Semester VII (Final Year)

S. No.	Course Code	Course Title	Hrs./ week			Credits
			L	**T**	**P**	
1	PCC-CH701	Process Equipment Design-II	3	1	2	4
2	PEC-CH701	Professional Elective-III	2	1	0	3
3	PEC-CH702	Professional Elective-IV	2	1	0	3
4	OEC-CH701	Professional Open Elective-III	3	1	0	4
5	PROJ-CH701	Project-Phase-I	0	0	12	6
6	PROJ-CH702	Evaluation Of Internship	0	0	4	2
7	PROJ-CH703	Seminar-II	0	0	2	1
		Total	**10**	**04**	**20**	**23**
		Total academic engagement and credits	**34**			**23**

	Professional Elective-III	Professional Elective-IV	Professional Open Elective-III
1	Plant Utility	Advance Separation Processes	Chemical Process Safety
2	Fluidization Engineering	Catalysis	Operation Research
3	Chemical Project Engineering & Economics	Polymer Technology	Finite Elements Methods

Course Code	Semester	Course Title	Load	Credit
PCC-CH701	VII	Process Equipment Design-II	3L:1T:2P (06 hrs)	Credits:04

Prerequisite(s): Process Equipment Design-I

Course Objective: The objective of this subject is to introduce the undergraduate students with the most important separation equipments in the process industry, and provide proper understanding of unit operations. At the end of study the student will come to know basic operations of chemical process equipments.

Course content:

Module 1: **9 hrs**

Scale up criteria and scale up of process equipment. Process design calculations for heat exchanges equipment double pipe and shell and tube heat exchangers general description, heat transfer coefficients and pressure drop by Kern's & Bell's methods rating on existing unit.

Module 2: **7 hrs**

Design of a new system having one or more units in series: single effect evaporator, multiple effect evaporators with boiling point elevation.

Module 3: **7 hrs**

Process design calculations for mass exchange equipment plate and packed column for distillation and absorption including column diameter and height.

Module 4: **10 hrs**

Detailed process and mechanical design, Flash drum , Kettle reboiler, condenser, cooling tower rotary drier, tray drier.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Knowledge about process design calculations for heat exchanges

CO2: Describe the concept about design of evaporators.

CO3: Design of packed column for distillation and absorption.

CO4: Design of utility equipments such as reboilers, rotary drier, tray drier etc.

Text/Reference Book:

1. Perry, Robert etal; Perry's Chemical Engg. Handbook; TMH
2. Ludwig E; Applied process design in chemical petrochemical plants; Gulf publishing
3. Mahajani V V, Umarji SB; Process Eqipment Design; MacMillan Pub. 4. Kern D; Process Heat Transfer; TMH 5. Smith B. D; Design of equilibrium stages.
4. Coulson JM. Richardson JF; Chemical engg. Vol ;. Pergaman process

List of Experiment (Pl. expand it):

List of Experiments (Please expand it): Each student should design a complete chemical process plant with mechanical design details of at least three major equipments.

Course Code	Semester	Course Title	Load	Credit
PEC-CH701 (1)	VII	Plant Utility	2L:1T:0P (03 hrs)	Credits:03

Prerequisite(s): Fluid Mechanics and Engineering Thermodynamics

Course Objective

The objective of subject to understand the applications of boiler, turbine IC Engines and design of chimney.

Module 1: **8 hrs**

Thermodynamics: Laws of perfect gases, thermodynamics processes, First and Second Law of thermodynamics, Entropy, The clausius inequality, Steady Flow Processes, carnot Cycle. Properties of steam: Use of steam tables, measurement of dryness fraction, entropy of steam, temperature entropy and mollier charts, clausius clapeynon equation, Rankine Cycle.

Module 2: **9 hrs**

Steam Generators: General Description, Boiler Mounting and Accessories, Natural and Artificial Draught, Equivalent Evaporation and Thermal efficiency. Fuels use in boilers – liquids, gaseous and hydrocarbon

Module 3: **7 hrs**

Turbine: Theory and working of impulse, reaction and gas turbine. Bleeding and reheating. Introduction to refrigeration, various cycles, coefficient of performance. Applications of refrigeration

Module 4: **9 hrs**

Internal Combustion Engine: Cycle of operation, two and four stroke cycle, general description of S.I and C. I. engines, ignition, injection and governing

Module 5: **8 hrs**

Water: Sources, conditioning and management of water for cooling of hot gases, cooling towers, cooling ponds. Design of chimney. Constructional details and design aspects.

Text/Reference Book:

1. Fundamental of Engineering Thermodynamics – John and Howel

2. Thermodynamics An Engineering Approach – Y.A. Cengel and M.A. Boles

3. Applied Thermodynamics – Aestop

4. Applied Thermodynamics – R N Joel

Course Outcomes:

After completion of this course, the students are able to:

CO1: Ability to understand the application of laws of thermodynamics.

CO2: Ability to discuss about boilers.

CO3: Ability to understand theory and working of turbine and refrigeration.

CO4: Ability to understand about internal combustion engine.

CO5: Ability to understand the application of utility.

Course Code	Semester	Course Title	Load	Credit
PEC-CH701(2)	VII	Fluidization Engineering	2L:1T:0P (03 hrs)	Credits:03

Prerequisite(s): Chemical Process Calculation, Chemical reaction engineering

Course Objective: The objective of this subject is to introduce the undergraduate students with the basic principles of fluidization phenomena and practical aspects of fluidization operations for industrial application.

Course content:

Module 1: **9 hrs**

Introduction: The phenomenon of fluidization; Advantages and disadvantages of fluidized beds; Industrial applications of fluidized beds

Module 2: **7 hrs**

Hydrodynamics of Fluidization System: General bed behavior pressure drop, Flow regimes, Incipient fluidization, pressure fluctuations, phase holdups, Measurement techniques, Empirical correlations for solids holdup, liquid holdup and gas holdup, Flow models - generalized wake model, structural wake model and other important models.

Module 3: **7 hr**

Characteristics of solids: Classification of solids; Flow characteristics and its outline in the different types of fluidization. Flow pattern of fluidization system: Frictional pressure drop, Solid movement, mixing, segregation and staging.

Module 4: **10 hrs**

Heat and Mass Transfer Fluidization Systems: Particle to gas mass transfer phenomena Heat transfer - Heat transfer between fluidized beds and surfaces and its analysis by model in two and three phase system

Module 5: **9 hrs**

Miscellaneous Systems: Moving bed, Slurry bubble columns, Two phase and three phase inverse fluidized bed, Bubbling fluidized beds, Entrainment and elutriation from fluidized beds, Design of fluidized bed reactors

Course Outcomes:

After completion of this course the student will be able to understand and learn

1. Basic concept and application of fluidization systems.
2. Hydrodynamics of Fluidization System
3. Solid Mixing and Segregation
4. Heat and Mass Transfer Fluidization Systems
5. Design of fluidized bed reactors

Text/Reference Book:

1. Gas-Liquid-Solid Fluidization Engineering, Liang-Shih Fan, Butterworths, 1989.
2. Fluidization Idealized and Bubbleless, with Applications, Mosoon Kwauk, Science Press, 1992.

3. Fluidization Engineering, O. Levenspiel and D. Kunii, John Wiley, 1972.

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Course Code	**Semester**	**Course Title**	**Load**	**Credit**
PEC-CH701 (3)	VII	Chemical Project Engineering & Economics	2L:1T:0P (03 hrs)	Credits:03

Prerequisite(s): Material and Energy Balance Calculations and Equipment Design

Course Objective: To provide the comprehensive knowledge of Chemical Project Engineering and Economics

Module 1:

Scope of project engineering, the role of project engineer, plant location and site selection, preliminary data for construction projects, process engineering, flow diagrams, plot plans, engineering design and drafting.

Module 2:

Planning and scheduling of projects- bar chart and network techniques, procurement operations, office procedures, contracts and contractors, project financing, statutory sanctions

Module 3:

Details of engineering design and equipment selection- design calculations excluded vessels, heat exchangers, process pumps, compressors and vacuum pumps, motors and turbines, other process equipment.

Module 4:

Product cost estimation, Cash Flows, Time value of money, investment costs, sales, profits, taxes, Depreciation. Economic feasibility of project using order-of magnitude, plant and equipment cost estimation, balance sheet, and profit and loss account. Financial ratio analysis,

Module 5:

Input/output structure of the flow sheet, Recycle structure of the flow sheet; Separation system, Heat Exchanger Networks. Process design development and general design considerations.

Course Outcomes:

After completion of this course, the students are able to:

CO1. Bridges boundaries between engineering and chemical industry management.

CO2. Provide the students with a basic understanding and importance of design of chemical plants.

CO3. Understand the responsibilities of project engineer, which includes schedule preparation, pre-planning and resource forecasting for engineering and other technical activities relating to the project.

CO4. Understand the Product cost estimation and Economic feasibility of project.

CO5. Understand the Input/output structure of the flow sheet and Process design development and general design considerations.

Text/Reference Book:

1**.** Douglas, J. M., “Conceptual Design of Chemical Processes,” McGraw-Hill, 1989.

2. Peters, M. S. and Timmerhaus, K. D., “Plant Design and Economics for Chemical Engineers,” 4th ed., McGraw-Hill, 1991.

3. Biegler, L., Grossmann, I. E. and Westerberg, A. W., “Systematic Methods of Chemical Engineering and Process Design,” Prentice Hall, 1997.

4.Rase & Barrow, Project Engineering of Process Plants, John Wiley, 1974.

Course Code	Semester	Course Title	Load	Credit
PEC-CH702(1)	VII	Advanced separation process	2L:1T:0P (06 hrs)	Credits:03

Prerequisite(s): Chemical Process Calculation, Mass transfer-I

Course Objective: The objective of this subject is to introduce the undergraduate students with the most important separation equipments in the process industry, and provide proper understanding of unit operations.

Course content:

Module 1: **9 hrs**

Fundamentals of separation processes; Membrane based separation processes; classifications; Design aspects, Membrane separation technique: Principles, mechanisms, cross flow, Classification, application & advantages of membrane separation processes.

Module 2: **7 hrs**

Reverse Osmosis: Concept of osmosis and reverse osmosis, different types of membrane modules and membrane material for R.O., Advantages and commercial applications of R.O. Ultrafiltration and nano filtration: Concept & working principle, Commercial applications of ultrafiltration and nano filtration

Module 3: **7 hrs**

Pressure Swing Adsorption: Concept & Working, Advantages & Disadvantages of PSA over cryogenic distillation, Purification of hydrogen, oxygen, Nitrogen & other commercial applications of PSA, Concept & Working of Pressure Swing Distillation

Module 4: **10 hrs**

Ion Exchange: basic principle and mechanism of separation, Ion exchange resins, regeneration and exchange capacity. Exchange equilibrium, affinity, selectivity and kinetics of ion exchange. Design of ion exchange systems

Module 5: **9 hrs**

Supercritical fluid extraction-Super Critical Extraction Working Principal, Advantage & Disadvantages of supercritical solvents over conventional liquid solvents, Advantage & Disadvantages of supercritical extraction over liquid- liquid extraction, Commercial applications of supercritical extraction.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Concept and application of Membrane based separation processes

CO2: Concept and working of Reverse Osmosis

CO3:Concept and working of Pressure Swing Adsorption and Pressure Swing Distillation processes

CO4: Concept and working of Ion exchange

CO5: Concept and application of Supercritical fluid extraction

Text/Reference Book:

1. Handbook of Separation Process Technology by R W Rousseau (John Wiley & Sons).

2. Supercritical Fluid Extraction by M A Mchugh & V J Krukonis (Butterworth Heinmann).

3. Large Scale Adsorption & Chromatography by W C Wankat (CRC Press Inc).

4. "Membrane separation Processes" by Kaushik Nath, PHI pvt. Ltd., 2008

5. Perry Chemical Engineers Handbook' 7th Edition by R.H Perry and D. Green. 6. "Encyclopedia of Chemical Engineering" by Kirk & Othmer.

Course Code	Semester	Course Title	Load	Credit
PEC-CH702 (2)	VII	Catalysis	2L:1T:0P (03 hrs)	Credits:03

Prerequisite(s): Chemical reaction engineering

Course Objective: The objective of this subject is to introduce the undergraduate students with Concepts related to homogeneous and heterogeneous catalysis**,** Catalysts Characterization and preparation

Course content:

Module 1: **9 hrs**

Concepts related to homogeneous and heterogeneous catalysis, Biocatalysts, catalysts preparation methods - Laboratory Techniques, Zeolites, Enzymes, Solid Catalysts, Powder Catalysts, Pellets, Composition, Active ingredients, Supportive materials, Catalysts activation.

Module 2: **7 hrs**

Catalysts Characterization: Bulk density, Thermal stability, Surface area measurements, BET Theory, Pore size distribution, Chemisorption techniques, Crystallography and surface analysis techniques, XRD, XPS, techniques for catalyst characterization.

Module 3: **7 hrs**

Theories of Catalysts: Crystal structure and its defects, Geometric and electronic factors, Analysis of transition model catalysis, Chemistry and thermodynamics of adsorption, Adsorption isotherms – Langmuir model, Freundich model, Langmiur Hinshel-wood model, Rideal -Eely mechanism, Determination of rate controlling steps, Inhibition

Module 4: **10 hrs**

Mass and Heat Transport in Porous Catalysts: Internal and external transport, fixed bed, Fluidized bed reactors, Effect of internal transport on selectivity. Effectiveness factor and Thiele modulus

Module 5: **9 hrs**

Catalyst Deactivation: Poisons, sintering of catalysts, Kinetics of deactivation, Catalyst regeneration.

Course Outcomes:

After completion of this course the student will be able to understand and learn

CO1. Catalyst types, synthesis methods

CO2: Catalyst characterization

CO3: Theories of catalysis

CO4: Detailed modeling of industrial catalytic systems

Text/Reference Book:

1. Satterfield, C.N. 'Heterogeneous Catalysis in Industrial Practice', 2ed, Krieger Pub. Co., 1996.
2. Emmett, P.H., 'Catalysis Vol. I and II, Reinhold Corp.', New York, 1954.
3. Smith, J.M., 'Chemical Engineering Kinetics '', McGraw Hill, 1971

Course Code	Semester	Course Title	Load	Credit
PEC-CH702 (3)	VII	Polymer Technology	2L:1T:0P (03 hrs)	Credits:03

Prerequisite Course: Engineering Chemistry

Course Objective: To provide the comprehensive knowledge of different types of polymers and its application.

Module 1: **8 hrs**

Polymerization Chemistry: Chain, step and miscellaneous polymerization reactions and polymerization technique. Polymerization kinetics: Free radical, cationic and anionic polymerization, poly-condensation and polymerization.

Module 2: **9 hrs**

Polymerization Processes: Bulk solution, emulsion and suspension polymerization, thermoplastic composites, fiber reinforcement fillers, surface treatment reinforced thermo-set composites resins, fillers, additives.

Module 3: **6 hrs**

Polymer reactions: Hydrolysis, acidolysis, aminolysis, hydrogenation, addition and substitution reactions, reactions of various specific groups, cyclyzation and cross linking reactions, reactions leading to graft and block copolymer.

Module 4: **7 hrs**

Manufacturing processes of important polymers: Plastics- polyethylene, polypropylene polyvinyl chloride & copolymer, polystyrene; Phenol-formaldehyde, epoxides, urethane, Teflon, elastomers, robbers, polymeric oils - silicon fibers - cellulosic (Rayon), polyamides (6:6 Nylon), Polyesters (Dacron). Acrylic-olefin.

Module 5: **8 hrs**

Composite materials - Ceramic and other fiber reinforced plastics, Polymer degradation - Thermal, Mechanical, Ultrasonic, Photo, High energy radiation, Ecology and environmental aspects of polymer industries.

Course Outcomes:

After completion of this course, the students are able to:

CO1: Ability to understand the principle of polymerization chemistry.

CO2: Ability to understand emulsion and suspension polymerization and thermoplastic composites.

CO3: Ability to understand polymer reaction like hydrolysis, aminolysis, hydrogenation etc.

CO4: Ability to know manufacturing processes of important polymers.

CO5: Ability to understand composite materials, polymer degradation, ecology and environmental aspects of polymer industries.

Text/Reference Book:

1. Rodringuez; Principles of polymer systems; TMH
2. Billmayer Jr, Fred W.; Textbook of polymer science; Wiley tappon
3. David J Williams; Polymer science & engineering; PHI
4. Mc. Keley, JH; Polymer processing; John Wiley

Semester VIII (Final Year)

S. No.	Course Code	Course Title	Hrs./ week			Credits
			L	T	P	
1	PCC-CH801	Transport Phenomena	3	1	0	4
2	PEC-CH801	Professional Elective-V	3	0	0	3
3	OEC-CH801	Professional Open Elective-IV	2	0	0	3
4	PROJ-CH801	Project Phase-II	0	0	12	6
		Total	**08**	**01**	**12**	**16**
		Total academic engagement and credits	**21**			**16**

	Professional Elective-V	Professional Open Elective-IV
1	Chemical Process Synthesis	Environmental Pollution & Waste Management
2	Petrochemical Engineering	Green Buildings
3	Energy Conservation In Chemical Process Industry	Non-Conventional Energy Resources

Course Code	Semester	Course Title	Load	Credit
PCC-CH801	VIII	Transport Phenomena	3L:1T:0P (04 hrs)	Credits:04

Prerequisite Course: Fluid mechanics, Heat Transfer, Mass Transfer

Course objective: Acquire the knowledge about momentum, heat and mass-transport, shell balance, transport equation and macroscopic balance equation.

Module 1: 6 hrs

Similarity in momentum, heat and mass-transport - Newton's laws of viscosity, Fouriers laws of conduction and Fick's laws of diffusion, Flux-transport property relationships, Estimation of transport properties measurement and correlations, velocity distribution in Laminar flow of falling film. Flow over an inclined plane, a circular tube an annulus and between two parallel plates..

Module 2: 8 hrs

Shell balance approach for developing equations of change for momentum, heat and mass transport, Equations of change and their approximations for transport in one dimension.

Module 3: 10 hrs

Transport equations in turbulent flow and equations for turbulent fluxes, velocity, temperature and concentration profiles for laminar and turbulent flow conditions, temperature and concentration profiles for conductive and convective transport in solids and fluids.

Module 4: 9 hrs

Macroscopic momentum and heat balance equations, Kinetic energy calculations. Constant area and variable area flow problems. Flow through bends, time determination for emptying of vessels.

Course Outcome:

CO1: Ability to understand similarity in momentum, heat and mass transport.

CO2: Ability to understand shell balance approach for developing equation of change for momentum, heat and mass transport

CO3 Ability to understand transport equation in turbulent flow and concentration profile for laminar and turbulent flow condition.

CO4: Ability to understand constant area and variable area flow problems, time determination for emptying of vessel.

Text/Reference Book:

1. Bird R.B., Stewart W.E. and Lightfoot EW; Transport phenomena; Wiley tappon
2. Brodkey RS and Hershey -Transport phenomena a unified approach; TMH
3. Geancoplis; Transport processes & separation process principles; PHI learning.

Course Code	Semester	Course Title	Load	Credit
PEC-CH801(1)	VIII	Chemical Process Synthesis	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Heat Transfer, Mass Transfer, Fluid Mechanics, Chemical Reaction Engineering

Course Objective: The aim of this subject is to expose the students to understand the basic piping design and its application to chemical engineering.

Course Content-

Module 1: **10 hrs**

Synthesis of steady state flow sheet: Introduction, Flow sheets, the problem of steady state flow sheeting, general semantic equation of equipment, Generalization of the method of synthesis of process flow sheet, Recycle structure of the flow sheet, separation systems.

Module 2: **8 hrs**

Heuristics for process synthesis: Raw materials and Chemical reactions, Distribution of chemicals, Separations, Heat exchangers and furnaces, pumping pressure reduction and conveying of solids.

Module 3: **7 hrs**

Algorithmic methods for process synthesis: Reactor design and reactor network synthesis, Synthesis of separation trains, sequencing of ordinary distillation columns Optimization of flow sheet with respect to heat exchanger network, Introduction, Network of heat exchanger, Some necessary conditions for the existence of an optimal exchanger network, Maximum heat transfer in a single exchanger (rule1), Hot and cold utilities (rule2), Condition of optimality for the minimum area network, Three special situations in energy transfer, Heat content diagram representation of the network problem, Matching of heat content diagram for minimum network area, Rules of adjustment of the minimum heat exchanger network to find the optimal solution.

Module 4: **8 hrs**

Safety in Chemical plant design: Introduction, Reliability of equipment, prevention of accidents. Process Hazard analysis.

Module 5: **7 hrs**

Economic evaluation: Time value of money, Methods for Profitability evaluation, Rate of return, Net Present Worth, Capitalized cost , Discounted Cash flow analysis.

Course Outcomes

CO1: Ability to familiarize with problem of steady state flow sheeting.
CO2: Ability to understand the Heuristics for process synthesis.
CO3: Ability to understand algorithmic methods for process synthesis.
CO4: Ability to understand about Reliability of equipment.
CO5: Ability to analyze the economics of chemical process.

Text/Reference Book:

1. Seider W. D., SeaderJ. D. and Lewin D. R., Product and Process Design Principles: Synthesis, Wiley, 2016.
2. Robin Smith, Chemical Process Design and Integration, John Wiley & sons Ltd,2005.
3. Bieglar L.T, Grossman E.I and Westerberg A.W., Systematic Methods of Chemical Process Design, Prentice Hall Inc., (1997)
4. Douglas J. M., Conceptual Design of Chemical Processes, McGraw Hill International, 1988.

Course Code	Semester	Course Title	Load	Credit
PEC-CH801(2)	VIII	Petrochemical Engineering	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Fuel Technology, Engineering Chemistry

Course Objective: The aim of this subject is to expose the students to understand the basic piping design and its application to chemical engineering.

Course Content-

Module 1: **10 hrs**

Feed Stock And Source Of Petrochemicals:-Overview of Petrochemical Industry – The key growth area of India, Economics – Feed stock selections for Petrochemicals – Steam cracking of Gas and Naphtha to produce Olefins, Di-olefins and Production of Acetylene.

Module 2: **8 hrs**

Synthesis Gas Production:-Steam reforming of Natural gas – Naphtha and Heavy distillate to produce Hydrogen and Synthesis gas – Production of Methanol – Oxo process.

Module 3: **7 hrs**

Primary Unit Processes: - Fundamental and Technological principled involved in Alkylation – Oxidation – Nitration and Hydrolysis.

Module 4: **8 hrs**

Secondary Unit Processes: - Fundamental and Technological principled involved in Sulphonation, Sulfation and Isomerisation.

Module 5: **7 hrs**

Tertiary Unit Processes:- Fundamental and Technological principles involved in Halogenation and Esterification

Course Outcomes

CO1: Ablity to understand the principles of various unit processes in the petrochemical industry.
CO2: Ability to understand the Synthesis Gas Production.
CO3: Ability to understand Primary Unit Processes.
CO4: Ability to understand Secondary Unit Processes.
CO5: Ability to analyze the Tertiary Unit Processes.

Text/Reference Book:

1. Margaret Wells, “Handbook of Petrochemicals and Processes”, 2nd Edition, Ash Gate Publishing Limited, 2002.
2. Sami Matar, and Lewis F. Hatch., “Chemistry of Petrochemical Processes”, 2nd Edition, Gulf Publishing Company, 2000.
3. Dryden, C.E., “Outlines of Chemical Technology”, 2nd Edition, Affiliated East-West Press, 1993.
4. Bhaskara Rao, B.K., “A Text on Petrochemicals”, Khanna Publishers, 2000.
5. Sukumar Maiti, “Introduction to Petrochemicals”, 2nd Edition, Oxford and IBH Publishers,2002.

Course Code	Semester	Course Title	Load	Credit
PEC-CH801(3)	VIII	Energy Conservation in Chemical Process Industry	3L:0T:0P (03 hrs)	Credits:03

Prerequisite Course: Chemical Engineering Thermodynamics, Material and Energy Balance Calculations, Applied Physics

Module 1:
Energy resources, Energy conversion processes and devices – Energy conversion plants, Conventional, Thermal, Hydro, Nuclear fission , and Non – conventional – Solar, Wind Biomass, Fuel cells, Magneto Hydrodynamics and Nuclear fusion.

Module 2:
Energy Scenario – Global and Indian –Impact of Energy on economy, development and environment, Energy policies, Energy strategy for future.

Module 3:
Analysis of scope and potential for energy conservation, Thermal insulation, Efficiency improvement in boilers, furnaces and heat recovery techniques,

Module 4:
Energy conservation Principles, Energy economics, Energy conservation technologies, Waste heat recovery

Module 5:
Energy Conservation Opportunities, Energy Conservation analysis of pumps, Process integration as a measure of energy conservation.

Course Outcomes
CO1: Know the energy conservation process.
CO2: Know energy scenario and Energy strategy for future.
CO3: Evaluate the performance of industrial boilers and furnaces.
CO4: Understand the Energy conservation Principles and Waste heat recovery.
CO5. Understand the Energy Conservation Opportunities and Process integration as a measure of energy conservation

Text/Reference Book:

1. Amlan Chakrabarti, Energy Engineering and Management, Prentice Hall India, 2011.
2. Eastop T. D. and D. R. Croft, Energy Efficiency for Engineers & Technologists, Longman, 1990.
3. Albert Thumann P. E. and W. J. Younger, Handbook of Energy Audits, Fairmont Press, 2008. 4. Doty S. and W. C. Turner, Energy Management Hand book, 7/e, Fairmont Press, 2009.
4. Rao S. and B. B. Parulekar, Energy Technology, Khanna Publishers, 2005.
5. Rai G. D., Non-conventional Energy Sources, Khanna Publishers, 2011.