POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-401**
Course Title	PROCESS HEAT TRANSFER
Number of Credits	3 (L: 2: T: 1: P: 0)

COURSE LEARNING OBJECTIVES:

- To study the fundamental concepts of heat transfer viz., conduction, convection, radiation,Boiling and Condensation.
- To use these fundamentals in typical engineering applications (Heat exchanger and Evaporator)and current research.

COURSE OUTCOMES: On completion of the course, the student can able

- To Estimate Steady State Heat Transfer Rates From/To Objects
- To Use Equations For Different Types Of Convection And Solve For Heat Transfer Rate By Convection
- To Estimate The Rate Of Radiation Heat Transfer With And Without Participating Medium, Ability
- To Identify The Roll Of Re-Radiating Surface, Radiation Shields, Boiling And Condensation.
- To Estimate Steam Economy, Capacity Of Single And Multiple Effect Evaporators.

COURSE CONTENT:

UNIT-I: Basic modes of heat transfer and the laws governing them. Steady state conduction throughplane and composite walls general heat conduction equation, concepts of thermal diffusivity and equivalent thermal conductivity.

UNIT-II: Convection – Dimensional analysis and empirical correlations, Critical insulation thickness for cylindrical and spherical surfaces, Physical significance of the dimensionless groups.

UNIT-III: Thermal Radiation laws, spectrum of electromagnetic radiation, Black and Gray bodies and configuration factor – typical examples. Boiling and condensation.

UNIT-IV: Heat Exchangers – classification, overall and individual film coefficients, mean temperature difference, LMTD correction factor for multiple pass exchanger

UNIT-V: Evaporation, single and multiple effect operation, material and Energy balance in evaporators, boiling point elevation, Duhring's rule, effect of liquid head.

REFERENCE BOOKS:

1. DC. Sikdar, "Process Heat Transfer and Chemical Equipment Design", Revised Ed., Khanna Publishing House

2. W. L. McCabe and J. C. Smith, "Unit Operations In Chemical Engineering", 7th Edn.,McGraw Hill Publishing Co.

3. Binay K. Dutta, "Heat Transfer Principles and applications" Prentice Hall of India Pvt. Ltd.

4. C. M. Narayanan & B. C Bhattacharya, 'Unit operations and Processes' Vol-I, CBS Publishers & Distributors,

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POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

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Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-401**
Course Title	PROCESS HEAT TRANSFER(lab)
Number of Credits	1 (L:0: T:0: P:2)

LIST OF EXPERIMENT

- Temperature distribution in a metal rod
- Thermal Conductivity of metal rod
- Radiation
- Natural convective heat transfer
- Forced convective heat transfer
- Double pipe heat exchanger
- Shell and Tube Heat exchanger
- Plate Heat Exchanger
- Condenser
- Heat Transfer in Jacketed Kettle
- Open pan evaporator

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

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Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-402**
Course Title	MASS TRANSFER-I
Number of Credits	3 (L:2: T:1: P:0)

COURSE LEARNING OBJECTIVES:

- To learn the concept of diffusion in gas, liquid & solid.
- To understand the basics of interphase mass transfer.
- To learn application of gas-liquid operation and simultaneous heat and mass transfer operations.

COURSE OUTCOMES: On completion of the course, the student will be:

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

COURSE CONTENT:

UNIT-I: Definition- Ficks law, Molecular and eddy diffusion, Diffusion in gaseous mixtures, liquid mixtures and solids, measurement and calculation of diffusivities. Mass transfer coefficients – Individual and overall with relations, Theories of mass transfer, Analogies between momentum, heat and mass transfer to predict mass transfer coefficients.

UNIT-II: Absorption – Solubility, theory of gas absorption, Concept of Equilibrium and operating lines. Mass Transfer Equipments- Batch and continuous, Stage wise contactors and Differential contactors, Concept of HTU and NTU, Tower packings and packing characteristics,

UNIT-III: Humidification Theory, Psychometric Chart, Adiabatic Saturator, Wet Bulb Theory, Methods of Humidification and dehumidification, Cooling towers,

UNIT-IV: Drying Theory and Mechanism, Drying Characteristics, Estimation of Drying time, drying rate curve, Classification of Driers, Description and Application of Driers, Continuous driers.

UNIT-V: 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.

REFERENCE BOOKS:

1. Binay. K.Dutta " Principles of Mass Transfer and Separation Processes"., PHI Learning

2. R.E. Treybal, "Mass Transfer Operations", McGraw Hill Book Co., New York.

3. N. Anantharaman and K.M.Meera Sheriffa Begum, "Mass Transfer Theory and Practice", Printice Hall of India Pvt. Ltd., New Delhi.

4. J. M. Coulson and J. F. Richardson, "Chemical Engineering", Vol. II, Butterworth Heinemann, New York.

5. W.L. McCabe, J.C. Smith and P. Harriot, "Unit Operations of Chemical Engineering", McGraw Hill Book Co., New York.

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-402**
Course Title	MASS TRANSFER-I(lab)
Number of Credits	1(L:0: T:0: P:2)

LIST OF EXPERIMENTS:

1. Diffusion
2. Wetted wall column
3. Simple Distillation
4. Steam Distillation
5. Surface evaporation
6. Liquid-Liquid Extraction
7. Leaching
8. Adsorption
9. Air drying
10. Packed Column Distillation

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-403**
Course Title	Chemical Reaction Engineering
Number of Credits	3 (L: 2: T: 1: P: 0)

COURSE LEARNING OBJECTIVES:

- Introduce basic concepts of chemical kinetics like homogeneous and heterogeneous reactions, rate of reaction, order and molecularity of reaction, concentration and temperature dependency of rate of reaction
- Build up the concepts to analyze kinetic data and determine the rate expression for a reaction
- This course will guide students to make use of key concepts and techniques of chemical kinetics to design single reactor and multiple reactors.
- Analyze multiple reactions to determine selectivity and yield.
- Work together in same-discipline teams to solve engineering problems.

COURSE OUTCOMES:

On completion of the course, the students:

- Will understand the classification of chemical reactions, factors affecting the rate of reaction, and the effect of temperature on rate of reaction.
- Will gain the knowledge on analyzing the laboratory data for determining the order of reaction and reaction rate constant Ability to relate rate of reaction with design equation for reactor sizing.
- Will familiar with the comparisons of ideal reactor types (batch, plug flow, mixed flow and select the most suitable one.
- Will familiar with the determining optimal ideal reactor design for multiple reactions for particular yield or selectivity.

COURSE CONTENT:

UNIT-I Basics of Rate process and Chemical Kinetics: Introduction – Rate of a Chemical Reaction, kinetics of homogeneous reactions: Concentration dependent, Temperature dependent term of rate equation, Searching for a mechanism. Interpretation of Batch Reactor data.

UNIT-II Types and Mechanisms of Chemical Reactions, Single Ideal Reactors, Batch, Mixed flow reactors and plug flow reactors – Performance equations.

UNIT-III Reactors for Multiple Reactions, Size comparison of single reactors for single reactions. Multiple Reactor system for single reactions. Reactions in parallel, reactions in series and series - parallel reactions of first order. Recycle reactor, auto catalytic reactions.

UNIT-IV Heat Effects: Temperature and pressure effects on single and multiple reactions.

UNIT-V Non - ideal flow: Residence time distribution studies: C, E, F and I curves.

REFERENCE BOOKS:

1. K. A. Gavhane Chemical Reaction Engineering -I, Nirali Prakashan Publications,Pune

2. S C Roy and C Guha, ‘A Text book of Chemical Reaction Engineering’ Dhanpat Rai & Co. (P) Ltd.,

3. O. Levenspiel, “Chemical Reaction Engineering”, Wiley Easter Ltd., New York.

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-403**
Course Title	Chemical Reaction Engineering (lab)
Number of Credits	1 (L:0: T:0: P:2)

LIST OF EXPERIMENTS:

1. Batch reactor
2. Plug flow reactor
3. Mixed flow reactor
4. Adiabatic reactor
5. Combined reactor: Mixed flow -plug flow
6. Combined reactor: Plug flow -mixed flow
7. RTD studies
8. Photochemical reactor

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-404**
Course Title	Chemical Engineering thermodynamics
Number of Credits	3 (L:2: T:1: P:0)

COURSE LEARNING OBJECTIVES:

This course will impart

- Knowledge on the concepts of thermodynamics.
- Use of thermodynamics concepts in chemical engineering applications and
- Appreciate the relationship between thermodynamics with separation and reactions.

COURSE OUTCOMES:

- On completion of the course, the students will be familiar with,
- Fundamentals of thermodynamics as applied to various processes
- Thermodynamics Properties as applied to ideal and real gases
- Determination of equilibrium states for mixture of gases, phases and chemical reaction
- Relationship between thermodynamics, separations and reactions.

COURSE CONTENT:

UNIT-I:

Introduction to Basic laws and Terminologies in Thermodynamics- Statement of First law, P-V-T behavior of pure fluids - Heat effects accompanying chemical Reactions - Statements of second law- Clausius Inequality-Mathematical Statement of Second law-Third Law of Thermodynamics.

UNIT-II:

Applications to Laws of Thermodynamics - Flow processes: Flow in pipes, Flow through nozzles, Compression-Refrigeration

UNIT-III:

Thermodynamic Properties of Pure Fluids- Classification of Thermodynamic properties –Work function and Gibb's Free energy-Fundamental Property relations-Maxwell's equations Clapyeron equation- -Differential equations of Entropy Relationship between Cp and Cv-Effect of pressure and volume on Cp and Cv- Gibb's Helmholtz Equation

UNIT-IV:

Thermodynamic Properties of Solutions - Introduction to fugacity and activity, Activity coefficients- Partial molar properties- Lewis Randall rule-Roults and Henry's law-Gibbs Duhem Equation

UNIT-V:

Phase Equilibria and Chemical Reaction Equilibria - Criteria for phase equilibrium, Criterion of stability, Phase equilibria in single and multiple component systems, Duhem's theorem, VLE for Ideal solutions, Reaction stoichiometry-Equilibrium constant- Feasibility of reaction- Effect of temperature, pressure, volume and other factors

REFERENCE BOOKS:

1. J.M. Smith, Hendrick Van Ness, Michael M. Abbott, Introduction to Engineering Thermodynamics, McGraw Hill, New York.
2. K.V.Narayanan, A Textbook of Chemical Engineering Thermodynamics, PHI Learning, New Delhi.
3. S. Sundaram, Chemical Engineering Thermodynamics, Ahuja Publishers, New Delhi.

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

Syllabus of Examination - AICTE Pattern

Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-405**
Course Title	Program elective- I (A) Petroleum Refining & Petrochemical Technology
Number of Credits	3 (L:2: T:1: P:0)

COURSE LEARNING OBJECTIVES:

- To impart introductory knowledge of petroleum refining and corresponding processes.
- To provide an insight into petrochemical industry.

COURSE OUTCOMES

- On completion of the course, the students will be able to develop overview of petroleum industry and know about origin, formation composition and characterization of crude oil.
- Comprehend primary processing mechanisms of crude to obtain various petroleum cuts.
- Know about secondary conversion techniques and treatment processes in petroleum refinery to get products of desired yield and quality
- Understand manufacturing processes and applications of various petrochemicals
- Grasp environmental and safety aspects in petroleum refinery and petrochemical industries.

COURSE CONTENT:

UNIT-I:

Introduction & primary processing: Origin & formation of crude oil, Classification of crude, Characterization of crude, Distillation practise, Atmospheric distillation, Vacuum distillation.

UNIT-II:

Secondary Processing: FCCU, Hydro cracking, Visbreaking, Coking, Reforming, Alkylation, Isomerisation and polymerization processes.

UNIT-III:

Treatment Techniques: Physical & chemical impurities in petroleum fractions, General mechanisms for removal of Sulphur, Treatment of LPG, Gasoline, Kerosene, Diesel and Lube oils. Properties of ATF and Bitumen.

UNIT-IV:

Petrochemical: Building blocks, intermediates, major petrochemicals and their applications,

UNIT-V:

Chemicals from methane and synthesis gas, Chemicals from olefins, Chemicals from aromatics, Synthetic fibres, plastics and rubber.

REFERENCE BOOKS

1. B.K. Bhaskarao, Bulk Chemicals from Petroleum, Khanna Publishing House
2. B. K. Bhaskara, “Modern Petroleum Refining Processes”, Oxford and IBH Publishing Company, New Delhi.
3. W.L. Nelson, “Petroleum Refinery Engineering”, McGraw Hill, New York.
4. O.P. Gupta, “Elements of Petroleum Refinery Engineering”, Khanna Publishing House
5. Saikat Maitra & O.P. Gupta, “Elements of Petrochemical Engineering”, Khanna Publishing House, New Delhi

POLYTECHNIC ENGINEERING

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Syllabus of Examination - AICTE Pattern

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Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-405**
Course Title	Program elective -I(B) Safety in Chemical Process Industries
Number of Credits	3 (L:2: T:1: P:0)

COURSE LEARNING OBJECTIVES:

- Students learn about implementation of safety procedures, risk analysis and assessment, hazard identification.

COURSE OUTCOMES:

On completion of the course the students will

- understand the importance of safety measures
- Know Different types of prevention techniques
- identify the risks in process management in different types of process industries.

COURSE CONTENT:

UNIT-I:

Hazard identification methodologies, risk assessment methods - PHA, HAZOP, MCA, ETA, FTA, consequence analysis,

UNIT-II:

Hazards in work places - nature and type of work places, types of hazards, hazards due to improper house-keeping, hazards due to fire in multi-floor industries and buildings, guidelines and safe methods in the above situations.

UNIT-III:

Workers' exposures to hazardous chemicals, TLVs of chemicals, physical and chemical properties of chemicals leading to accidents like fire explosions, ingestion and inhalation, pollution in work places due to dangerous dusts, fumes and vapours, guidelines and safe methods in chemicals handling, storage and entry into confined spaces.

UNIT-IV:

Hazards peculiar to industries like fertilizer, heavy chemicals, petroleum, pulp and paper, tanneries, dyes, paints, pesticides, glass and ceramics, dairy and sugar industries, guidelines for safeguarding personnel and safeguarding against water, land and air pollution in the above industries.

UNIT-V:

Safety education and training - safety management, fundamentals of safety tenets, measuring safety performance, motivating safety performance, legal aspects of industrial safety, safety audit.

REFERENCE BOOKS:

1. Dr B.K. Bhaskara Rao, Er. R.K. Jain, and Vineet Kumar, "Safety in Chemical Plants/Industry and Its Management" Khanna Publishers.

2. S.C. Sharma, "Industrial Safety and Maintenance Management", Khanna Book Publishing Co. Private Limited, New Delhi

POLYTECHNIC ENGINEERING

Sri Satya Sai University of Technology & Medical Sciences, Sehore (M.P.)

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Undergraduate Diploma Courses in Engineering & Technology

Department of Chemical Engineering

Semester-IV

Course Code	**DCMA-406**
Course Title	Minor project
Number of Credits	2 (L:0: T:0: P:4)

Course objectives: The following objective should be fulfilled in minor project study , and student must learn about any Chemical, Petrochemical, Pharmaceutical, Oil and Gas industry where they can learn to apply the Technical knowledge in real Industrial situations.

Course outcomes

Gain experience in writing Technical reports/projects

.• Expose students to the engineer's responsibilities and ethics.

- Expose the students to future employers.

- Understand the social, economic and administrative considerations that influence the Working environment of industrial organizations.

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Semester-IV

Course Code	**DCMA-407**
Course Title	Mandatory Course (Essence of Indian Knowledge and Tradition)
Number of Credits	0 (L:2: T:0: P:0)

Course Objectives:

1 To explore the intersections between modern scientific principles and traditional Indian knowledge systems, highlighting their complementarities and unique contributions.

2To provide students with a comprehensive understanding of holistic health care practices, including Yoga and Ayurveda, and their applications in promoting well-being.

3To impart knowledge about the historical and cultural significance of the Vedas and other ancient Indian texts, fostering an appreciation for their enduring relevance in contemporary society.

Course outcomes:

1. Students will be able to critically analyze and apply concepts from both modern science and Indian knowledge systems to contemporary health and wellness challenges.
2. Students will gain practical knowledge and skills in Yoga and other holistic health practices, enabling them to incorporate these methods into their personal and professional lives for enhanced well-being.
3. Students will demonstrate an understanding of the historical and philosophical underpinnings of the Vedas and other Indian scriptures, appreciating their influence on modern thought and practices in holistic health care.
4. Modern Science
5. Indian Knowledge System
6. Yoga
7. Holistic Health care
8. वेद,

Reference Books:

1. Cultural Heritage of India-Course Material by V. Sivaramakrishna-Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
2. Modern Physics and Vedant by Swami Jitatmanand - Bharatiya Vidya Bhavan
3. The wave of Life by Fritzof Capra
4. Tarkasangraha of Annam Bhatta, Inernational by V N Jha- Chinmay Foundation, Velliarnad,Amaku,
5. Science of Consciousness Psychotherapy and Yoga Practices by RN Jha - Vidyanidhi Prakasham, Delhi, 2016

THE END