (numerical problems).	15%	8
4	**Unit 4: Rotational Motion** Translational and rotational motions with examples, Definition of torque and angular momentum and their examples, Conservation of angular momentum (quantitative) and its applications. Moment of inertia and its physical significance, radius of gyration for rigid body, Theorems of parallel and perpendicular axes (statements only), Moment of inertia of rod, disc, ring and sphere (hollow and solid); (Formulae only).	15%	6
5	**Unit 5: Properties of Matter** Elasticity: definition of stress and strain, moduli of elasticity, Hooke's law, significance of stress-strain curve. Pressure: definition, units, atmospheric	20%	6

	pressure, gauge pressure, absolute pressure, Fortin's Barometer and its applications. Surface tension: concept, units, cohesive and adhesive forces, angle of contact, Ascent Formula (No derivation), applications of surface tension, effect of temperature and impurity on surface tension. Viscosity and coefficient of viscosity: Terminal velocity, Stokes law and effect of temperature on viscosity, application in hydraulic systems. Hydrodynamics: Fluid motion, stream line and turbulent flow, Reynold's number Equation of continuity, Bernoulli's Theorem (only formula and numerical) and its applications		
6	**Unit 6: Heat and Thermometry** Concept of heat and temperature, modes of heat transfer (conduction, convection and radiation with examples), specific heats, scales of temperature and their relationship, Types of Thermometers (Mercury thermometer, Bimetallic thermometer, Platinum resistance thermometer, Pyrometer) and their uses. Expansion of solids, liquids and gases, coefficient of linear, surface and cubical expansions and relation amongst them, Co-efficient of thermal conductivity, engineering applications	**15%**	**6**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. **Engineering Physics**
   By Rakau and S.L. Gupta | Dhan Patrai & Co
2. **Engineering Physics**
   By Vijayakumar, G
3. **Engineering physics**
   By DK Bhattacharya & Poonam Tandan
4. **Engineering physics**
   By PV Naik

7)

a) **Course Name:** Applied Physics Lab

b) **Course Code:** 03692104

c) **Prerequisite:** High School Level Physics

d) **Rationale:** Applied Physics aims to give an understanding of this world both by observation and by prediction of the way in which objects behave. Concrete use of physical principles and analysis in various fields of engineering and technology are given prominence in the course content

e) **Course Learning Objective:**

CLO 1	Gain and demonstrate proficiency in various laboratory techniques and instruments used in applied physics experiments, such as oscilloscopes, spectrometers, and force sensors.
CLO2	Discover experiments with accuracy and attention to detail, following established procedures to obtain reliable and reproducible results.
CLO 3	Analyze, and interpret experimental data using appropriate statistical methods, graphical techniques, and data analysis tools to draw meaningful conclusions.
CLO 4	Design and plan experiments to test hypotheses or explore physical phenomena, including selecting appropriate methods, materials, and equipment for the intended investigation.

f) **Course Learning Outcomes:**

CLO 1	Identify physical quantities, select their units for use in engineering solutions, and make measurements with accuracy by minimizing different types of errors.
CLO2	Analyze type of motions and apply the formulation to understand banking of roads/railway tracks and conservation of momentum principle to describe rocket propulsion, recoil of genetic.
CLO 3	Examine scientific work, energy and power and their units. State the principle of conservation of energy.
CLO 4	Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems.
CLO 5	Describe the phenomenon of surface tension, effects of temperature on surface tension and solve statics problems that involve surface tension related forces. Describe the viscosity of liquids, coefficient of viscosity and the various factors affecting its value.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE-** Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

W - Weightage (%), T - Teaching hours

1.	**To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.** To measure length, radius of a given cylinder, a test tube and a beaker using a Vernier caliper and find volume of each object.
2.	**To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge** To determine diameter of a wire, a solid ball and thickness of cardboard using a screw gauge
3.	**To find the moment of inertia of a flywheel.** To find the moment of inertia of a flywheel.
4.	**Measurement of Viscosity by Redwood Viscometer** Measurement of Viscosity by Redwood Viscometer
5.	**To find the coefficient of linear expansion of the material of a rod. (Young's Modulus** To find the coefficient of linear expansion of the material of a rod. (Young's Modulus
6.	**To find the co-efficient of friction between wood and glass using a horizontal board.** To find the co-efficient of friction between wood and glass using a horizontal board.
7.	**To find surface tension of a liquid using capillary rise method** To find surface tension of a liquid using capillary rise method
8.	**To find frequency of given tuning fork with the help of a sonometer.** To find frequency of given tuning fork with the help of a sonometer.
9.	**To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.** To determine radius of curvature of a convex and a concave mirror/surface using a spherometer.
10.	**To determine Force constant with the help of periodic time of oscillations of spring** To determine Force constant with the help of periodic time of oscillations of spring
11.	**To verify triangle and parallelogram law of forces.** To verify triangle and parallelogram law of forces.
12.	**To determine force constant of a spring using Hook's Law.** To determine force constant of a spring using Hook's Law.

i) Text Book and Reference Book:

1. **Engineering Physics**
   By Rakau and S.L. Gupta | Dhan Patrai & Co
2. **Engineering Physics**
   By Vijayakumar, G
3. **Engineering physics**
   By PV Naik

8)

a) Course Name: Communication Skills – II

b) Course Code: 03693153

c) Prerequisite: Knowledge of English Language.

d) Rationale: Basic Communication skills are essential for all Diploma Engineers.

e) Course Learning Objective:

CLOBJ 1	Develop learning & establish a platform for the students that they can easily learn through various life skills required in the organization for becoming an asset for the organization.
CLOBJ 2	Analyze new words are formed, role of syllable, vowel, consonant in pronunciation of word.
CLOBJ 3	Enhance formal communication as well as to participate in events like debate, extempore etc, and to introduce them to various international Language testing systems
CLOBJ 4	Encourage them to overcome stage fear through classroom activities.
CLOBJ 5	Cultivate Reading Skill through the usage of comprehensions.

f) Course Learning Outcomes:

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO 2	Apply and analyze the right kind of pronunciation with regards to speech sounds and be able to get different types of pronunciations.
CLO 3	Competent to read, understand, and interpret a text intrinsically as well as extrinsically. The learner can browse a text quickly to come-up with a gist and personal interpretation. One is able to create a healthy work-environment and prove to be an asset or one of the most reliable resources to the Organization. As a professional, one is mature to bridge the gulf between the existing behavior/ lifestyle and the expected corporate behavior cum lifestyle with the help of learning life skills.
CLO 4	Apply the concepts of grammar, various strategies and the usage of formal language in written expression. By using synonyms rewrite the same text in the same format and meaning. Write the gist of the given text.
CLO 5	Enhanced ability to understand and interpret written texts, leading to better grasp of subject matter across disciplines.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**-**	**100**	**-**	**-**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-

Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Listening Skills** Listening Process and Practice - Introduction, importance of good Listening Skills, difference between listening and hearing, types of listening, Barriers to effective Listening, traits of a good listener.	**15%**	**6**
2	**Listening Skills – Questions** With audio aids, Students will be able to listen to dialogues, improve in gathering information and to summarize the content. To listen and understand day-to-day conversations and to solve questions based on audio files.	**10%**	**1**
3	**Building Vocabulary** Synonyms, Antonyms, Homophones, Homonyms, Homographs, Phrasal verbs, idioms & phrases, One word substitution.	**15%**	**1**
4	**Introduction to Phonetics** Sounds: Consonant, Vowel, Diphthongs, transcription of words (IPA) weak forms, syllable division, word stress, intonation and voice.	**15%**	**6**
5	**Speaking Skill Building Introduction** To enable students to eliminate stage fright and engage in conversation with others.	**5%**	**2**
6	**Speaking Skill Building Activity** Enables students to engage in formal communication as well as to participate in events like debate, extempore etc., and to introduce them to various international Language testing systems.	**5%**	**1**
7	**Tourism Pitch** Classroom activity which helps students to express their feelings and experiences in English. Encouraging students to overcome stage fear.	**5%**	**1**
8	**Lifeboat** Classroom Activity to encourage Communication and Convincing Skills.	**5%**	**1**
9	**Reporter** Classroom activity to encourage Communication and Convincing Skills.	**5%**	**1**
10	**Paragraph Jumble** Enhance the skill of writing by completing the paragraph in appropriate and sensible form.	**5%**	**4**
11	**Life Skills** Self-Awareness, Sympathy, Empathy, Emotional Intelligence.	**5%**	**4**
12	**Reading Comprehension** A Day's Wait- Ernest Hemingway, My Lost Dollar - Stephen Leacock.	**10%**	**2**
	Total	**100%**	**30**

I) Text Book and Reference Book:

1. **Technical Communication: Principles And Practice**
   By Sangeetha Sharma, Meenakshi Raman | Oxford University Press
2. **Effective Technical Communication**
   By Dr. Bharti Kukreja, Dr. Anupama Jain | S.K. Kataria & Sons | 1st
3. **Active English**
   By Juneja & Qureshi | Macmillan

SEMESTER 3

1)

a) C**ourse Name:** Entrepreneurship and Start-ups

b) Course Code: 03600201

c) Prerequisite: Understanding of financial statements (income statement, balance sheet, and cash flow statement), budgeting, and financial planning.

d) Rationale: The main objective of this course is to understanding the concept and process of entrepreneurship - its contribution and role in the growth and development of individual and the nation and learning the process and skills of creation.

e) Course Learning Objective:

CLO 1	Assume key concepts of entrepreneurship, including the entrepreneurial mindset, types of entrepreneurships, and the role of innovation in creating new ventures.
CLO2	Defend market research to assess industry trends, identify target markets, analyze competitors, and determine customer needs.
CLO 3	Make up a comprehensive business plan that includes an executive summary, market analysis, organizational structure, product/service description, marketing strategy, financial projections, and funding requirements.
CLO 4	Create and manage financial plans, including budgeting, financial forecasting, and understanding financial statements and metrics

f) Course Learning Outcomes:

CLO 1	Inspect the dynamic role of entrepreneurship and small businesses
CLO2	Organizing and Managing a Small Business
CLO 3	Relate Financial Planning and Control
CLO 4	Solve Strategic Marketing Planning
CLO 5	Organize New Product or Service Development
CLO 6	Classify Business Plan Creation

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**-**	**20**	**20**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	**Topics**	**Weightage (%)**	**Teaching Hours**
1	**Introduction to Entrepreneurship and Start – Up** Definitions, Traits of an entrepreneur, Intrapreneurship, Motivation, Types of Business Structures, Similarities/differences between entrepreneurs and managers.	**15%**	**5**

2	**Business Ideas and their implementation** Discovering ideas and visualizing the business, Activity map, Business Plan	**15%**	**2**
3	**Idea to Start-up** Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Marketing and accounting, Risk analysis	**20%**	**2**
4	**Management** Company's Organization Structure: Recruitment and management of talent	**20%**	**2**
5	**Financing and Protection of Ideas** Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses	**20%**	**2**
6	**Exit strategies for entrepreneurs** Exit strategies for entrepreneurs, bankruptcy, succession and harvesting strategy	**10%**	**2**
	Total	**100%**	**15**

i) Text Book and Reference Book:

1. **Entrepreneurial Development**
   By Srinivasan. N. P | New Delhi: S. Chand 1999
2. **ENTREPRENEURAL DEVELOPMENT**
   By Vasant Desai | Himalaya Publication
3. **Entrepreneurial Development**
   By David Holt

(2)

a) **Course Name:** Mechanical Operations

b) **Course Code:** 03602221

c) **Prerequisite** Basic understanding of mechanical engineering principles, including force, motion, energy, and material properties.

d) **Rationale:** The operations of chemical plants require use of material handling and size reduction equipment, screens, agitator, mixers, centrifuges, cyclones, filters and other mechanical separation equipment.

e) **Course Learning Objective:**

CLOBJ 1	Compare calculate and interpret various specific properties of particulate solids, including particle density, bulk density, diameter, sphericity, equivalent diameter, specific surface area, and shape factor. They will apply these calculations to characterize and analyze particulate systems in different industrial processes.
CLOBJ 2	Show proficient in performing screen analysis, including cumulative and differential analysis. They will be able to evaluate the capacity and effectiveness of screening equipment, derive and apply formulas for overall effectiveness, and use this analysis to optimize solid separation processes.
CLOBJ 3	Conclude principles of size reduction and the application of different size reduction laws (Ratzinger's, Bond's, Kick's). They will be able to classify, compare, and select appropriate size reduction equipment, and perform calculations related to energy and power requirements for size reduction processes.
CLOBJ 4	Recall and apply various separation and filtration techniques, including sedimentation, filtration, and solid particle separation methods. They will understand the principles, construction, and operation of equipment such as gravity thickeners, filter presses, cyclones, and centrifuges, and be able to select and implement these techniques for effective solid-liquid separation in industrial applications.

f) **Course Learning Outcomes:**

CLO 1	Inference the basic principles of particles preparation and their characterization
CLO2	Have knowledge about different size reducing equipment and power requirements during size reduction
CLO 3	Have an understanding on solid fluid separation equipment
CLO 4	Have an understanding of solid storage and their conveying in chemical process industries

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-

Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Properties of Particulate Solids** Fundamentals of Unit operation and Unit process, Specific properties of solids: Particle density and Bulk density, diameter, sphericity, equivalent diameter, specific surface area, volume surface mean diameter, mass mean diameter, shape factor, Calculation of particle diameter, sphericity, equivalent diameter, specific surface area, volume, surface mean diameter, mass mean diameter, and shape factor, numbers of particles in solid.	**5%**	**5**
2	**Screen Analysis** Basics of Ideal and actual screen, Types of screen analysis: Cumulative analysis, Differential analysis, Applications of screen analysis. Capacity and effectiveness of screen, Derivation of formula for overall effectiveness of screen, Calculation of capacity and effectiveness of screen.	**12%**	**6**
3	Size Reduction Principles of Size reduction and its application, Classification, comparison and selection of size reduction equipment are based on size reduction principle. Characteristics of comminution products. Energy and power required in comminution. Laws of size reduction: (I) Ratzinger's law (ii) Bond's law (iii) Kick's law. Calculation of power required for size reduction using empirical laws. Work index. Principle, construction and working of Jaw crusher, Gyratory crusher, Fluid Energy mill, Ribbon Blender, Roll crusher, and Ball Mill. Derivation of equation of angle of nip, Calculation of angle of Nip for Roll crusher. Derivation of equation of critical speed of Ball mill and its calculations. Difference between open and close circuit grinding, Pulverize	**17%**	**7**
4	Sedimentation Fundamentals of sedimentation, Batch sedimentation, Inter phase height Vs time curve for Batch sedimentation. Principle of flocculation Principle, construction and working of Gravity thicker, Fundamentals of free and hindered settling, Construction and working of Tubular centrifuge, Principle, construction and working of Cyclone separator, cut diameter and efficiency of cyclone, Terminal settling velocity Stokes law and Newton's law	**18%**	**8**
5	Filtration basics of filtration , Classification of equipment's for liquid-solid separation , Principle, construction and working of filter press, leaf filter, rotary vacuum filter, cartridge filter, Filter media and its characteristics, Basics of Filter aids, Method of application, Constant rate filtration and constant pressure filtration, Brief description of specific cake resistance and filter media resistance for constant rate, constant pressure	**20%**	**9**

	and vacuum filtration (without numerical), Classification of centrifugal equipment's, Principle, construction and working of batch centrifuge, Advantages and disadvantages of centrifuge over filter press, Agitated Netsch filter.		
6	Separation of Solid Particles Definition and application of solid separation, Factors affecting selection of equipment for solid separation, working principle and construction of a) Jigging b) Elutriation c) Double cone classifier d) Electrostatic precipitator) Magnetic separator f) Froth flotation cell, Differential settling methods, sink and float method.	**13%**	**6**
7	Agitation and Mixing Define agitation and mixing, give their applications, Classification of Impellers and brief explanation, Vortex formation and swirling ,Methods of Vortex prevention, Construction and working of agitation vessel ,Derivation of equation for power consumption in agitation vessel ,Calculations of power consumption in baffled and unbaffled tank Flow number, Factors affecting agitation, Purpose of mixing solids and pastes, Factors affecting selection of mixing equipment's, Rate of mixing and mixing index for pastes & powder, Calculation of mixing index, Construction and working of a) Ribbon blender b) Kneaders c)Pug mill d) Ban bury mixer e) Muller mixer	**15%**	**4**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Narayanan C.M.& Bhattacharya B.C. "Mechanical Operations for Chemical engineers", Khanna Publishers. 3 rd. Ed.1999 (Textbook)
2. Chemical Engineering Series, Chemical Engineering Design, R. K. Sinnott, Coulson and Richardson's; 4th Edition, VI volume, Elsevier Publication.
3. Unit Operation of Chemical Engineering W.L. McCabe, J.C. Smith, P. Harriott; McGraw-Hill publication Badger and Bencher, "Introduction to Chemical Engineering". Tata McGraw hill.

(3)

a) **Course Name:** Mechanical Operations Lab

b) **Course Code:** 03602208

c) **Prerequisite:** Zeal to Learn the Subject.

d) **Rationale:** The operations of chemical plants require use of material handling and size reduction equipment, screens, agitator, mixers, centrifuges, cyclones, filters and other mechanical separation equipment.

e) **Course Learning Objective:**

CLOBJ 1	Accurately measure and analyze various types of particle densities (bulk, particle, and repose), particle size distributions, and the angle of repose. They will utilize appropriate methods and equipment, such as optical particle analyzers and sieve analysis, to quantify these properties and interpret their implications for material handling and processing.
CLOBJ 2	Recommend and apply principles of size reduction and separation, including the operation of equipment like jaw crushers, ball mills, and drop weight crushers. They will also evaluate screen effectiveness and apply settling studies to separate solids based on their characteristics. Students will be able to select and optimize equipment and processes for effective size reduction and solid separation.
CLOBJ 3	Improve proficiency in designing and analyzing filtration and agitation processes, including constant pressure and constant volume filtration. They will be able to explain the functioning of various filtration equipment (e.g., filter presses, rotary vacuum filters) and agitation vessels, and apply this knowledge to optimize solid-liquid separation and mixing operations in industrial settings.

f) **Course Learning Outcomes:**

CLO 1	Rate the fundamentals involved in the Mechanical operations.
CLO2	Create and application of the concept of Particulate properties and its measurements.
CLO 3	Make use of liquid-solid and gas-solid separations

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**-**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Experiment List:

Exp. No.	Name of the Experiment
1	**Different types of density of particle (Bulk, Particle, Repose)** The particle density of a particulate solid or powder, is the density of the particles that make up the powder, in contrast to the bulk density, which measures the average density of a large volume of the powder in a specific medium (usually air).
2	**Angle of repose** The angle of repose, or critical angle of repose, of a granular material is the steepest angle of descent or dip relative to the horizontal plane to which a material can be piled without slumping.
3	**Particle size distribution** For the physical characterization of particles Microtrap offers a range of optical particle analyzers. Microtrap is the only worldwide supplier of dynamic image analysis, static image analysis, laser diffraction and sieve analysis equipment with an extensive understanding of the strengths and weaknesses of each method.
4	**Screen effectiveness** The effectiveness of a screen (screen efficiency) is a measure of success of the screen in closely separating undersize and oversize materials. In case of a perfectly functioned screen, all the oversize materials would be in overflow and all the undersize material would be in underflow.
5	**Jaw crusher** A jaw crusher is a compression type crusher, comprised of a fixed jaw and moving jaw positioned in a (V). The movable jaw compresses material against the fixed jaw, crushing the material to the desired size. The material exits the jaw through the bottom of the crusher otherwise, known as the discharge opening.
6	**Ball mill** A ball mill is a type of grinder used to grind or blend materials for use in mineral dressing processes, paints, pyrotechnics, ceramics, and selective laser sintering. It works on the principle of impact and attrition: size reduction is done by impact as the balls drop from near the top of the shell.
7	**Drop weight crushes** Product Description. This setup is used to determine the crushing law of constants using drop weight crusher. About 25 grams of the sample size 4+5 is taken in the crushing chamber. The weight of the metallic block (weight to be dropped) and the height through which it falls is determined.
8	**Drag studies** Aerodynamics is the study of how moving objects interact with the air. How the body behaves when it comes in contact with the air determines the forces induced by the air flowing over and around the body.
9	**Settling studies** Settling is the process by which particulates settle to the bottom of a liquid and form a sediment. Particles that experience a force, either due to gravity or due to centrifugal motion will tend to move in a uniform manner in the direction exerted by that force
10	**Separation of solids using settling characteristics** Settling, in soil mechanics, refers to sedimentation; i.e., the settling out of solid particles from suspension in water. The velocity of settling depends on the size, shape, and density of the particles, and on the viscosity of the water. Particles may be classified in size by relative settling rates.

11	**Constant Pressure Filtration** In the early stages of the filtration cycle, the pressure drop across the cloth is small and filtration proceeds at more or less a constant rate. As the cake increases, the process becomes more and more a constant-pressure one and this is the case throughout most of the cycle.
12	**Constant Volume Filtration** The volume of filtrate collected per unit time (dB/dt) is termed as the rate of filtration. As the filtration proceeds, solid particle accumulates on the filter medium forming a packed bed of solids, called filter cake
13	**Agitated vessel** Generally, agitation refers to forcing a fluid by mechanical means to flow in a circulatory or other pattern inside a vessel. Mixing usually implies the taking of two or more separate phases, such as a fluid and a powdered solid or two fluids, and causing them to be randomly distributed through one another.
14	**Storage of Solids** Cement storage silos. There are different types of cement silos such as the low-level mobile silo and the static upright cement silo. The low-level silos are fully mobile with capacities from 10 to 75 tons. The static upright silos have capacities from 20 to 80 tons.

i) Text Book and Reference Book:

1. Unit operations of Chemical Engineering (Textbook) By Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill

4)

a) **Course Name:** Fluid Flow Operation

b) **Course Code:** 03602219

c) **Prerequisite:** It is important to fluid transport, and fluid mechanics

d) **Rationale:** The information about the basic concepts and principles of hydrostatics, hydrodynamics and their applications in handling various fluids like gases, vapors, liquids and scurries are provided in this course which is required for smooth and proper operation of fluid transportation machinery.

e) **Course Learning Objective:**

CLOBJ 1	Asses the fundamental principles of fluid mechanics and the continuum hypothesis.
CLOBJ 2	Compile forces acting on fluids, including normal and shear stresses, and their applications in fluid statics.
CLOBJ 3	Label system and control volume approaches, Reynolds transport theorem, and integral balances to solve mass and momentum conservation problems in fluid systems.
CLOBJ 4	Examine flow measurement techniques, differential analysis methods, potential flow, boundary layer theory, similitude analysis, compressible flows, turbulence structure, and its visualization using Reynolds decomposition and spectral analysis.

f) **Course Learning Outcomes:**

CLO 1	The knowledge of fundamental concepts in fluids statics and to use dimensional analysis for scaling experimental results.
CLO2	The ability to analyses frictional flow in pipes and piping networks and to compute the heat loss and power requirements for chemical process equipment's
CLO 3	The ability to select the metering equipment's and fluid moving machinery for appropriate chemical engineering operations.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**UNIT 1: Introduction to fluid mechanics:** Concept of fluid mechanics & its application, Types of fluid and properties of fluid, Newton's law of viscosity, Newtonian and non-Newtonian fluid, Concept of pressure, Pressure and height relationship, Pressure measuring Device (such as U-tube manometer, Inclined manometer & Differential manometer).	**14%**	**7**
2	**UNIT 2: Flow of incompressible fluids:** Reynold's experiment, Concept of laminar & turbulent flow, Reynold's number and simple numerical, Concept of flowrate (volumetric, mass, molar flowrate), Concept of Velocity (Point, Average & Mass Velocity), Types of flow, stream line and stream tube.	**10%**	**4**
3	**UNIT 3: Basic equations of fluid flow:** Concept of conservation of mass (continuity equation), Different types of energies associated with flowing fluids, Bernoulli's equation, Correction factor in Bernoulli's equation (hf, α, twp.), Simple numerical of Bernoulli's equation.	**10%**	**5**
4	**UNIT 4: Friction in flowing fluids:** Types of friction, flow of incompressible fluid in pipes, Shear stress distribution in pipe & Relation between skin friction and wall shear, Laminar flow in pipe (Velocity distribution in pipe). Laminar flow of Newtonian fluids, Hagen Poiseuille equation, Fanning friction factor for laminar & turbulent flow, Friction losses from sudden enlargement and contraction, Simple numerical.	**26%**	**11**
5	**UNIT 5: Flow measurement:** Principle, construction, working, application, advantages & disadvantages and equation derivation of 1. Orifice 2. Venturi 3. Pitot tube, Rotameter (only theory), Simple Numerical of orifice and Venturi meter.	**14%**	**7**
6	**UNIT 6: Transportation and metering of fluid:** Difference between pipe and tube, Different types of valves and its application. Construction, working & application of 1. Gate valve 2. Ball valve 3. Check valve 4. Control valve. Various types of fittings & its application, Classification of pump. Principle, construction, working, application advantages & disadvantages of 1. Centrifugal 2. Reciprocating 3. Rotary pump. Cavitation and NPSH in centrifugal pump. Construction, Working and application of 1. Fan 2. Blower 3. Compressor. Vacuum pump & Jet ejector	**26%**	**11**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Fluid Mechanics (Textbook) By V. L. Streeter | McGraw-Hill
2. Introduction to Fluid Mechanics, (Textbook) By R. W. Fox, P. J. Pritchard and A. T. McDonald | 7th Edition, Wiley-India 2010.
3. Fluid Mechanics and Hydraulic Machines (Textbook) By R.K. Bansal | Laxmi Prakashan
4. Fluid Dynamics and Heat Transfer (Textbook) By James G. Knudson and Donald Katz | McGraw Hill Publication
5. Unit Operation of Chemical Engineering (Textbook) By W.L. McCabe, J.C. Smith, P. Harriott | McGraw-Hill publication
6. Unit operations of Chemical Engineering (Textbook) By Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill
7. Chemical Engineering Series, Chemical Engineering Design, (Textbook) By R. K. Sinnott, Coulson and Richardson's | 4th Edition, VI volume, Elsevier Publication

5)

a) **Course Name:** Fluid Flow Operation Lab

b) **Course Code:** 03602210

c) **Prerequisite:** Basic knowledge of fluid transport

d) **Rationale:** Using these concepts power requirement for pumps, blowers and compressors can be determined and friction losses through pipes and fittings can also be calculated. Therefore, this course is one of the important courses since it attempts to develop these skills in students.

e) **Course Learning Objective:**

CLOBJ 1	Illustrate Bernoulli's theorem and its implications in fluid dynamics through theoretical study and experimental verification.
CLOBJ 2	Analyze pressure drop across pipe fitting and its correlation with friction factor vs Reynolds number to comprehend fluid flow characteristics.
CLOBJ 3	Evaluate Reynolds Experiment Apparatus to distinguish between laminar and turbulent flows, grasping their significance in practical applications.
CLOBJ 4	Apply experimental methods to calibrate Venturi meter and Orifice meters, determining their coefficients of discharge to ensure accurate flow measurements.
CLOBJ 5	Demonstrate proficiency in flow measurement techniques using V-notch weirs and Pitot tubes, along with understanding the operational principles of centrifugal and reciprocating pumps.

f) **Course Learning Outcomes:**

CLO 1	Understand and application of the principles & concepts of learned in momentum transfer theory course.
CLO2	The ability to solve hydro static and fluid flow problems using Newton's laws of motion.
CLO 3	The ability to analyze frictional flow in pipes and piping networks and to compute the heat loss and power requirements for chemical process equipment's.
CLO 4	The ability to select the metering equipment's and fluid moving machinery for appropriate chemical engineering operations.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
0	**-**	**2**	**-**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Experiment List:

Exp. No.	Name of the Experiment
1	Different types of manometers
2	Major losses in pipe flow
3	Minor Losses (Globe Valve, Bends and Elbows)
4	Major losses in spiral coil flow
5	Major losses in helical coil flow
6	Flow through Packed Bed
7	Flow through Fluidized Bed
8	Calibration of orifice meter
9	Calibration of venturi meter
10	Calibration of pitot tube
11	Calibration of channel
12	Characteristics of reciprocating pump
13	Characteristics of centrifugal pump

i) Text Book and Reference Book:

1. Unit operations of Chemical Engineering (Textbook) By Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill
2. Unit Operation – I By K. A. Givhan | Nirali Prakashan, Pune

6)

a) **Course Name:** Chemical Engineering Materials

b) **Course Code:** 03602215

c) **Prerequisite:** Basic knowledge of materials

d) **Rationale:** Students, while working in industries related to chemical manufacturing, require knowledge of various classes of material, including metals and alloys, ceramics, polymers, composites, coatings, insulating materials, adhesives and lubricants for various applications.

e) **Course Learning Objective:**

CLOBJ 1	Demonstrate the physical, chemical, and mechanical properties of materials relevant to chemical engineering, including metals, polymers, ceramics, and composites.
CLOBJ 2	How to select appropriate materials for various chemical engineering applications based on factors such as durability, corrosion resistance, and thermal stability.
CLOBJ 3	Solve materials behave under different conditions, including stress, temperature changes, and chemical exposure. Understand concepts such as stress-strain relationships, phase diagrams, and failure mechanisms.
CLOBJ 4	Experiment with the mechanisms of material degradation and corrosion in chemical environments. Learn how to mitigate these issues through material selection, coatings, and design modifications.

f) **Course Learning Outcomes:**

CLO 1	Explain the classification schemes that are used to categorize engineering materials.
CLO2	Explain the differences in the mechanical behavior of engineering materials based upon bond type, structure, composition, and processing
CLO 3	Describe the basic structures and repeat units for common thermoplastics and relate the distribution of molecular weights, degree of polymerization, percent crystallinity, and glass transition temperature to properties in service.
CLO 4	Create model of the unique properties and characteristics of polymer-based materials
CLO 5	Select common manufacturing processes and recent technological developments that is used in creating products from plastics and composites.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr. No.	**Content**	**Weightage (%)**	**Teaching Hours**
1	**Properties Of Materials:** Scope of material science, Definition of Melting point, Boiling point, Specific heat, Thermal conductivity, Thermal expansion, Thermal	**10%**	**4**

	insulation, Stresses, Strain, Yield stress, Fatigue, Creep, Principles of selection of materials, Mechanical, Electrical and magnetic properties of materials - Deformation of materials - Heat Treatment techniques		
2	**Structure and Imperfections in Crystals:** Crystal structure Crystal geometry, structure of solids, methods of determining structures. Imperfection in crystals - types of imperfection. Point imperfection	**15%**	**6**
3	**Metals and Alloys:** Properties and uses of Cast iron, Wrought iron, Mild steel, Stainless steel, Comparison of ferrous metals and alloys, Properties and uses of metals: Aluminum, Zinc, Chromium, Nickel, Tin, Copper, Titanium, Tungsten, Platinum and Silver	**17%**	**7**
4	**Ceramic Materials: Ceramic** materials, Composition, properties and uses of China clay, fire clay, bentonite, Classification, properties and uses of refractories, Composition, properties and uses of Soda lime glass, borosilicate glass, high silica glass, fiber glass, glass wool, form glass, Composition, properties and uses of Porcelain, Composition Properties and types of Cement	**16%**	**8**
5	**Organic Materials:** Definition and importance of Polymer, Addition and condensation Polymerization, Plastics: definition, classification, general properties and uses of different polymeric materials, Rubbers: definition, classification, general, properties and uses of different elastomers, Compare natural and synthetic rubber, Vulcanizing of rubber	**12%**	**7**
6	**Protective Coatings and Insulations:** Paints: classification and uses, Ingredients of paints: their properties and importance, Special types of paints and their applications, Varnishes: classification and uses, Ingredients of Varnishes, Types of insulations, Properties and applications of different :(I) Electric insulation (ii)Thermal insulation	**15%**	**7**
7	**Composites, Lubricants and Adhesives:** List of composite materials, Properties and uses of Fiber reinforced plastics (FRP), Metal matrix composites (MMC), Ceramic matrix composites (CMC), Classification, properties and uses of Synthetic lubricants, Semisolid lubricants, Advanced materials (Biomaterials, nanomaterials) with special reference to the applications in chemical Industries	**15%**	**6**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Engineering Materials (Textbook) By S C Rangwala | Charter
2. Safe Handling of Hazardous Chemicals by A.K. Rohatgi | J.K. Enterprise
3. Engineering Metrology and Instrumentation by R.K. Rajput

7)

a) **Course Name:** Chemical Technology – I

b) **Course Code:** 03602217

c) **Prerequisite:** Understanding of general chemistry concepts such as atomic structure, chemical bonding, and stoichiometry.

d) **Rationale:** This course is a comprehensive overview of industrial chemical processes and their applications. These are crucial knowledge areas for the future engineer and technologist to ensure that production methods are optimized, engineering problems are solved, and that efficiency and safety are ensured in industrial situations.

e) **Course Learning Objective:**

CLOBJ 1	Take part in Chemical Processes
CLOBJ 2	Analyze Manufacturing Processes and Engineering Challenges
CLOBJ 3	Apply Chemical Knowledge to Industrial Applications
CLOBJ 4	Evaluate Environmental and Economic Impacts
CLOBJ 5	Design and Propose Innovations in Chemical Technology

f) **Course Learning Outcomes:**

CLO 1	Identify and Categorize Unit Operations and Symbols.
CLO2	Explain Manufacturing Processes for Natural Products and Edible Oils.
CLO 3	Analyze Chemical Reactions in Industrial Processes.
CLO 4	Apply Knowledge to Design and Evaluate Inorganic Chemical Processes.
CLO 5	Develop and Interpret Process Flow Sheets and Evaluate Engineering Challenges.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit I: Acid And Alkali** Scope and classification of chemical Industries. Hall – Physical and Chemical properties, application, Manufacturing process. H2SO4 – Physical and Chemical properties, application, Mining of Sulfur and Manufacturing process and Major engineering problems. Soda Ash – Physical and Chemical properties, application, Manufacturing process and Major engineering problems. Caustic soda. – Physical and Chemical properties, application, Manufacturing process Manufacture process	**28%**	**11**
2	**Unit II: Fertilizer industries** Introduction to Fertilizer industries Ammonia - Physical and Chemical properties, uses, application manufacturing processes. Urea -Physical and Chemical properties, uses, application manufacturing processes. Nitric acid - Physical and Chemical properties, uses, application manufacturing processes. Phosphoric acid-Physical and Chemical properties, uses, application manufacturing processes. NPK fertilizer.	**27%**	**11**
3	**Unit III: Cement And Lime** Introduction of cement and lime Cement - Properties, uses, types, Manufacturing process of Portland Cement, Major Engineering problems of cement industry. Lime - Properties, uses, types, Manufacturing process	**15%**	**8**
4	**Unit IV: Coal And Coal Chemicals** Types of coal and coal chemicals Coking of coal, Distillation of coal tar, Gasification of coal, Hydrogenation of coal.	**15%**	**7**
5	**Unit V: Metallurgical Industries** Iron ores, bauxite and copper pyrites Production of pig iron by Bessemer process, Aluminum from bauxite; and extraction of copper from copper pyrites	**15%**	**8**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. R. Publishers Gopal and M. Sittig, “Dryden’s Outlines of Chemical Technology: For The 21st Century” Third Edition, Affiliated East-West.
2. G.T. Austin, “Shreve’s Chemical Process Industries”, McGraw Hill, New York.
3. O.P. Gupta, “Chemical Process Technology”, Khanna Publishing House Engineering chemistry marry jane & shut; encage learning
4. Wavemaker, S.C. Bhatia “Chemical Process Industries volume I and II” CBS Publishers& Distributors

(8)

a) **Course Name:** Chemical Process Calculation

b) **Course Code:** 03602223

c) **Prerequisite:** Basic Knowledge of Mathematics-I, Mathematics-II.

d) **Rationale:** It is designed to build a solid foundation in unit conversions, chemical calculations, material and energy balances, and combustion processes, all of which are critical for efficient and safe operation in industrial processes.

e) **Course Learning Objective:**

CLOBJ 1	Demonstrate the ability to convert units between different systems and apply these conversions in chemical process calculations.
CLOBJ 2	Perform basic chemical calculations to determine the composition of mixtures, including mass, volume, and concentration.
CLOBJ 3	Apply the ideal gas law to calculate important physical properties of gases, including understanding wet and dry bulb thermometry.
CLOBJ 4	Analyze and solve material balance problems for processes both with and without chemical reactions, including recycling and bypass operations.
CLOBJ 5	Take part in processes by applying principles of energy balance, including heat of formation, heat of reaction, and combustion air requirements.

f) **Course Learning Outcomes:**

CLO 1	Demonstrate an understanding of the significance of studying unit operations and processes in chemical engineering.
CLO2	Judge units and dimensions and adapt equations when transitioning between different unit systems.
CLO 3	Apply principles of physics and chemistry to analyze and solve problems relevant to the process industry.
CLO 4	Integrate and synthesize data to formulate and solve mass and energy balance problems.
CLO 5	Utilize mathematical techniques to solve complex mass and energy balance problems, including those with chemical reactions.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**1**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Unit I: Unit System** Introduction to process calculation, define different unit systems, Importance of physical quantities of Units, Convert units among different systems	**9%**	**4**
2	**Unit II: Basic Chemical Calculations** Calculate important physical quantities, Calculate composition of mixtures and solutions	**11%**	**5**
3	**Unit III: Ideal Gas Law** Derive ideal gas law. State reference conditions. Calculate important quantities for ideal gas mixture. Wet and dry bulb thermometry.	**12%**	**6**
4	**Unit IV: Material Balance in Processes Without Chemical Reaction** Explain law of conservation of mass, calculate mass balance of important unit operations at steady state condition, describe recycling and by-passing operations	**19%**	**9**
5	**Unit V: Material Balance in Processes with Chemical Reaction** Explain basic concepts of material balance with chemical reaction, Calculate mass balance with chemical reaction.	**17%**	**8**
6	**Unit VI: Energy Balance** Calculate heat capacity, specific heat, heat capacity of gas mixture and liquid mixture, explain concepts of sensible heat and latent heat, Calculate standard heat of formation and heat of reaction, Hess's law of summation	**20%**	**7**
7	**Unit VII: Combustion** Describe combustion, describe calorific values, calculate calorific value and air requirement for combustion, ORSAT analysis	**12%**	**6**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Process Calculations" Venkataramani, V., Anantharaman, N., Begum, K. M. Meera Sheriff; Second Edition, Prentice Hall of India.
2. Stoichiometry B.I. Bhatt, Thakor; McGraw Hill Publishing Company Limited
3. Stoichiometry and Process Calculations K.V. Narayanan, B. Lakshmi Kutty; Prentice Hall of India Pvt. Ltd

9)

a) **Course Name:** Professional Communication and Critical Thinking

b) **Course Code:** 03693203

c) **Prerequisite:** Knowledge of English Language.

d) **Rationale:** Advance level of communication and personality development is crucial for and after placement,

e) **Course Learning Objective:**

CLOBJ 1	Discover the ability to clearly and confidently articulate ideas and information in various professional settings, including presentations, meetings, and discussions.
CLOBJ 2	Improve skills in writing clear, concise, and professional documents such as reports, emails, proposals, and executive summaries.
CLOBJ 3	Develop the ability to analyze complex problems, identify underlying issues, and evaluate potential solutions using logical reasoning and evidence-based approaches.

f) Course Learning Outcomes:

CLO 1	Develop basic speaking and writing skills including proper usage of language and vocabulary so that they can become highly confident and skilled speakers and writers.
CLO2	List of the latest trends in basic verbal activities such as presentations, facing interviews and other forms of oral communication.
CLO 3	Explain skills of group presentation and communication in team.
CLO 4	Develop non-verbal communication such as proper use of body language and gestures.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
1	-	-	1	-	100	-	-	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

W - Weightage (%), **T** - Teaching hours

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Story Mason** Classroom activity to encourage students to speak on topics they are good at, hence boosting confidence of students.	5%	1
2	**Determiners, Articles, and Interrogatives** This session will enable students to understand proper usage of Determiners and Articles. It will also enhance their daily speaking conversational/ communication skills. Preparation of verbal section in	10%	2

	company's aptitude exam.		
3	**Subject-Verb Agreement** This will enable students to understand the formation of sentence with the usage of subject-verb agreement.	**10%**	**1**
4	**Reading-Skill Building** Types of Reading – reading for different purposes An Astrologer's Day-Magadi Days Enhance reading skills by collecting information, know the importance of reading.	**10%**	**1**
5	**Reading Comprehension** Learn to solve the reading comprehension questions in an easy manner and also in less amount of time Introduction, Factual & Inferential comprehension, Reasons for Poor Comprehension Able to solve reading comprehension in less amount of Time by practicing.	**10%**	**2**
6	**Mafia the art of Observation and Convincing** The interesting activity is targeted toward improving observation and convincing skills. A team activity in which every single Individual is a very important person of his team to win.	**5%**	**1**
7	**Direct and Indirect Speech** This session will enable students to understand proper usage of narration.	**10%**	**1**
8	**Industry Expectation** In this class the students will be made to understand what will be the world after their college life will be, how they should prepare themselves from that competitive world with full of challenges for them.	**5%**	**1**
9	**Mirror & Water Images** Reflection of an object into a mirror and water. It is obtained by inverting an object laterally (mirror) & vertically (water).	**10%**	**1**
10	**Sentence Correction** It will also enhance their daily speaking conversational/communication skills. Preparation of verbal section in company's aptitude exam.	**5%**	**1**
11	**Play Teacher** Classroom activity to encourage students to speak on topics they are good at, hence boosting confidence of students.	**5%**	**1**
12	**Professional Writing** Email and report.	**5%**	**1**
13	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	**10%**	**1**
	Total	**100%**	**15**

i) Text Book and Reference Book:

1. **Active English**
   By Juneja & Qureshi | Macmillan
2. **Verbal and Non-verbal reasoning**
   By B.S. Sijvali and Indu Shivali | Arihant Publication
3. **Competitive English**
   By Azhar Siddiqui | Macmillan

SEMESTER 4

1)

a) Course Name: Basics of Petroleum and Petrochemical

b) Course Code: 03628251

c) Prerequisite: A basic understanding of organic chemistry (hydrocarbons), thermodynamics, and fluid mechanics is essential. Additionally, familiarity with industrial safety and petroleum industry basics is helpful.

d) Rationale: The Petrochemical industry in India is poised for explosive growth in the coming years. The various chapters of Basics of Petrochemicals like Importance of Petrochemical industry, IUPAC names, oil recovery methods etc ,

e) Course Learning Objective:

CLOBJ 1	Identify the global and regional significance of petroleum in the energy sector.
CLOBJ 2	Describe the processes involved in refining crude oil (e.g., distillation, cracking, reforming).
CLOBJ 3	tay updated on advancements in petroleum technology, alternative fuels, and global energy transitions.

f) Course Learning Outcomes:

CLO 1	Demonstrate knowledge of the origin, exploration, and classification of crude oil and natural gas.
CLO2	Recognize the major petrochemical products (e.g., plastics, polymers, synthetic rubbers) and their industrial uses.
CLO 3	Assess physical and chemical properties of fuels and petrochemical products using standard laboratory techniques.
CLO 4	Use fundamental knowledge of chemistry, thermodynamics, and fluid mechanics to address real-world challenges in the industry.
CLO 5	Collaborate effectively on projects related to petroleum refining and petrochemical production while fostering innovative problem-solving.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**UNIT 1The Petrochemical Industry** 1.1 Introduction,1.2 Historical aspects and overview, 1.3 Petrochemical industry, 1.4 Petrochemicals (1) Primary petrochemicals (2) Product and End Use 1.5 Production of petrochemicals	**15%**	**7**
2	**UNIT 2Oil And Gas Exploration Methods** Geological and geophysical methods, Drilling: Introduction to drilling operations, Basics of drilling, Drilling rig, drilling equipment & its component	**25%**	**10**
3	**UNIT 3Reservoir Drives & Oil Recovery** 3.1 Primary oil recovery, secondary oil recovery, 3.2 Enhanced oil recovery methods: 3.2.1 Chemical, Thermal & Others Recovery of Heavy Oil & Tar 3.2.2 Sand Bitumen: Oil Mining & Non Mining Methods	**30%**	**14**
4	**UNIT 4Feedstock Preparation By Gasification** Introduction, Gasification Chemistry, General Aspects, Pretreatment Reactions, Primary Gasification, Secondary Gasification, Hydrogasification	**30%**	**14**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Gas Processing.
   By Speight,Janes A

2. A Text Book on Petrochemicals.
   By Dr. B.K. Bhaskara Rao,

3. Fundamentals of Petroleum & Petrochemical engineering, Uttam Ray Chaudhuri, CRC Press, 2011

2)

a. **Course Name:** Mass Transfer – I

b. **Course Code:** 03602277

c. **Prerequisite:** Basic knowledge of diffusion, gas absorption, humidification, drying etc.

d. **Rationale:** To learn the concept of diffusion in gas, liquid & solid. Try to understand the basics of inter phase mass transfer. Also deliver application of gas-liquid operation and simultaneous heat and mass transfer operations.

e. **Course Learning Objective:**

CLOBJ 1	Define key terms and concepts in mass transfer, such as diffusion, flux, and mass transfer coefficient.
CLOBJ 2	Explain Fick's laws of diffusion and their significance in mass transfer processes.
CLOBJ 3	Apply Fick's laws to solve diffusion-related problems in gaseous, liquid, and solid media.
CLOBJ 4	Analyze drying rate curves to determine critical moisture content and predict drying times for various materials.
CLOBJ 5	Design an experimental setup for measuring diffusivity in a liquid mixture, incorporating appropriate methods and equipment.
CLOBJ 6	Evaluate the performance of different types of gas absorption equipment and packing materials based on operational efficiency and effectiveness.

f. **Course Learning Outcomes:**

CLO 1	Familiar with the basic phenomenon of mass transfer involving phases.
CLO 2	Able to apply the concepts of mass transfer in gas-liquid systems like absorption, humidification, drying and crystallization.
CLO 3	Gaining good knowledge of required optimum condition for a gas-liquid system.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**1**	**-**	**4**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. Course Content:

Sr. No.	Content	Weightage (%)	Teaching (hr.)
1	**Fundamental of Mass Transfer** Definition- Ficks law, Molecular and eddy diffusion, Diffusion in gaseous mixtures, liquid mixtures and solids, measurement and calculation of diffusivities. Mass transfer coefficients - Individual andoverall, with relations, Theories of mass transfer, Analogies between momentum, heat and mass transfer to predict mass transfer coefficients	**25%**	**10**
2	**Gas Absorption** Absorption − Solubility, theory of gas absorption, Concept of Equilibrium and operating lines. Gas Absorption Equipment's-Batch and continuous, Stage wise contactors and Differential contactors, Concept of HTU and NTU, Tower packing 's and packing characteristics, Types of packing.	**20%**	**9**
3	**Humidification Operation** Humidification Theory, Psychometric Chart, Adiabatic Saturator, Wet-Bulb Theory, Methods of Humidification and dehumidification, Cooling towers,	**22%**	**10**
4	**Drying** Drying Theory and Mechanism, Drying Characteristics, Estimation of Drying time, drying rate curve, Classification of Driers, Types of Dryers, Description and Application of Driers, Continuous driers.	**20%**	**9**
5	**Crystallization** Crystallization, Solubility curve, Types of crystals, Principles of Crystallization, Supersaturation Theory, Factors governing nucleation and crystal growth. Theory of crystallization, Classification of crystallizers and their applications	**13%**	**7**
	Total	**100%**	**45**

i. Text Book and Reference Book:

1. Mass Transfer Operations by Tribal, R. E | McGraw Hill | 3rd ed
2. Principles of Mass transfer and Separation Process by Dutta, B.K., 2007 | Prentice-Hall of India Pvt. Ltd., New Delhi
3. Unit operations of Chemical Engineering by Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill
4. Fundamentals of Heat and Mass Transfer by Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incorporeal, David P. DeWitt | Willey
5. Chemical Engineering Series, Chemical Engineering Design by R. K. Sinnott, Coulson and Richardson 's; 4th Edition, VI volume, Elsevier Publication.
6. Mass Transfer: Theory and Practice by N. Anantharaman, K.M. Meera Sheriff Begum, PHI Learning put ltd

(3)

a. **Course Name:** Mass Transfer – I Lab

b. **Course Code:** 03602266

c. **Prerequisite:** Basic knowledge of diffusion, gas absorption, humidification, drying etc.

d. **Rationale:** Inspect experience analysis of mass transfer operations.

e. **Course Learning Objective:**

CLOBJ 1	Describe the principles governing diffusivity in liquid-liquid systems and how temperature affects it.
CLOBJ 2	Compute the diffusivity of a liquid-liquid system at various temperatures using provided data and formulas.
CLOBJ 3	Investigate and differentiate the rate of absorption in trays versus packed towers through experimental analysis.
CLOBJ 4	Construct drying curves for different materials and utilize them to estimate drying time and equilibrium moisture content.
CLOBJ 5	Simplify the yields of crystals from saturated solutions with and without seeding, assessing the impact of seeding on crystal formation.

f. **Course Learning Outcomes:**

CLO 1	Analyze the concept of diffusion and convection
CLO 2	Label the different types of distillation
CLO 3	Relate the contactors used in chemical Process Industries.
CLO 4	Surve the usage and employability of devices for determining the separation factors and efficiencies of the systems.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

h. Experiment List:

Sr. NO.	Name of Experiment List
1	**Determine diffusivity of liquid-liquid system at room temperature**
2	**Determine diffusivity of liquid-liquid system at different temperature**
3	**Find out rate of absorption in a tray or packed tower**
4	**Find out the property of atmospheric air with the help of wet bulb and dry bulb temperature**
5	**Prepare drying curve of moist sand and moist limestone**
6	**Find out equilibrium moisture content and drying time of wet solid**
7	**Find out the yield of crystals from saturated solution without seeding**
8	**Find out the yield of crystals of from saturated solution with seeding**

i. Text Book and Reference Book:

1. Mass Transfer Operations by Tribal, R. E | McGraw Hill | 3rd ed
2. Principles of Mass transfer and Separation Process by Dutta, B.K., 2007 | Prentice-Hall of India Pvt. Ltd., New Delhi
3. Unit operations of Chemical Engineering by Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill
4. Fundamentals of Heat and Mass Transfer by Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incorporeal, David P. DeWitt | Willey
5. Chemical Engineering Series, Chemical Engineering Design by R. K. Sinnott, Coulson and Richardson 's; 4th Edition, VI volume, Elsevier Publication.
6. Mass Transfer: Theory and Practice by N. Anantharaman, K.M. Meera Sheriff Begum, PHI Learning put ltd

4)

a) **Course Name:** Pollution Control and Effluent treatment

b) **Course Code:** 03602267

c) **Prerequisite:** Basic Knowledge of Waste Management, Waste Disposal, Effluent.

d) **Rationale:** The operations of chemical plants require use of material handling and size reduction equipment, screens, agitator, mixers, centrifuges, cyclones, filters and other mechanical separation equipment.

e) **Course Learning Objective:**

CLOBJ 1	Identify and classify various types of pollution (air, water, soil, noise, etc.) and their primary sources in industrial, agricultural, and urban settings.
CLOBJ 2	Infer key environmental regulations, standards, and policies related to pollution control and effluent treatment (e.g., EPA, Clean Water Act, and Air Quality Standards).
CLOBJ 3	Translate the technologies and engineering solutions used to control and reduce pollution in different sectors (e.g., air scrubbers, catalytic converters, filtration systems).
CLOBJ 4	Interpret stages of effluent treatment, including primary, secondary, and tertiary treatments, and the processes involved (e.g., biological, chemical, and physical treatment methods).
CLOBJ 5	Extend how to design, operate, and maintain wastewater treatment plants, including aspects such as sludge treatment, membrane filtration, and bio-remediation.
CLOBJ 6	Demonstrate the methods for safe handling, treatment, and disposal of hazardous wastes generated by industrial processes, including legal and environmental requirements.

f) **Course Learning Outcomes:**

CLO 1	Define & classify pollution and pollutant - (Air, Water, solid)
CLO 2	Describe removal of pollutants by applying various treatment methods
CLO 3	Identify Sources of Pollution
CLO 4	Happen Environmental audit and ISO 14001

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching (hr.)
1	**Basics of Environmental Pollution:** Introduction of pollution and pollutants, Types of pollution and pollutants Sources of air, water, noise, radioactive and land pollution, Effects of air, water, noise, radioactive and land pollution.	**20%**	**9**
2	**Air Pollution:** Ambient air sampling, Sampling of gaseous air pollutants and particulate pollutants Particulate control equipment's , Gravity Settling Chamber, Cyclone separator, Fabric Filter, Wet Scrubber and Electrostatic Precipitator, Thermal incineration, Methods for control of Sulfur dioxide emission, Extraction of sulfur from fuels, Hydrodesulphurization of coal, Desulphurization of fuel oils, Desulphurization of flue gases by Dry processes(using metal oxides and activated carbon) and wet processes(wet scrubbing methods), Methods for control of Nitrogen Oxides, Absorption of NOx, Adsorption of NOx, Catalytic reduction, Control of carbon monoxide, Control of hydrocarbons.	**32%**	**14**
3	**Water Pollution:** Dissolved oxygen, BOD,COD, VM, Suspended Matter, Dissolved solids, pH, Water sampling methods, Grab sampling, Composite sampling, Waste water treatment methods, Primary treatment, Pretreatment, Sedimentation, Floatation, Secondary treatment, Aerobic process, Anaerobic process: Activated sludge process and trickling filter, Suspended solids treatment methods, Micro straining, Coagulation, Filtration, Dissolved solids and treatment methods, Ion exchange, Reverse Osmosis, Electrolysis, Facultative ponds, Chemical oxidation/Disinfection, Thickening, Digestion, Conditioning, Dewatering, Oxidation and ultimate sludge removal, Effluent treatment planted, Norms of GPCB for potable water, Forward Osmosis, Ultra filtration.	**28%**	**12**
4	**Solid Waste Management:** Solid waste, Methods of solid waste disposal, Open Dumping, Sanitary Land filling, Incineration, Compositing, Reuse, recovery and recycling, Plastic Segregation and Recycling.	**10%**	**5**
5	**Environmental audit and ISO 14001:** Environmental audit, Procedure for environmental audit, ISO 14001, Benefits of ISO 14001, ISO 14001- Assessment process	**10%**	**5**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Environmental Pollution Control Engineering, By Rao C.S. | New Age International
2. Pollution Control in Process Industries by Mahajan S.P
3. Environmental Engineering by Pandey G. N., Carney G. C. | Tata Mc Graw Hill, New Delhi.

(5)

a) **Course Name:** Pollution Control and Effluent treatment Lab

b) **Course Code:** 03602268

c) **Prerequisite:** Basic Knowledge of Waste Disposal, Waste Management, Effluent.

d) **Rationale:** Apply principles developed in chemical engineering courses to the analysis of chemical engineering processes and unit operations.

e) **Course Learning Objective:**

CLOBJ 1	Develop skills to measure and analyze pollutants in air, water, and soil using various laboratory instruments and techniques (e.g., gas analyzers, spectrophotometers, pH meters).
CLOBJ 2	Learn how to collect, handle, and prepare samples of industrial and municipal effluents for laboratory testing, including understanding the characteristics of different types of waste streams.
CLOBJ 3	Gain hands-on experience in analyzing water quality parameters such as Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), pH, turbidity, and dissolved oxygen (DO).
CLOBJ 4	Conduct experiments to measure air pollutants (e.g., particulate matter, sulfur dioxide, nitrogen oxides) using equipment such as air samplers and gas analyzers.
CLOBJ 5	Apply physical, chemical, and biological treatment processes to laboratory-scale wastewater treatment systems, including coagulation, flocculation, filtration, and activated sludge processes.
CLOBJ 6	Recall experience in analyzing and treating sludge from wastewater treatment processes, including thickening, stabilization, and dewatering methods.
CLOBJ 7	Perform experiments on solid waste management, including characterization, recycling methods, composting, and analysis of leachate from waste disposal.

f) **Course Learning Outcomes:**

CLO 1	Relate the fundamentals involved in the pollution and pollutant.
CLO 2	Show and application of the concept of various treatment methods.
CLO 3	Discuss Environmental audit and ISO 14001.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**50**	**-**	**-**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Experiment List:

Sr. NO.	Name of Experiment List
1	Prepare detail charts of various Pollutants and sources of pollution
2	Remove suspended Impurities from air using cyclone system
3	Remove suspended Impurities from air using fabric filter
4	Determine hardness (Temporary and Permanent hardness) of given water sample
5	Determine COD of the given effluent sample
6	Measure suspended particles in liquids using Turbidity meter
7	Determine BOD of given sample
8	Determine Dissolved Oxygen in effluent sample
9	Determine total dissolved solids in given effluent sample using heat treatment
10	Remove suspended solid by coagulation
11	Prepare chart for treatments of different solid waste
12	Prepare Environmental Audit report for any Chemical Industry

i) Text Book and Reference Book:

1. Environmental Pollution Control Engineering by Rao C.S | 2nd edition.
2. Pollution Control in Process Industries by Mahajan S. P. | Tata Mc Graw Hill, New Delhi, 21st

6)

a) **Course Name:** Process Heat Transfer

b) **Course Code:** 03602279

c) **Prerequisite:** Basic knowledge of different modes of heat transfer.

d) **Rationale:** The knowledge of the basic concepts and principles of heat transfer helps smooth and proper operation of various heat exchangers, evaporators and condensers. Using the concepts of conduction, convection and radiation heat losses through pipes, equipment and storage tanks can be estimated.

e) **Course Learning Objective:**

CLOBJ 1	Define the three primary modes of heat transfer (conduction, convection, and radiation) and explain their importance and application in process industries.
CLOBJ 2	Apply Fourier's Law to calculate heat transfer rate, heat flux, and temperature gradient in various materials, and solve problems involving steady-state heat conduction through composite walls, cylinders, and spheres.
CLOBJ 3	Differentiate between free and forced convection and apply Newton's Law of convective heat transfer to determine individual and overall heat transfer coefficients for various practical scenarios.
CLOBJ 4	Identify and describe different types of heat exchangers based on flow patterns and construction, and analyze their performance using the Log Mean Temperature Difference (LMTD) method to solve related calculations.
CLOBJ 5	Explain the principles of heat transfer during phase changes, including boiling and condensation, and apply dimensionless groups such as Prandtl Number, Reynolds Number, Grashoff Number, and Nusselt Number to analyze phase change processes.
CLOBJ 6	Describe fundamental concepts of thermal radiation, including emission, wavelength, and emissive power, and apply radiation laws such as Kirchhoff's Law, Planck's Law, Stefan-Boltzmann Law, and Wien's Law to solve radiation-related problems.

f) **Course Learning Outcomes:**

CLO 1	Classify Modes of heat transfer.
CLO 2	Derive equations of steady state heat transfer through wall, cylinder and sphere.
CLO 3	Make use of shell and tube heat exchangers.
CLO 4	Demonstrate heat transfer with phase change
CLO 5	Calculate radiation based on radiation laws.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
3	1	0	4	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Fundamental of Heat Transfer** Definition and importance of heat transfer in process Industries, Modes of heat transfer: (a)Conduction (b)Convection (c)Radiation, Steady state and unsteady state heat transfer	8%	2
2	**Heat Transfer by Conduction** Foresaw of heat conduction with Concepts of (a) Heat transfer rate (b) Heat flux (c) Temperature gradient, Thermal conductivity and its variation with temp, Steady state(S.S.) heat conduction through composite wall, S.S. heat conduction through composite cylinder up to three layers, Sushant conduction through composite sphere up to three layers, Simple problems by direct use formula, Thermal Conductivity of solids, liquids and gases, Hot and cold Insulation: (a) Optimum thickness of insulation, (b)Lagging of steam pipe, Derivation of equation for critical radius of insulation and calculations.	22%	10
3	Heat Transfer by Convection Types of Convection, Free convection, Force convection, Newtons Law of convective heat transfer, Individual and Overall heat transfer coefficient, Simple Problems of Convection	10%	5
4	Heat exchangers Types of heat exchanger based on flow pattern, function and construction, Double pipe heat exchanger (a)Countercurrent (b) Concurrent, Shell and tube heat exchanger: (a) 1-1 Pass (b)1-2 Pass (c) 2-4 Pass, Plate type heat exchanger, Finned type (extended surface) heat exchanger, Spiral type heat exchanger, Heat transfer in agitated vessels, L.M.T.D.: derivation of equation and simple calculations, Overall heat transfer co-efficient of heat exchangers and heat exchanger area.	20%	10
5	Heat Transfer with Phase Change Heat transfer with phase change, Significance of dimensionless groups (a) Prandtl No. (b) Reynold No. (c) Grashoff No. (d)Nusselt No., Phenomena of Boiling (a)Pool and Nucleate boiling, Phenomena of Condensation: (a) Drop wise and film wise Condensation (b)Commonly used Condensers	15%	6

6	Thermal Radiation Fundamental facts of radiation, Concepts of radiation:(a) Emission of radiation (b) Wavelength of radiation (c) Emissive power (d) Black body (e) Gray body (f) White body (g) Opaque body (h)Monochromatic wavelength, Radiation laws: (a) Kirchhoff's Law (b) Plank's Law (c) Stefan Boltzmann Law (d) Wein's law, Simple calculations of radiation between black surfaces	**15%**	**6**
7	Evaporation Introduction of evaporation, Characteristics of liquid for evaporation, Single and Mult effect evaporation with flow arrangement, Types of evaporators: (a) Short tube evaporator (b)Agitated film evaporator (c) Long tube vertical evaporators (I)Forced circulation (ii)Upward flow [Climbing film] (iii)Downward flow [falling film] (iv) Triple Effect Evaporator, Evaporator capacity and economy, Direct use of formula for solving simple evaporation problems.	**10%**	**6**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Process Heat Transfer by D. Q. Kern, | McGraw Hill.
2. Badger and Bencher, "Introduction to Chemical Engineering". Tata McGraw hill.
3. Engineering heat transfer By Gupta & Prakash | Nem Chand & Brothers, New Delhi, 1999 (Seventh Edition)
4. Heat Transfer: A Basic Approach by M. Annexationistic | McGraw-Hill Inc
5. Unit Operations of Chemical Engineering by McCabe W L, SmithJ C, Harriott | McGraw-Hill Publication
6. Unit Operation –II By Givhan, K.A. | Givhan, K.A.
7. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar | S.K. Kataria & Sons

7)

a) Course Name: Process Heat Transfer Lab

b) Course Code: 03602264

c) Prerequisite: Basic knowledge of different modes of heat transfer

d) Rationale: The knowledge of the basic concepts and principles of heat transfer helps smooth and proper operation of various heat exchangers, evaporators and condensers. Using the concepts of conduction, convection and radiation heat losses through pipes, equipment and storage tanks can be estimated.

e) Course Learning Objective:

CLOBJ 1	Measure the thermal conductivity of a metal rod using experimental techniques and analyze the impact of material properties on heat transfer rates.
CLOBJ 2	Determine the thermal conductivity of a liquid using appropriate laboratory methods and evaluate how liquid properties affect heat transfer.
CLOBJ 3	Calculate the thermal conductivity of a composite wall by analyzing the heat transfer through multiple layers and apply the results to practical insulation problems.
CLOBJ 4	Evaluate the thermal conductivity of various insulating materials and recommend suitable materials for effective thermal insulation in specific applications.
CLOBJ 5	Analyze the heat transfer rates due to natural convection in a given system and apply theoretical models to predict convective heat transfer performance.

i. Course Learning Outcomes:

CLO 1	Organize Experimental Measurement of Thermal Conductivity
CLO 2	Relate Heat Transfer Mechanisms
CLO 3	Recall of Overall Heat Transfer Coefficient Determination
CLO 4	Match in Calculating Condensation Rates
CLO 5	Estimate Determination of Emissivity

j. Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
-	-	2	1	-	-	50	-	-	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE** Continuous Evaluation, **ESE-** End Semester Examination

k. Course Content:

Sr. NO.	Name of Experiment List
1	Thermal Conductivity of Metal Rod
2	Thermal Conductivity of Liquid

3	Thermal Conductivity of composite wall
4	Thermal conductivity of Insulating material
5	Heat Transfer by Natural Convection
6	Heat Transfer by Forced convection
7	Heat Transfer through lagged pipe
8	Determine the overall heat transfer coefficient for Shell and Tube Heat exchanger
9	Determine the overall heat transfer coefficient for Plate type Heat Exchanger
10	Determine the overall heat transfer coefficient for Double Pipe Heat Exchanger
11	Calculate the rate of Condensation in Dropwise and Film wise Condensation
12	Determine Emissivity using Stefan Boltzmann apparatus
13	Determine Emissivity of Gray Body
14	Determine the Economy of open pan evaporators

I. Text Book and Reference Book:

1. Process Heat Transfer by D. Q. Kern, | McGraw Hill
2. Unit Operation –II By Givhan, K.A. | Givhan, K.A.

8)

a) **Course Name:** Essence of Indian Knowledge and Tradition

b) **Course Code:** 03600251

c) **Prerequisite:** A basic understanding or interest in philosophical concepts, including ethics, metaphysics, and epistemology, particularly within the Indian context (optional but beneficial).

d) **Rationale:** The course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.

e) **Course Learning Objective**

CLOBJ 1	Keen to learn the fundamental principles and concepts of Indian knowledge and tradition, including its philosophical, spiritual, and cultural aspects.
CLOBJ 2	Analyze the historical development and evolution of Indian thought, from ancient Vedic period to modern times, highlighting key figures, texts, and movements.
CLOBJ 3	Importance of Indian knowledge systems to various fields, including science, mathematics, medicine, and the arts.

f) **Course Learning Outcomes:**

CLO 1	Elaborate the role of Modern Science.
CLO 2	Ability to understand, connect up and explain basics of Indian Traditional knowledge modern scientific perspective.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
2	**-**	**-**	**0**	**20**	**20**	-	**-**	-	**40**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Topics**	**Weightage (%)**	**Teaching Hours**
1	**Basic Structure of Indian Knowledge System** I) Vedas, (ii) Unveda (Ayurveda, Dhanuveda, Gandhveda, Sthanya etc.) (iii) Vedanga (Education, Kalna, Nan rut, Grammar, Jyotish verses), (iv) Upanayana (Dharma level, Viramas, Purana, Takoma level)	**60%**	**10**
2	**Modern Science and Indian Knowledge System**	**15%**	**2**
3	**Yoga and Holistic Health care**	**15%**	**1**
4	**Case Studies**	**10%**	**2**
	Total	**100%**	**15**

9)

a) **Course Name:** Chemical Technology -II lab

b) **Course Code:** 03602272

c) **Prerequisite:** Students should have completed the Chemical Technology - I Lab course, which covers the fundamental principles and techniques of chemical technology, including laboratory safety, measurement, and instrumentation.

d) **Rationale:** The course aims at Students should have a good understanding of mathematical concepts, including algebra, calculus, and statistics, as they are essential for data analysis and interpretation in chemical technology.

e) **Course Learning Objective**

CLOBJ 1	Design and conduct experiments to investigate chemical processes and unit operations, including reaction kinetics, mass transfer, and separation processes.
CLOBJ 2	Conclude, Collect, analyze, and interpret data from laboratory experiments, including statistical analysis and error propagation
CLOBJ 3	Develop and implement laboratory safety protocols, including proper handling and disposal of chemicals, use of personal protective equipment, and emergency procedures.

f) **Course Learning Outcomes:**

CLO 1	Estimation of Acid and Iodine Values
CLO 2	Illustrate Vegetable Oil Extraction
CLO 3	Determine of Glycerine and Alcohol
CLO 4	Make use of Synthesis of Organic Compounds

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	50	**-**	-	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr. NO.	**Name of Experiment List**
1	**Estimate Acid value in oil sample**
2	**Estimate iodine value in oil sample**
3	**Extract vegetable oil from seed**

4	**Prepare Glycerin**
5	**Prepare alcohol**
6	**Prepare citric acid**
7	**Prepare nitrobenzene**
8	**Prepare indigo dye**
9	**Prepare soap**
10	**Prepare detergent**

10)

a. **Course Name:** Chemical Technology –II

b. **Course Code:** 03602273

c. **Prerequisite:** Students should have a good understanding of mathematical concepts, including algebra, calculus, and statistics, as they are essential for data analysis and interpretation in chemical technology.

d. **Rationale:** The course aims Communicate experimental results and findings effectively through written reports and oral presentations.

e. **Course Learning Objective**

CLOBJ 1	Experiment with chemical technology, research, and development, or further education in related fields.
CLOBJ 2	Plan an understanding of the role of chemical technology in addressing global challenges, including energy, environment, and health.
CLOBJ 3	Make up critical thinking and problem-solving skills to troubleshoot process issues and optimize chemical processes.

f. **Course Learning Outcomes:**

CLO 1	Identify the various unit operations and processes with their symbols
CLO 2	Dissect the manufacturing process of natural products processing and industrial microbial Processes and edible oils
CLO 3	Inspect the various chemical reactions involved in the process
CLO 4	Motive the manufacturing process of inorganic chemicals
CLO 5	Evaluate the process flow sheet and understand the major engineering problems encountered in the processes.

g. **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
4	**-**	**-**	**4**	**20**	**20**	-	**60**	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

Sr.	**Topics**	**Weightage (%)**	**Teaching Hours**
1	**Natural Product Industries**1.1Basics of oil and fat 1.2 Physical properties of oil 1.3 Introduction to Carbohydrates 1.4 Manufacturing Process of (I) Vegetable oil (ii) Hydrogenated products of oil (iii) Sugar from sugar-cane (iv) Starch from maize (v) Dextrin from starch 1.5 Chemicals from sea, Production of bromine from sea water	**25%**	**18**
2	**Pulp and Paper Products**2.1 Fundamentals of Pulp and paper 2.2 Methods of pulp production 2.3. Sulphate (Kraft) pulp process 2.4. Manufacturing of paper using Fourdrinier machine	**15%**	**12**

3	**Fuel and Industrial Gases**3.1 Fuels 3.1 Important industrial gases: types, sources, uses 3.3 Production of fuel gases (I) producer gas (ii) water gas (iii) coke oven gas (iv) natural gas 3.4 Industrial electrolytic processes	**15%**	**12**
4	**Fermentation Industries**4.1 Fermentation 4.2 Manufacture of (I) Ethyl alcohol by fermentation (ii) Lactic acid from corn sugar (iii) Citric acid from molasses (iv) vinegar by Frings' method 4.3 Biotechnology in Chemical Engineering	**25%**	**9**
5	**Miscellaneous**5.1 Definition & applications of dye 5.2 Manufacture of (I) Aniline by reduction of nitrobenzene, (ii) Anthraquinone from phthalic anhydride, 5.3. Azo Dye, Vat dye and Reactive dye 5.4 Soap and detergent 5.5 Manufacture of (I) soap by continuous hydrolysis and saponification (ii) Linear Alkyl Benzene (LAB)	**20%**	**9**
	Total	**100%**	**60**

i. Text Book and Reference Book:

1. R. Publishers Gopal and M. Sittig, "Dryden's Outlines of Chemical Technology: For The 21st Century" Third Edition, Affiliated East-West
2. G.T. Austin, "Shreve's Chemical Process Industries", McGraw Hill, New York

11)

a) **Course Name:** Employability Skills

b) **Course Code:** 03693251

c) **Prerequisite:** Knowledge of English Language.

d) **Rationale:** Cracking aptitude is the first step towards cracking placements and competitive exams

e) **Course Learning Objective**

CLOBJ 1	Develop effective verbal, non-verbal, and written communication skills for professional settings.
CLOBJ 2	Analyze the ability to contribute effectively to group projects and resolve conflicts in a constructive manner.
CLOBJ 3	Function critical thinking and decision-making skills through real-life case studies and simulations.

f) **Course Learning Outcomes:**

CLO 1	Improve their critical thinking.
CLO 2	Prepares them for Campus Placement & Competitive Exams.
CLO 3	Builds up their confidence level.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
1	**-**	**-**	**1**	**-**	**100**	-	**-**	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) **Course Content:**

Sr.	**Topics**	**Weightage (%)**	**Teaching Hours**
1	**Critical Thinking - Case Studies** Critical thinking is based on pure logical thinking. Solving a critical reasoning question requires nothing but reasoning ability of the candidate. This session deals with the basic logic involved in critical reasoning questions and covers all the type of questions in CT. Worksheets would be provided to students for further practice.	**8%**	**2**
2	**Coding & Decoding, Alphabetical Series** Understand various types of questions which they can come across in the given topic. Tips and tricks to solve questions on the above-mentioned topics.	**8%**	**1**

3	**Analogy and Odd Man Out** Understand various types of questions which they can come across in the given topic. Tips and tricks to solve questions on the above-mentioned topics.	**8%**	**1**
4	**Direction Sense** Able to solve all the direction sense question in competitive exams and aptitude exams of different Companies.	**8%**	**1**
5	**Blood Relations** Able to solve all the Blood Relation questions in competitive exams and aptitude exams of different companies.	**8%**	**1**
6	**Paper Folding** In this section of nonverbal reasoning a figure is obtained by folding a piece of paper containing same design along the dotted line.	**6%**	**1**
7	**Seating Arrangement** Candidates are required to arrange the objects either in a row or circle on the basis of information. Questions are presented in distorted form to create confusion and to taste the candidate's ability to analyze the information step by step in order to answer the question.	**8%**	**1**
8	**Completion of Figure** In each of the following figure, a part of figure is missing. Find out from the given options, the right figure to fit in the missing figure.	**6%**	**1**
9	**Completion of Series** In these questions a series of figures is given as problem figure & the candidate are asked to select one of the figures from the set of answer figure which will continue the given sequence.	**8%**	**2**
10	**Entrepreneurship Skills (Selling the Concept)** This topic will help students develop the skills necessary to develop into Self- Sufficient business leaders through Entrepreneurship studies.	**8%**	**1**
11	**Resume Building** The students will have a proper understanding of the content and how it is to be presented in resume.	**8%**	**1**
12	**Group Discussion** It is a systematic exchange of information, views and opinions about a topic, problem, issue or situation among the members of a group who share some common objectives.	**8%**	**1**
13	**Interview Skills** Students are prepared for their interviews, question and answers, how to react on some unique	**8%**	**1**
	Total	**100**	**15**

i) Text Book and Reference Book:

1. **Non-Verbal Reasoning**
   By B S Sewali and Indu Sewali | Arihant
2. **Develop Your Contributor Personality**
   I-become Publishers, Mumbai

SEMESTER – 5

1)

a) Course Name: Plant Design and Economics

b) Course Code: 03628307

c) Prerequisite: Basic knowledge of process operations (PFDs, mass/energy balances) and equipment like distillation columns and heat exchangers. Understanding of cost estimation, feasibility analysis, and industrial safety standards.

d) Rationale: The course bridges theoretical knowledge and practical application by teaching students to design efficient, safe, and cost-effective petrochemical plants. It prepares them to address real-world challenges in plant design, optimization, and economic feasibility.

e) Course Learning Objective

CLOBJ 1	Develop skills to interpret and design process flow diagrams (PFDs) and piping and instrumentation diagrams (P&IDs).
CLOBJ 2	Apply safety protocols and environmental standards in plant design.
CLOBJ 3	Gain knowledge of project planning, budgeting, and scheduling in the petrochemical industry.
CLOBJ 4	Learn the fundamentals of designing chemical and petrochemical plants, including layout and equipment selection.

f) Course Learning Outcomes:

CLO 1	Perform cost estimation, profitability analysis, and feasibility studies for plant projects.
CLO 2	Implement industrial safety and environmental compliance in plant design.
CLO 3	Propose solutions to improve plant efficiency, reduce costs, and enhance productivity.
CLO 4	Demonstrate knowledge of project management, budgeting, and planning to meet industry demands.
CLO 5	Design basic layouts and select appropriate equipment for petrochemical plants.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**1**	**0**	**0**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching (Hr.)
1	**Unit – I Introduction to Plant Design** Basic considerations in chemical engineering plant design, optimization and feasibility of plant design.	**5%**	**2**
2	**Unit –II Basics of Process and Plant Design Plant designs**: Chemical Engineering Designs, Process Design, Equipment Design, Continuous v/s Batch Process, Types of flow diagrams, Pilot plant, Importance of Laboratory development pilot plant	**19%**	**8**
3	**Unit – III Selection of Process Equipment** Selection of process equipment, Standard v/s Special equipment, Specification sheet for equipment, Selection of equipment's: Heat transfer equipment, Mass transfer equipment	**14%**	**10**
4	**Unit – IV Plant Layout and Location :** Principles of plant layout, Methods of plant layout: Unit area Concept, Two- dimensional layout, Scale models, Factors for selection of plant location: Primary factors and specific factors	**14%**	**6**
5	**Unit – V Economic Evaluation of Projects :** Total Capital Investment, Fixed capital investment, Working capital investment, Equipment cost estimation, Cost-Size, Numerical based on Cost Indices, Depreciation and it's types, Methods for determining depreciation, Arbitrary methods, Methods with interest on investment, Numerical for depreciation, Profitability analysis: Net and gross earnings, Methods of profitability, Percent return on investment, Pay- out time period, Present worth, Turn-over ratio, Break-even analysis (Analytical method), Break-even chart (Graphical method), Numerical of Break-even analysis	**38%**	**16**
6	**Unit – VI Optimum Design** : General procedure for determining optimum condition: Analytical procedure with one variable, Numerical for optimum design, Engineering application of optimization	**10**	**3**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. **Plant Design and Economics for Chemical Engineers (TextBook)**
   By Max Peters, Klaus Timmerhaus | McGraw Hill
2. **Engineering Optimization: Theory and Practice**
   By Singiresu S. Rao | John Wiley & Sons

3. **Chemical Engineering Plant Design (TextBook)**
By Vilbrandt, Frank Carl and Dryden,Charles E. | McGraw Hill, New Delhi, 4th edition
4. **Chemical Engineering Series, Chemical Engineering Design, (TextBook)**
By R. K. Sinnott, Coulson and Richardson's | 4th Edition, VI volume, Elsevier Publication.
5. **Process Engineering Economics (TextBook)**
By Process Engineering Economics | Marcel and Dekker

2)

a) Course Name: Mass Transfer - II

b) Course Code: 03602323

c) Prerequisite: Basic knowledge of Distillation, Liquid-Liquid Extraction Leaching, Adsorption etc.

d) Rationale: The operations which involve changes in composition of solutions are known as the mass transfer operations. Mass transfer operations are required for preliminary purification of raw materials or final separation of products from by-products.

e) Course Learning Objective:

CLOBJ 1	Explain the fundamental principles of distillation, liquid-liquid extraction, leaching, and adsorption, including key concepts such as vapor-liquid equilibria, distribution coefficient, and adsorption equilibria.
CLOBJ 2	Make Use of Raoul's Law, Dalton's Law, and material balance equations to solve practical problems in distillation and extraction processes, demonstrating an ability to apply theoretical principles to real-world scenarios.
CLOBJ 3	Analyze and interpret the performance of separation processes like distillation, liquid-liquid extraction, and adsorption using methods such as the McCabe-Thiele method, Rayleigh's equation, and ternary phase diagrams.
CLOBJ 4	Apply the effectiveness of different separation techniques and equipment, such as distillation columns, extractors, and adsorbents, in terms of efficiency, practicality, and suitability for various applications.
CLOBJ 5	Design and optimize separation systems, including distillation columns and leaching setups, incorporating considerations for reflux ratios, feed plate locations, and operational parameters to achieve desired separation and purification outcomes.

f) Course Learning Outcomes:

CLO 1	Show the importance of Gas-Liquid operations.
CLO 2	Apply principles of distillation including vapor-liquid equilibria, Raoul's law, and differential distillation. Evaluate Liquid-Liquid Extraction techniques.
CLO 3	Demonstrate knowledge of Leaching methods and equipment.Describe Adsorption processes, including types and equilibria.
CLO 4	Understand the importance of Gas-Liquid operations.
CLO 5	Compose principles of distillation including vapor-liquid equilibria, Raoul's law, and differential distillation. Evaluate Liquid-Liquid Extraction techniques.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**	-	**60**	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Distillation**1.1 Distillation as a versatile separation method 1.2 Vapor Liquid Equilibria :- Constant pressure equilibria and Constant temperature equilibria 1.3 Raoul's law, Daltons law 1.4 Relative volatility and derivative 1.5 Differential or Simple distillation - Derivation of Rayleigh's equation 1.6 Flash or equilibrium vaporization - Material balance 1.7 The fractionation operation 1.8 McCabe and Thiele method for enriching and stripping section 1.9 Feed Plate and Feed Line 1.10 Total reflux ratio, Minimum reflux ratio, Optimum reflux ratio 1.11 Fundamentals of Azeotropic and extractive distillation 1.12 Simple numerical of Rayleigh's equation and McCabe and Thiele method.1.13 Reboilers and their use	30%	15
2	**Liquid-Liquid Extraction**2.1 Fields of application of Liquid application 2.2 Distribution coefficient 2.3 Ternary systems 2.4 Equilateral triangular co-ordinates system- (I) System of three liquids-one pair partially Soluble (II) system of three liquids-two pair partially Soluble 2.5 Effect of temperature and pressure on solubility 2.6 Choice of solvent 2.7 Material balance for single stage system 2.8 Equipment: (I) Mixer and settler (II) Rotating disc contactor (III) centrifugal extractor.	25%	12
3	**Leaching**3.1 Industrial applications of leaching 3.2 Preparation of solid 3.3 Temperature of leaching 3.4 Methods of operation and equipment for (a) Unsteady state operation: (I) In place operation (II) Continues counter current decantation with flow sheet, (III) Leaching of vegetable seeds: - 1. Reticle 2. Kennedy extractor 3. Bollman extractor 4. Continuous horizontal extractor	20%	7
4	**Adsorption**4.1 Definition and industrial application of Adsorption 4.2 Types of adsorptions and Nature of adsorbents 4.3 Adsorption Equilibria (I) Single gases and vapors (II) Adsorption hysteresis (III) Effect of temperature on adsorption and Heat of adsorption 4.4 Adsorption from liquids (I) Adsorption from dilute solution (II) The Freundlich's equation (III) Adsorption from concentrated solutions 4.5 Higgins contactor	25%	11
	Total	100%	45

i) Text Book and Reference Book:

1. Mass Transfer Operations by Tribal, R. E | McGraw Hill | 3rd ed
2. Principles of Mass transfer and Separation Process by Dutta, B.K., 2007 | Prentice-Hall of India Pvt. Ltd., New Delhi
3. Unit operations of Chemical Engineering by Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill
4. Fundamentals of Heat and Mass Transfer by Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incorporeal, David P. DeWitt | Willey
5. Chemical Engineering Series, Chemical Engineering Design by R. K. Sinnott, Coulson and Richardson 's; 4th Edition, VI volume, Elsevier Publication.
6. Mass Transfer: Theory and Practice by N. Anantharaman, K.M. Meera Sheriff Begum, PHI Learning.

3)

a) Course Name: Mass Transfer – II Lab

b) Course Code: 03602308

c) Prerequisite: Basic knowledge of Distillation, Liquid-Liquid Extraction Leaching, Adsorption etc.

d) Rationale: The operations which involve changes in composition of solutions are known as the mass transfer operations. Mass transfer operations are required for preliminary purification of raw materials or final separation of products from by-products.

e) Course Learning Objective:

CLOBJ 1	Inspect the principles, construction, and working of gas-liquid equipment, and apply these principles using physical models to demonstrate their operation in practical scenarios.
CLOBJ 2	Analyze and interpret a vapor-liquid equilibria curve at atmospheric pressure for a Benzene-Xylene system, and analyze the data to understand the phase behavior and separation characteristics
CLOBJ 3	Conduct a simple distillation using a glass assembly, and evaluate the results to assess the efficiency of separation and the quality of the distillate.
CLOBJ 4	Construct a ternary diagram for a system of three liquids, and analyze the diagram to determine phase relationships and compositions within the system.
CLOBJ 5	Measure the recovery of salt using a sand-salt mixture in a single-stage leaching process, analyze the efficiency of the process, and study cross-current liquid-liquid extraction for acetic acid from benzene using water as a solvent.

f) Course Learning Outcomes:

CLO 1	Choose the concept of diffusion and convection
CLO 2	Make use of the different types of distillation
CLO 3	simplify the contactors used in chemical Process Industries.
CLO 4	Explain the usage and employability of devices for determining the separation factors and efficiencies of the systems.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		**Total**
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination.

h) Course Content:

Sr. NO.	Name of Experiment
1	**Demonstrate principle, construction and working of equipment's for gas–liquid operations with models**
2	**Prepare vapor liquid equilibria curve at atmospheric pressure for Benzene-Xylene**
3	**Carry out simple distillation in glass assembly**
4	**Prepare ternary diagram for a system of three liquids**
5	**Obtain tie-line data for Acetic Acid, Benzene and water**
6	**Measure recovery of salt using sand-salt mixture in single stage leaching**
7	**To study the (cross current) liquid-liquid extraction for extracting acetic acid from benzene using water as solvent. Drag studies**
8	**Remove color impurities from water using charcoal**

i) Text Book and Reference Book:

1. Mass Transfer Operations by Tribal, R. E | McGraw Hill | 3rd ed
2. Principles of Mass transfer and Separation Process by Dutta, B.K., 2007 | Prentice-Hall of India Pvt. Ltd., New Delhi
3. Unit operations of Chemical Engineering by Warren L. McCabe, Julian C. Smith, Peter Harriott | Mc-Graw-Hill
4. Fundamentals of Heat and Mass Transfer by Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incorporeal, David P. DeWitt | Willey
5. Chemical Engineering Series, Chemical Engineering Design by R. K. Sinnott, Coulson and Richardson 's; 4th Edition, VI volume, Elsevier Publication.
6. Mass Transfer: Theory and Practice by N. Anantharaman, K.M. Meera Sheriff Begum, PHI Learning put ltd.

4)

a) Course Name: Petroleum Refining and Petrochemical Technology

b) Course Code: 03602327

c) Prerequisite: The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire the following competency: Operate Petroleum Refinery and Petro-Chemical plant.

d) Rationale: The development of refining and Petro-chemical industries in the country has made it compulsory for the chemical engineers to get acquainted with important aspects of petroleum refining and petrochemical technology.

e) Course Learning Objective:

CLOBJ 1	Explain the fundamental principles of petroleum refining, including distillation, cracking, reforming, and other conversion processes.
CLOBJ 2	Translate the processes involved in the production of key petrochemicals, such as ethylene, propylene, and aromatics.
CLOBJ 3	Assess the efficiency and environmental impact of refining and petrochemical processes, considering energy consumption and emissions.
CLOBJ 4	Apply engineering principles to design and optimize units in a petroleum refinery, such as catalytic converters and separation systems.
CLOBJ 5	Integrate safety protocols, environmental regulations, and sustainable practices into refining and petrochemical operations.

f) Course Learning Outcomes:

CLO 1	Defend the occurrence and history of petroleum, its composition, and the development of refineries.
CLO 2	Utilize treatment of crude oil with a grasp testing methods of petroleum products.
CLO 3	Analyze cracking methods with a focus on the purpose and techniques involved.
CLO 4	Apply treatment techniques for gasoline, kerosene, and lube oil.
CLO 5	Maximize the development of the petrochemical industry in Gujarat and India.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching (Hr.)
1	**Basics of Petroleum and Refinery** 1.1 Occurrence and history of Petroleum, Crude Petroleum oil reserves in India 1.2 Composition of Petroleum, Classification of Petroleum 1.3 Refineries development in Gujarat and India 1.4 Refinery processes: 1) Physical changes 2) Chemical changes 1.5 Refinery products	**12%**	**4**
2	**Fractionation of Petroleum** 2.1 Primary treatment of crude: 1) Dehydration and Desalting of crude oil 2) Pipe still heater 2.2 Atmospheric distillation of crude 2.3 Vacuum distillation of crude residue 2.4 Physical properties of Petroleum Products (Petrol, Kerosene, Diesel, Lube Oil, Bitumen,) 2.5 Important Test of Petroleum Products (Petrol, Kerosene, Diesel, Lube Oil, Bitumen)	**18%**	**8**
3	**Refinery Processes** 3.1 Cracking and Purpose of Cracking 3.2 Cracking methods 1) Thermal cracking: Delayed Coking, Vis breaking 2) Catalytic Cracking: FCC, Hydrotreating, Hydrocracking, Alkylation 3.3 Reforming 1) Purpose of Reforming 2) Platforming (Pt catalyst-Reforming)	**18%**	**8**
4	**Treatment Techniques** 4.1 Treatment of Gasoline 1) State the purposes of Sulphur removal 2) Doctor's sweetening 3) MEROX treatment 4.2 Treatment of Kerosene 1) Liquid SO2 extraction 4.3 Treatment of Lube Oil 1) Purpose of dewaxing 2) Dewaxing with solvent: Ketone Dewaxing 3) Dewaxing with solvent: Propane Dewaxing 4) Dewaxing without solvent	**22%**	**10**
5	**Petrochemicals** 5.1 Development of petrochemical industry in Gujarat and in India 5.2 Building blocks, intermediates, major petrochemicals and their application 5.3 Manufacturing of important C1 compounds 1) Methanol 2) Formaldehyde 5.4 Manufacturing of important C2 compounds 1) Ethylene dichloride 2) Vinyl chloride 3) Ethylene Oxide 5.5 Manufacturing of important C3 compounds 1) Polypropylene 2) Propylene oxide 5.6 Chemicals from aromatics 5.7 Manufacturing of important Aromatic Compounds : 1) Manufacture of Linear Alkyl Benzene 2) Manufacture of Phenol by benzene sulfonate process	**30%**	**15**
Total		**100%**	**45**

i) Text Book and Reference Book:

1. Text on petrochemicals by Rao, B.K. Bhaskar, Khanna Publishers Delhi,1998,2nd Edition.
2. A Text Book on Petrochemicals. By Dr. B.K. Bhaskara Rao.
3. Dryden's Outline of Chemical Technology, 3rd Edition, M. Gopal Rao, Marshall Sitting.
4. Shreve's Chemical Process Industries, George Austin.
5. Modern Petroleum Refining Processes (5th Edition) By Dr. B.K. Bhaskara Rao.

5)

a) **Course Name:** Petroleum Refining and Petrochemical Technology Lab

b) **Course Code:** 03602310

c) **Prerequisite:** The course should be taught and implemented with the aim to develop required skills in students so that they are able to acquire the following competency: Operate Petroleum Refinery and Petro-Chemical plant.

d) **Rationale:** The development of refining and Petro-chemical industries in the country has made it compulsory for the chemical engineers to get acquainted with important aspects of petroleum refining and petrochemical technology.

e) **Course Learning Objective:**

CLOBJ 1	Explain the fundamental principles of petroleum refining, including distillation, cracking, reforming, and other conversion processes.
CLOBJ 2	Explain the processes involved in the production of key petrochemicals, such as ethylene, propylene, and aromatics.
CLOBJ 3	Illustrate efficiency and environmental impact of refining and petrochemical processes, considering energy consumption and emissions.
CLOBJ 4	Apply engineering principles to design and optimize units in a petroleum refinery, such as catalytic converters and separation systems.
CLOBJ 5	Integrate safety protocols, environmental regulations, and sustainable practices into refining and petrochemical operations.

f) **Course Learning Outcomes:**

CLO 1	Compare the occurrence and history of petroleum, its composition, and the development of refineries.
CLO 2	Perform primary treatment of crude oil with a grasp testing methods of petroleum products.
CLO 3	Analyze cracking methods with a focus on the purpose and techniques involved.
CLO 4	Apply treatment techniques for gasoline, kerosene, and lube oil.
CLO 5	Extend the development of the petrochemical industry in Gujarat and India.

g) **Teaching & Examination Scheme:**

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Exp. No.	Name of the Experiment
1	Prepare a detail chart of modern refinery
2	Determine flash point by Penskey Martin method
3	Determine fire point by Penskey Martin method
4	Measure smoke point of kerosene
5	Measure cloud point lubricating oil
6	Measure pours point lubricating oil
7	Determine penetration number of Grease
8	Measure softening point and drop point of Grease
9	Measure Viscosity of lube oil by Redwood Viscometer
10	Measure Aniline point of lubricating oil

i) Text Book and Reference Book:

1. Text on petrochemicals by Rao, B.K. Bhaskar, Khanna Publishers Delhi,1998,2nd Edition.
2. A Text Book on Petrochemicals. By Dr. B.K. Bhaskara Rao.
3. Dryden's Outline of Chemical Technology, 3rd Edition, M. Gopal Rao, Marshall Sitting.
4. Shreve's Chemical Process Industries, George Austin.
5. Modern Petroleum Refining Processes (5th Edition) By Dr. B.K. Bhaskara Rao.

6)

a) Course Name: Polymer Science and Compounding

b) Course Code: 03602331

c) Prerequisite: Studying "Polymer Science and Compounding" includes a strong foundation in chemistry, physics, and mathematics. Knowledge of organic chemistry, thermodynamics, and material characterization techniques is also essential.

d) Rationale: Studying "Polymer Science and Compounding" in the context of chemical and petrochemical engineering enables optimization of polymerization reactions, material selection based on performance criteria, and development of efficient processing techniques.

e) Course Learning Objective:

CLOBJ 1	Relate the fundamental principles of polymer chemistry and synthesis.
CLOBJ 2	Analyze the physical and chemical properties of various polymers and their applications.
CLOBJ 3	Inspect for compounding and processing polymer materials.
CLOBJ 4	Develop skills to troubleshoot and optimize polymer formulations for specific uses.

f) Course Learning Outcomes:

CLO 1	Demonstrate proficiency in synthesizing and characterizing different types of polymers.
CLO2	Evaluate and predict the performance of polymer materials in various applications.
CLO 3	Apply compounding techniques to optimize polymer properties for desired functions.
CLO 4	Discuss problems related to polymer processing and formulation.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**150**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Topics	Weightage (%)	Teaching (Hr.)
1	Raw materials and its Structure-Property Concept of the basic starting materials of synthetic polymers, viz. petroleum and natural gas; Monomers – their characteristics, functionality and types; Natural polymers and their derivatives. Concept of the basic their starting materials of synthetic polymers, viz. petroleum and natural gas; Monomers – their characteristics, functionality and types; Natural polymers and their derivatives. Classification of polymers – linear, branched, graft, crosslinked, thermosets and thermoplastics, homo -, hetero -, co - & Ter- polymers.	**22%**	**10**
2	Polymerization Degree of polymerization, development of the ideas of molecular mass averages, molecular weight distribution and their relevance to mechanical properties and flow behavior. Polymerization – basic types and criteria for polymerization – chain and step growth (addition and condensation). Importance and significance of stereo-regular polymers & their practical. Importance and example Ring opening polymerization and its practical importance & example.	**18%**	**8**
3	Rubber Physics Basic principles involved on the origin of rubber like behavior and rubber Elasticity. Concept of viscoelasticity. Application of the concept of viscoelasticity in rubber processing such as calendar nip swell & extension die swell.	**10%**	**5**
4	Rubber Materials Natural Rubber -- source, production systems for sheet and block rubber, gradation system, processing characteristics & curing systems. Synthetic Rubbers such as SBR, PBR, NBR, CR, IIR, EPDM - their grades, Polymer Blends --- their importance and applications, concept of miscibility/ compatibility; useful blends rubber-plastic, rubber-rubber e.g. NBR/PVC blends, NR/SBR, NR/PBR etc.	**28%**	**12**
5	Compounding Functions and uses of accelerators, retarders, peptizes, tackifiers, process aids, activators, softeners, extenders, reclaimed rubbers, crumb rubbers, mineral rubbers, rubber substitute (factice), pigments, blowing agents. Fillers, reinforcing, semi – reinforcing and extending fillers, non-black and black fillers – their grades and classification and usage.	**22%**	**10**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1.Polymer Science and Technology by Prem Amoy Ghosh and Uma Shankar Srivastava
2. Polymer Science and Engineering: A Comprehensive Handbook by Raghunath Choudhary, Dilip Giri, and Dilip Maiti
3. Polymer Science and Technology: Plastics, Rubber, Blends, and Composites by A.K. Chakraborty and Suman Dutta
4. Introduction to Polymer Science and Technology by Mustafa Akay
5. Polymer Science: A Textbook by V. R. Gowariker, N. V. Viswanathan, Jayadev Sreedhar
6. Polymer Compounding: Principles and Applications by Jiri George Drobny
7. Polymer Chemistry: Principles and Practice by David Walton

7)

a) Course Name: Health Environment and Safety

b) Course Code: 03628309

c) Prerequisite: Basic understanding of industrial safety practices, hazardous materials, and chemical properties. Knowledge of environmental laws, regulations, and waste management principles.

d) Rationale: The course equips students with essential knowledge and skills to manage health, safety, and environmental risks in the petrochemical industry. It ensures the safe operation of plants while adhering to environmental regulations and promoting worker well-being.

e) Course Learning Objective:

CLOBJ 1	Recognize potential hazards in petrochemical processes and assess associated risks.
CLOBJ 2	Apply safety protocols, risk assessments, and preventive measures to ensure a safe working environment.
CLOBJ 3	Learn emergency response procedures, fire safety, and first aid protocols specific to petrochemical industries.

f) Course Learning Outcomes:

CLO 1	Demonstrate knowledge of health, safety, and environmental laws and apply them in real-world petrochemical settings.
CLO 2	Identify workplace hazards, assess risks, and recommend appropriate safety measures to minimize accidents.
CLO 3	Propose strategies for pollution control, waste reduction, and sustainable practices in petrochemical plants.
CLO 4	Effectively manage emergency situations, including fire hazards, chemical spills, and medical emergencies, with proper response techniques.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**0**	**0**	**3**	**20**	**20**		**60**	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**General introduction** The importance of health and safety, what accidents and work-related ill health are, and why they occur. Why the welfare of people at work is important. The approximate annual number of reported work related deaths, and injuries, which occur to people at, work in India, and the approximate costs involved. The meaning of: Hazard, Risk, Safe, Accident, Dangerous occurrence.	**10%**	**6**
2	**Occupational Health** The causes of work related ill health and the steps to control and prevent it. The appropriate measures to control the hazards associated with work related ill health including:- (a) Noise (b) Repetitive strain injury(RSI) (c) Display screen equipment (DSE) (d) Viral and bacterial infections e.g. legionnaires disease, hepatitis B. (e) Stress.	**30%**	**12**
3	**Personal Protective Equipment** Outcomes: The different types of PPE and the hazards against which they provide protection. FIRE Outcomes: The dangers associated with fire.The "fire triangle" and the three conditions required for fire to start and continue to burn. The need for provision of adequate methods of raising the alarm, and routes of escape in the event of fire.	**20%**	**10**
4	**Basics of Instrumentation & Process Dynamics** Importance of instrumentation in chemical plant, Classification of instruments, Basic elements of instruments, Compare Static and Dynamic Characteristics of instruments	**30%**	**12**
5	**Environment** Environmental Issues Related to safety & Health, Environmental Risks and the Disease Burden. Improving the Household Environment. Water Quality and Health.	**10%**	**5**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. **Industrial Safety, Health & Environment management**
   By Sunil S. Rao, R.K. Jain | Khanna Publishers, New Delhi, 2006
2. **Loss Prevention in the Process Industries, 2nd ed.**
   By Less, F. P., | Butterworth Heinemann, UK
3. **Water and Waste water Engineering**
   By Gorden, Fair& Gayer Okun | John willey& Sons

SEMESTER - 6

(1)

a) Course Name: Chemical Engineering Thermodynamics

b) Course Code: 03628355

c) Prerequisite: Basic knowledge of different terminologies, also understanding of laws of thermodynamics.

d) Rationale: Diploma Chemical engineer has to deal with the laws of thermodynamics which are applied to flow and non-flow processes in the plant to evaluate heat effects and energy transformation calculation accompanying physical and chemical changes.

e) Course Learning Objective:

CLOBJ 1	Verify the **first and second laws of thermodynamics** to analyze energy conservation, heat, and work in chemical systems.
CLOBJ 2	Validate energy and mass balance calculations for various chemical engineering processes involving heat transfer, work interactions, and phase changes.
CLOBJ 3	Determine the thermodynamic properties (e.g., internal energy, enthalpy, entropy, Gibbs free energy) of pure substances from thermodynamic tables, equations of state, and property charts.
CLOBJ 4	Justify concepts of phase equilibrium in pure and multicomponent systems and analyze phase diagrams (e.g., P-T, P-x, T-x diagrams) for vapor-liquid, liquid-liquid, and solid-liquid equilibria.
CLOBJ 5	Function Heat Engines, Refrigerators, and Heat Pumps
CLOBJ 6	Utilize Power and Refrigeration Cycles

f) Course Learning Outcomes:

CLO 1	Distinguish the various thermodynamic properties.
CLO 2	Explain various laws of Thermodynamics.
CLO 3	Implement the first law of thermodynamics for non-flow & flow process.
CLO 4	Recognize the application of laws of thermodynamics
CLO 5	Calculate the effects of heat changes during chemical reaction.
CLO 6	Apply the concepts of second law of thermodynamics.
CLO 7	Correlate the different thermodynamic properties.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**1**	**0**	**3**	**20**	**20**	-	**60**	-	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester valuation, **E**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**PVT Behavior** Pvt behavior of pure fluids, ideal gas and equation of state, ideal gas process: constant volume process, constant pressure process, constant temperature process, adiabatic process, polytropic process, equation of state for real gases, Vander wails equation, compressibility charts, simple examples (numerical).	**15%**	**8**
2	**Heat Effects Accompanying Chemical Reactions** Heat effects accompanying chemical reactions: (1) the standard heat of reaction (2) the standard heat of combustion (3) the standard heat of formation 1.2 Hess's law of constant heat summation 1.3 effects of temperature on heat of reaction temperature of reaction, simple numerical problem	**20%**	**10**
3	**Thermodynamic Properties of Pure Fluids** Classification of thermodynamic properties (1) reference properties (2) energy properties (3) derived properties 3.2 work function (Helmholtz free energy) 3.3 Gibbs free energy 3.4 fundamental properties relation (explain application) - maxwell' s equation, Clapeyron equation, Clausius Clapeyron equation	**25%**	**14**
4	**Thermodynamics Of Flow Process** 2.1 flow processes: continuity equation, energy equation 2.2 flow in pipes, flow through nozzle, 2.4 ejectors 2.5 compressors 2.6 throttling process (joule Thomson expansion) 2.7 simple numerical examples	**25%**	**8**
5	**Introduction To Non-Ideality** 5.1introduction to fugacity 5.2 standard state for fugacity 5.3 fugacity coefficient 5.4 effect of temperature and pressure on fugacity 5.5 fugacity's of solids and gases 5.6 thermodynamic diagrams 5.7 simple numerical examples	**15%**	**5**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Industrial Safety, Health & Environment management By Sunil S. Rao, R.K. Jain | Khanna Publishers, New Delhi, 2006
2. Loss Prevention in the Process Industries, 2nd ed. By Less, F. P., | Butterworth Heinemann, UK
3. Water and Waste water Engineering by Gorden, Fair& Gayer Okun | John willey & Sons

2)

a) Course Name: Utilities and Instrumentation

b) Course Code: 03628353

c) Prerequisite: Basic understanding of process operations, thermodynamics, and fluid mechanics. Knowledge of electrical circuits, control systems, and instrumentation used in industrial settings.

d) Rationale: This course provides essential knowledge of utility systems and instrumentation in petrochemical plants. It ensures students can effectively manage energy, water, and control systems for efficient plant operation.

e) Course Learning Objective:

CLOBJ 1	Apply principles of energy management to optimize utility consumption and improve plant efficiency.
CLOBJ 2	Design and troubleshoot simple control systems to ensure smooth plant operations.
CLOBJ 3	Study the basics of control systems, including manual and automated controls used in industrial processes.
CLOBJ 4	Identify and assess the impacts of risks and uncertainties on chemical plant economic evaluations, including sensitivity analysis and contingency planning.

f) Course Learning Outcomes:

CLO 1	Demonstrate the ability to manage and optimize utilities such as steam, water, and power in petrochemical plants.
CLO 2	Use instrumentation for monitoring and controlling process variables like temperature, pressure, and flow.
CLO 3	Analyze and apply control systems to ensure the efficient operation of petrochemical processes.
CLO 4	Propose solutions for improving energy efficiency and reducing utility consumption in plant operations.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
3	**0**	**0**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Basic Concepts** Static and dynamic characteristics of the instrument, elements of instruments, Measurement and its aim, Functional elements - Primary, Secondary, Manipulating, data transferring, Static characteristics - definition of Calibration, Accuracy, Precision, Repeatability, Drift, Sensitivity, Resolution, Dead zone, Static error, Dynamic Characteristics - definition of Speed of response, fidelity, lag, Dynamic error	14%	7
2	**Temperature & Pressure Measurement** various temperature measuring instruments, methods of measuring temperature by using sensor Temperature Scales; - Centigrade, Kelvin, Fahrenheit, Rankine, Methods of Temperature Measurement, Expansion Thermometer, Glass thermometer, Electrical temperature measuring instruments- RTD, thermocouple & Thermistor. Units of Pressure, Methods of Pressure Measurement, Elastic Pressure Transducer - Bourdon tube, Bellows, Diaphragm, Force-balance Pressure Gauges - Deadweight tester, Electrical Pressure Transducer - Strain gauge, LVDT, Measurement of Vacuum - McLeod gauge	28%	12
3	**Level Measurement** Various level measuring instruments, Methods of Liquid level Measurement, Direct Methods: Sight Glass, Float Indirect Methods: Pressure gauge, Air purge, Radioactive, Ultrasonic, Capacitive, Solid level Measurement	19%	8
4	**Water as Basic Utility**List and use of various utilities in chemical plant, Sources of water, Types of Water?Hard &Soft water, Boiler Feed water and demineralized water, Methods of water softening processes -Lime soda process (Hot & Cold), Zeolite process,Ion exchange process •, Phosphate process , Purification of water - Screening, Sedimentation, Coagulation, Filtration, Sterilization	14%	8
5	**Steam, Air & Inert Gases** Use of Steam, Air & Inert Gases as utilities, Properties of steam ,Enthalpy, Wet steam, Saturated Steam , Superheated steam, Specific volume of steam, Steam Generator: Classification, comparison, components, Factors affecting selection of Boiler, Construction and working of (a) Locomotive Fire tube boiler (b) Lancashire boiler, Utility air ,Compressed Air , Blower Air, Fan Air, Instrumental types of Air compressors, Reciprocating Air compressors, Multistage compressors, Rotary compressors	25%	10
	Total	100%	45

i) Text Book and Reference Book:

1. **Industrial instrumentation and control**
   By Singh, S.K. | Tata McGraw-Hill, 1987
2. **Process Control Instrumentation Technology,**
   By Curtis Johnson, | PHI Publication.
3. **Process Systems Analysis and Control**
   By Donald R Coughanowr and S.E.Leblanc, | McGraw Hill Publication.

3)

a) Course Name: Chemical Reaction Engineering

b) Course Code: 03602369

c) Prerequisite: Basic Chemistry (general, physical, and organic) and Chemical Thermodynamics. Mathematics (calculus, differential equations, and numerical methods). Fluid Mechanics, Heat/Mass Transfer, and Material/Energy Balances

d) Rationale: Chemical reactor design uses information, knowledge, and experience from a variety of areas like thermodynamics, chemical kinetics, fluid mechanics, heat transfer, mass transfer, and economics.

e) Course Learning Objective:

CLOBJ 1	Analyze and interpret reaction rate data and mechanisms for both homogeneous and heterogeneous reactions.
CLOBJ 2	Develop and apply design principles for various types of reactors (batch, CSTR, PFR) to optimize performance.
CLOBJ 3	Make use of mathematical models to predict the behavior of chemical reactors under different operating conditions.
CLOBJ 4	Examine the influence of heat and mass transfer on reactor performance and stability.
CLOBJ 5	Apply principles of process optimization, safety, and economics to design efficient and sustainable reactor systems.

f) Course Learning Outcomes:

CLO 1	Explain basic concepts to distinguish chemical reactions.
CLO 2	Calculate rate, rate constant, activation energy and order of reaction
CLO 3	Interpret kinetic data to find order of reacting.
CLO 4	Operate different reactors efficiently using basic knowledge about their functioning.
CLO 5	Improve volume, space time and space velocity for Ideal reactor.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
				Internal Evaluation			**ESE**		
L	**T**	**P**	**C**	**MSE**	**CE**	**P**	**Theory**	**P**	**Total**
4	**1**	**0**	**5**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr. No.	Content	Weightage (%)	Teaching Hours
1	**Basics of Chemical Reactions** Scope and importance of chemical reaction engineering, Classification of chemical reactions, a. Homogeneous vs. Heterogeneous, b. Catalytic vs. Non-catalytic c. Reversible vs. Irreversible d. By Molecularity e. Exothermic vs. Endothermic f. By order of reaction, Reaction rate on various basis and variables affecting the rate of reaction	**14%**	**18**
2	**Kinetics of Homogeneous Reactions** Rate equation/ Rate law, Concentration dependent term of rate Equation, Rate constant, Elementary and non-elementary reactions Molecularity and order of reaction, Temperature dependent term of rate Equation, and Temperature dependency from Arrhenius law Activation, numerical.	**19%**	**12**
3	**Interpretation of batch reactor data** Methods for analysis of kinetic data Differential vs. Integral method Half-life method, Relationship for constant volume batch reaction system, Total pressure of the system and the partial pressure of reacting material Concentration and Conversion, Integrated rate equation for different order of irreversible reactions: Unimolecular first order, Bi- molecular Second order, nth order, zero order, Numerical.	**24%**	**13**
4	**Ideal reactors** Features of ideal reactor, Different types of reactors: Batch reactor, Semi batch reactor, Flow reactors, MFR/CSTR, PFR (Tubular), Fixed bed reactors, Fluidized bed reactors, Multi phase reactors: Slurry reactor, Bubble column reactor, Trickle bed reactor.	**19%**	**5**
5	**Design of single Ideal reactor** Performance equation of: Single Ideal reactor for Single reaction Constant density system, Ideal batch reactor, Steady state mixed flow reactor, Steady state plug flow reactor, Space time, Space velocity, numerical.	**24%**	**12**
Total		**100%**	**60**

i) Text Book and Reference Book:

1. Chemical Reaction Engineering by Octave Leven spiel | Third Edition, John Wiley and Sons.
2. Essentials of Chemical Reaction Engineering by H. Scott Fogler | Fourth Edition, Prentice Hall International.
3. Chemical Engineering Kinetics, By J. M. Smith | McGraw-Hill.
4. The Engineering of Chemical Reactions by Lanny D. Schmidt | Second Edition, Oxford University Press

4)

a) Course Name: Chemical Reaction Engineering Lab

b) Course Code: 03602364

c) Prerequisite: Basic Chemistry (general, physical, and organic) and Chemical Thermodynamics. Mathematics (calculus, differential equations, and numerical methods). Fluid Mechanics, Heat/Mass Transfer, and Material/Energy Balances

d) Rationale: Chemical reactor design uses information, knowledge, and experience from a variety of areas like thermodynamics, chemical kinetics, fluid mechanics, heat transfer, mass transfer, and economics. Chemical reaction engineering is the synthesis of all these factors with the aim of properly designing a chemical reactor.

e) Course Learning Objective:

CLOBJ 1	Analyze and interpret reaction rate data and mechanisms for both homogeneous and heterogeneous reactions.
CLOBJ 2	Develop and apply design principles for various types of reactors (batch, CSTR, PFR) to optimize performance.
CLOBJ 3	Make use of mathematical models to predict the behavior of chemical reactors under different operating conditions.
CLOBJ 4	Examine the influence of heat and mass transfer on reactor performance and stability.
CLOBJ 5	Apply principles of process optimization, safety, and economics to design efficient and sustainable reactor systems.

f) Course Learning Outcomes:

CLO 1	Relate use of Chemical Reaction Engineering
CLO 2	Show interest in Kinetics and Order of Reaction.
CLO 3	Apply of Kinetics Studies in Continuous Stirred Tank Reactors.
CLO 4	Determination of Activation Energy and Frequency Factor.
CLO 5	Judge Analysis Techniques - Differential and Integral Methods.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
-	-	2	1	-	-	30	-	20	50

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Exp. No.	Name of the Experiment
1	Overview of Chemical Reaction Engineering
2	The Kinetics of Reaction and Order of Reaction
3	Kinetics Studies in Continuous Stirred Tank Reactor
4	Determination of Activation Energy
5	Determination of Frequency Factor
6	Differential method of Analysis
7	Integral Method of Analysis
8	Kinetics by Half Life method in a Stirred Cell
9	Pseudo-First Order Kinetics
10	The Kinetics Non-Elementary Reaction
11	Decomposition of Hydrogen Peroxide
12	Temperature Dependency of Reaction Rate

i) Text Book and Reference Book:

1. Chemical Reaction Engineering by Octave Leven spiel | Third Edition, John Wiley and Sons.
2. Essentials of Chemical Reaction Engineering by H. Scott Fogler | Fourth Edition, Prentice Hall International.
3. Chemical Engineering Kinetics, By J. M. Smith | McGraw-Hill.
4. The Engineering of Chemical Reactions by Lanny D. Schmidt | Second Edition, Oxford University Press.

5)

a) Course Name: Rubber Processing Technology and Tire Manufacturing

b) Course Code: 03602389

c) Prerequisite: A solid understanding of polymer science and compounding, along with knowledge of chemical reaction engineering, thermodynamics, materials science, process engineering, polymer rheology, and quality control.

d) Rationale: It provides a direct link to the industrial sector, where engineers can contribute to optimizing rubber processing techniques and improving tire manufacturing processes. Secondly, it equips engineers with a deep understanding of rubber materials, processing techniques, and the effects of process variables on tire performance.

e) Course Learning Objective:

CLOBJ 1	Relate the fundamental processes involved in the production and vulcanization of rubber.
CLOBJ 2	Survey of different rubber compounding techniques for various applications.
CLOBJ 3	Recall the technology and techniques used in tire design and manufacturing.
CLOBJ 4	Analyze quality control methods and testing procedures in rubber and tire production.

f) Course Learning Outcomes:

CLO 1	Adapt the fundamental properties of rubber and elastomers in relation to their processing and applications.
CLO2	Apply rubber compounding techniques for the development of specialized rubber products.
CLO 3	Demonstrate proficiency in tire manufacturing processes, including design, construction, and testing.
CLO 4	Evaluate the performance characteristics of rubber products, ensuring quality and safety standards in tire production.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
3	**-**	**-**	**3**	**20**	**20**	**-**	**60**	**-**	**100**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

W - Weightage (%), T - Teaching hours

Sr.	Topics	Weightage (%)	Teaching Hours
1	Mixing Principles of Mixing; distributive & dispersive mixing. Description construction and comparison of mixers and compounding equipment -- open mills and internal mixers; mixing energy; mixer geometry and practical mixing techniques including sequence of mixing and evaluation of quality of mixing (e.g. specific gravity and rheography; trouble shooting of mixing operation; post-mixing operations, handling and storage	**14%**	**6**
2	Extrusion & Calendaring Basic principles involved; types of Extruders – Ram & Screw & their comparison. Die and Die-swell; Function and layout of ancillary equipment for standard extrusion operations; trouble shooting of extruder operation. Construction, types and function of calendaring machine; calendaring processes; –fractioning, skim coating & sheeting; Roll floating, roll binding and calendar gauze control devices; Function and layout of ancillary equipment for standard calendaring operation. Trouble shooting of calendaring operation. Other methods of textile coating viz. spreading, dipping – their usefulness, limitation and comparison	**22%**	**10**
3	Molding Description and construction of equipment used in Compression molding, Transfer molding, and injection molding – their comparison. Mold shrinkage; Trouble Shooting of molding operations. Hydraulic systems used in molding presses; Single daylight and multiday light presses, vacuum system in presses. General features of mound design, (a) single impression, and (b) multiple impression and construction of a mound, mound clamping and loading and opening arrangements, mound cleaning mound lubricant. Methods of blank preparation, Various Trimming and Finishing methods	**18%**	**8**
4	Safety Human aspect and Machine aspects – safety methods used in bale cutting, mixing extrusion, calendaring, molding presses and in autoclaves.	**8%**	**4**
5	Tires and Tubes cycle tires, passenger car tires and truck tires; tire sizing and marking; different types of tire constructions – bias, radial & tubeless tires – their basic features and characteristics; different components of tires and their functioning; selection criteria of different reinforcement materials; method of tire building & curing; post curing treatments	**18%**	**8**

6	Basic Understanding of Quality Control Testing of Rubber & tire Standard test methods; limitation of test data, precision, accuracy and validity of test methods. Specification and standardization. Awareness about BIS and ISO standards on rubber, rubber chemicals and rubber-based products. Testing methods and their significance with respect to product performance, Stress/Strain properties: Tensile strength, Elongation, Modulus, Hardness, and Compression set under constant stress/strain – original and after accelerated ageing conditions.	**20%**	**9**
	Total	**100%**	**45**

i) Text Book and Reference Book:

1. Rubber Technology: Compounding, Processing, and Testing by R.N. Datta | Wiley, Pub. Year 2012
2. Rubber Technology: Principles, Manufacture, and Materials by John S. Dick and Arthur W. Bowen | Pearson, Pub. Year 2017
3. Rubber Technology Handbook by Werner Hofmann | Hanser Publications, Pub. Year 2018
4. Rubber Technology: Handbook of Rubber Processing and Compounding by A. K. Bhowmick, M. M. Godkind, and S. Mitra | CRC Press, Pub. Year 2011

6)

a) Course Name: Indian Constitution

b) Course Code: 03600351

c) Prerequisite Understanding the historical context of India's freedom struggle, colonial rule, and the events that led to the drafting of the Constitution.

d) Rationale: The course aims to give brief knowledge of Indian Constitution and administration of different bodies of India. To make governance better an engineer must conduce to E-governance through computers and knowledge of cyber laws.

e) Course Learning Objective:

CLOBJ 1	Analyze the historical circumstances that led to the framing of the Indian Constitution.
CLOBJ 2	Understand and interpret the core values enshrined in the Constitution, including justice, liberty, equality, and fraternity.
CLOBJ 3	Identify and explain the roles, powers, and functioning of the executive, legislature, and judiciary at both Union and State levels.

f) Course Learning Outcomes:

CLO 1	Understanding the Constitution
CLO2	Ability to understand, Union Government State Government, Local Administration and Election Commission

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	CE	P	Theory	P	
2	-	-	0	20	20	-	-	-	40

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Topics	Weightage (%)	Teaching Hours
1	**The Constitution – Introduction** The History of the Making of the Indian Constitution Preamble and the Basic Structure, and its interpretation Fundamental Rights and Duties and their interpretation, State Policy Principles.	25%	8
2	**Union Government** Structure of the Indian Union, President – Role and Power, Prime Minister and Council of Ministers, Lok Sabha and Rajya Sabha.	20%	4
3	**State Government** Governor – Role and Power, Chief Minister and Council of Ministers, State Secretariat.	20%	4

4	**Local Administration** District Administration, Municipal Corporation, Zila Panchayat.	**15%**	**7**
5	**Election Commission** Role and Functioning, Chief Election Commissioner, State Election Commission	**20%**	**7**
	Total	**100%**	**30**

i) Text Book and Reference Book

1. **An Introduction to the Constitution of India**
   By D.D. Basu | Prentice Hall, New Delhi
2. **An Introduction to the Constitution of India**
   By M. V. Pyle | Vikas New Delhi

7)

a) Course Name: Energy Conservation and Audit

b) Course Code: 03607343

c) Prerequisite Knowledge of energy conservation related topics and basic energy audit.

d) Rationale: Every day, energy use rises. One strategy to deal with rising energy demand is to boost energy production, which necessitates more investment, while another is to save energy, as energy conserved/saved is energy generated.

e) Course Learning Objective:

CLOBJ 1	Define and explain the principles of energy conservation and its importance in reducing energy consumption and environmental impact.
CLOBJ 2	Interpret the energy consumption patterns in industrial, commercial, and residential sectors.
CLOBJ 3	Develop strategies for implementing energy-saving measures in industries and organizations.

f) Course Learning Outcomes:

CLO 1	Identify demand supply gaps.
CLO2	Evaluate the industry's conservation strategies.
CLO3	Examine diagram of an industry's energy flow and identify the waste stream.
CLO4	Determine where energy is being wasted and propose alternatives.
CLO5	Elaborate the principles of energy auditing.

g) Teaching & Examination Scheme:

Teaching Scheme				Evaluation Scheme					
				Internal Evaluation			ESE		Total
L	T	P	C	MSE	CE	P	Theory	P	
3	-	-	3	20	20	-	60	-	100

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	Topics	Weightage (%)	Teaching Hours
1	**Introduction** General energy problem, Sector wise Energy consumption, demand supply gap, Scope for energy conservation and its benefits; Energy Efficiency Principle – Maximum energy efficiency, Maximum cost effectiveness; Mandatory provisions of EC act; Features of EC act-Standards and labeling, designated consumers, Energy Conservation Building Codes (ECBC)	25%	10

2	**Energy Conservation Approaches in Industries** Methods and techniques of energy conservation in ventilation and air conditioners- compressors pumps, fans and blowers - Area Sealing, Insulating the Heating / cooling fluid pipes, automatic door closing- Air curtain, Thermostat / Control. Energy conservation in electric furnaces, ovens and boilers.	**25%**	**10**
3	**Energy Conservation Option** New equipment, technology, staffing, training; Calculation and costing of energy conservation project; Depreciation cost, sinking fund method. Cost evaluation by Return On Investment (ROI) and pay back method etc.	**15%**	**6**
4	**Performance Improvement of Existing Power Plant** Cogeneration, small hydro, DG Set Demand side management; Load response programmers; Types of tariffs and restructuring of electric tariff technical measures to optimize T and D losses.	**15%**	**9**
5	**Energy Audit** Energy audit and its benefits; Energy flow diagram; Preliminary, Detailed energy audit; Methodology of -preliminary energy audit and Detailed energy audit – Phase I, Pre audit, Phase II- Audit and Phase III- Post audit; Energy audit report; Electrical Measuring Instruments- Power Analyzer.	**20%**	**10**
	Total	**100%**	**45**

i) Text Book and Reference Book

1.Energy conservation techniques
By P.M. Dave & Monished

2.Energy Technology
By O.P. Gupta, | Khanna Publishing House

3. Financial Management
By Prasanna Chandra | Mc-Grow hill Publications

4. 'Energy Conservation Building Code',
By Ministry of Power | Government of India

8)

a) Course Name: Utilities and Instrumentation Lab

b) Course Code: 03628352

c) Prerequisite Basic understanding of process operations, instrumentation, and control systems. Knowledge of utility systems like steam, water, and power, as well as experience with laboratory safety protocols.

d) Rationale: The lab course provides hands-on experience with the operation, troubleshooting, and optimization of utility systems and instrumentation in petrochemical plants. It bridges theoretical knowledge with practical skills essential for effective plant management and process control.

e) Course Learning Objective:

CLOBJ 1	Gain practical experience in operating and managing utility systems such as steam, water, and power in a lab setting.
CLOBJ 2	Learn to operate and calibrate various instruments for measuring parameters like temperature, pressure, and flow.
CLOBJ 3	Practice using control systems to monitor and adjust process variables in a controlled environment.
CLOBJ 4	Identify and resolve common issues related to utilities and instrumentation through hands-on troubleshooting.
CLOBJ 5	Follow safety protocols while working with industrial equipment and control systems in the laboratory.

f) Course Learning Outcomes:

CLO 1	Apply instrumentation techniques to measure and control parameters like temperature, pressure, and flow accurately.
CLO2	Set up and manage control systems for monitoring and adjusting process variables in laboratory experiments.
CLO3	Identify and correct problems related to utility systems and instrumentation effectively.
CLO4	Follow industry-standard safety procedures while performing experiments and handling laboratory equipment.
CLO5	Demonstrate the ability to operate and monitor utility systems such as steam, water, and power in a lab environment.

g) Teaching & Examination Scheme:

Teaching Scheme				**Evaluation Scheme**					
L	**T**	**P**	**C**	**Internal Evaluation**			**ESE**		**Total**
				MSE	**CE**	**P**	**Theory**	**P**	
-	**-**	**2**	**1**	**-**	**-**	**30**	**-**	**20**	**50**

L- Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h) Course Content:

Sr.	List of Practical
1	**Demonstrate different refrigeration cycles** Demonstrate different refrigeration cycles
2	**Measure Temperature by thermometer and thermocouple** Measure Temperature by thermometer and thermocouple
3	**Measure Temperature by Bi-metallic thermometer** Measure Temperature by Bi-metallic thermometer
4	**Measure Pressure by mechanical pressure gauge** Measure Pressure by mechanical pressure gauge
5	**Measure level using direct method** Measure level using direct method
6	**Measure viscosity by capillary tube method** Measure viscosity by capillary tube method
7	**Measure specific gravity by Hydrometer** Measure specific gravity by Hydrometer
8	**Measure humidity by Hair hygrometer** Measure humidity by Hair hygrometer
9	**Measure pH by pH meter** Measure pH by pH meter
10	**Prepare a chart of components of DCS system** Prepare a chart of components of DCS system
11	**Demonstrate working of control valves and actuators using char** Demonstrate working of control valves and actuators using char
12	**Prepare a chart of water treatment techniques** Prepare a chart of water treatment techniques