# M.Tech. Energy Conservation and Management

## Semester II

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AIM:
The course is intended to build up necessary background for the design of the various types of heat exchangers.

OBJECTIVE:
- To learn the thermal and stress analysis on various parts of the heat exchangers
- To analyze the sizing and rating of the heat exchangers for various applications

UNIT I  
FUNDAMENTALS OF HEAT EXCHANGERS  9

UNIT II  
FLOW AND STRESS ANALYSIS  9

UNIT III  
DESIGN ASPECTS  9

UNIT IV  
COMPACT AND PLATE HEAT EXCHANGERS  9

UNIT V  
CONDENSERS & COOLING TOWERS  9
Design of surface and evaporative condensers – cooling tower – performance characteristics.

TOTAL : 45 PERIODS

TEXT BOOK:

REFERENCES

AIM:
To detail on the importance of Total Energy Concept, its advantages and cost effectiveness.
OBJECTIVES:
- To analyze the basic energy generation cycles
- To detail about the concept of cogeneration, its types and probable areas of applications
- To study the significance of waste heat recovery systems and carryout its economic analysis

UNIT I INTRODUCTION

UNIT II COGENERATION TECHNOLOGIES

UNIT III ISSUES AND APPLICATIONS OF COGENERATION TECHNOLOGIES

UNIT IV WASTE HEAT RECOVERY SYSTEMS
election criteria for waste heat recovery technologies - recuperators - Regenerators - economizers - plate heat exchangers - thermic fluid heaters - Waste heat boilers classification, location, service conditions, design Considerations - fluidized bed heat exchangers - heat pipe exchangers - heat pumps – sorption systems.

UNIT V ECONOMIC ANALYSIS

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:
UNIT I  POWER PLANT FEATURES and POWER PLANT ECONOMICS  9

UNIT II  BOILER and ACCESSORIES  9


UNIT III  STEAM CYCLE APPLIANCES  9

UNIT IV  GAS CYCLE APPLIANCES  9
Gas turbine power plant: Classification and comparison of different types gas turbine power plants – Analysis of closed cycle and open cycle gas turbine plants – Methods to improve thermal efficiency – Components of gas turbine power plant – Advantages of gas turbine plant over diesel and thermal power plants.

UNIT V   EMERGING TECHNOLOGIES


Diesel electric power plants: Field of use – Outline of diesel electric power plant – Different types of engine and their working – Different systems of diesel power plant – Performance of diesel engines – Comparison of diesel plant with steam power plants.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

EM9324       OPTIMUM UTILIZATION OF HEAT AND POWER L T P C
                          3 0 0 3

UNIT I   ENERGY CONVERSION AND ITS USE

UNIT II   TARGETING AND $\Delta T_{\text{min}}$ OPTIMIZATION
Energy targeting – Area targeting – Unit targeting – Shell targeting – Cost targeting – $\Delta T_{\text{min}}$ optimization – Continuous targeting – Overall pinch targeting and continuous targeting.

UNIT III   PROCESS INTEGRATION and PINCH TECHNOLOGY
UNIT IV TOTAL ENERGY SYSTEMS AND SCHEMES

Total Energy Systems: Concept of total energy – Advantages and limitations – Total energy system and application – Various possible schemes employing steam turbines movers used in total energy systems – Potential and economics of total energy systems.


UNIT V THE ECONOMICS OF ENERGY SAVING SCHEMES


TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCE

EM9327 ENERGY ENGINEERING LABORATORY

LIST OF EXPERIMENTS

1. Proximate Analysis of Solid Fuels
2. Ultimate Analysis of Solid Fuels
3. Determination of Calorific Value of Solid/liquid Fuels using Bomb Calorimeter
4. Determination of Calorific Value of gaseous Fuels using Junker’s gas Calorimeter
5. Emission Test Using Combustion Gas Analyzer
6. Energy balance test on given steam boiler
7. Performance analysis of heat transfer equipments
8. Determination of heating/cooling load for the given space to be air – conditioned
10. Solar Radiation – Measurement and Analysis
11. Determination of dissolved Oxygen, suspended, volatile and fixed Solids
12. Determination of B.O.D and C.O.D
13. Control valve characteristics of flow co-efficient and range ability
14. Effect of P, PI, and PID controller on pressure control loop
15. Verifying the response of Interacting and Non – Interacting level systems

TOTAL: 45 PERIODS
UNIT I  ENERGY CONSERVATION PRINCIPLES AND PRACTICES  9

UNIT II  THERMAL ENERGY AUDITING AND CO-GENERATION  9

UNIT III  ENERGY CONSERVATION IN FLUID MOVING MACHINES, AND COOLING TOWERS  9
Centrifugal pumps – Energy consumption and energy saving potentials – Design consideration – minimizing over design – Case studies – Fans and blowers – Specification, safety margin, choice of fans, controls and design considerations – Air compressor and compressed air systems – selection of compressed air layout – Encon aspects to be considered at design stage – Case studies.

UNIT IV  ELECTRICAL ENERGY AUDITING  9

UNIT V  ENERGY MANAGEMENT, MONITORING and TARGETING  9
Organizational background desired for energy management persuasion / motivation / publicity role – Tariff Analysis – Industrial energy management systems – Energy monitoring, auditing and targeting – Economics of various energy conservation schemes – Energy policy and energy labeling.

L: 45 T:15 TOTAL: 60 PERIODS

TEXT BOOKS
REFERENCES

EM9332 VISUAL BASIC PROGRAMMING LABORATORY

1. Fundamental of VB Programming
2. VB Programme to Evaluate Thermodynamic Properties
3. VB Programme to Generate Steam Tables
4. VB Programme to Generate VLE Data
5. VB Programme to find theoretical air required and flue gas composition for a fuel of given composition
6. VB Programme to Evaluate performance of pumps and compressors
7. VB Programme to Evaluate performance of Cooling Towers
8. VB Programme to Evaluate performance of Heat Exchangers
9. Development of VB Programme for the design of Heat Exchangers
10. Development of VB Programme for the design of Distillation Columns

TOTAL: 45 PERIODS

EM9001 REFRIGERATION AND AIR CONDITIONING

UNIT I BASIC CONCEPTS AND TYPES OF REFRIGERATION

UNIT II DESIGN FEATURES OF ACCESSORIES
Design features of condensers, evaporators and cooling towers – Types of electrical systems for refrigeration – Various of domestic and industrial refrigeration equipment and their design features – Types of expansion devices – Temperature control – Defrosting.

UNIT III PHYCROMETRICS, HEATING, VENTILATION AND AIR - CONDITIONING
UNIT IV WORKING AND PERFORMANCE ANALYSIS OF REFRIGERATION SYSTEMS


UNIT V DESIGN OF REFRIGERATION EQUIPMENTS AND APPLICATION


TOTAL: 45 PERIODS

TEXT BOOKS


REFERENCES


EM9002 UNIT OPERATIONS IN INDUSTRIES L T P C

UNIT I CRUSHING, GRINDING and CONVEYING OF BULK SOLIDS 12

UNIT II MIXING AND FILTRATION 8
UNIT III EVAPORATION

UNIT IV HUMIDIFICATION AND DRYING

UNIT V DISTILLATION

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

EM9003 APPLIED MATHEMATICS FOR ENGINEERS

UNIT I TRANSFORM METHODS

UNIT II ELLIPTIC EQUATIONS

UNIT III CALCULUS OF VARIATIONS
Variation and its properties – Euler’s equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Some applications – Direct methods – Ritz and Kantorovich methods.
UNIT IV  NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

Solution of Laplace's and Poisson equation on a rectangular region by Liebmann's method – Diffusion equation by the explicit and Crank Nicolson – Implicit methods – Stability and Convergence criterion – Solution of wave equation by explicit scheme.

UNIT V  CONFORMAL MAPPING AND APPLICATIONS

The Schwarz – Christoffel transformation – Transformation of boundaries in parametric form – Physical applications – Application to fluid flow – Application to heat flow.

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

EM9005  SUSTAINABLE DEVELOPMENT

UNIT I  INTRODUCTION
Industrial activity and environment industrialization and sustainable development – Industrial ecology – Prevention versus control of industrial pollution – Regulations to encourage cleaner production based approached.

UNIT II  CLEANER PRODUCTION CONCEPT
Importance – Historical evolution – Benefits – promotion – barriers – Role of industry, government and institutional – Resume, recovery, recycle, substitution – Internet information and other CP resources.

UNIT III  CLEANER PRODUCTION PROJECT DEVELOPMENT

UNIT IV  LIFE CYCLE ANALYSIS and ENVIRONMENTAL MANAGEMENT SYSTEM

UNIT V  CASE STUDY
Industrial application of CP, LCA, EMS – Environmental audit

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

EM9006 ENERGY EFFICIENT BUILDINGS AND HVAC L T P C
3 0 0 3

UNIT I INDOOR ENVIRONMENT
Introduction to Architecture – Architecture as the art and science of designing buildings – Building science and its significance – Indoor environment – Components of indoor environment – Quality of indoor environment.

UNIT II THERMAL ANALYSIS AND DESIGN FOR HUMAN COMFORT

UNIT III SOLAR PASSIVE CONCEPTS FOR COOLING FOR BUILDINGS

UNIT IV ENERGY MANAGEMENT AND ENERGY AUDIT OF BUILDINGS

UNIT V ENERGY EFFICIENT LANDSCAPE DESIGN
Modification of microclimate through landscape elements for energy conservation – Energy conservation through site selection – Sitting and orientation – Energy conservation through integration of buildings and site – Site planning and site design.

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

EM9007 CARBON SEQUESTRATIONS AND TRADING L T P C
UNIT I GREENHOUSE GAS 3 0 0 3

UNIT II CARBON 9

UNIT III MANAGEMENT 9
Risk management and risk reduction – Carbon economics – Verification of carbon change.

UNIT IV CASE STUDIES 9
Carbon trading model – Century model – Case studies.

UNIT V RULES AND REGULATIONS 9

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCES
AIM:
To create awareness among the student community on anthropogenic degradation of environment and technologies available to limit the degradation.

OBJECTIVES:
- To impart knowledge on the atmosphere and its present condition, global warming and eco-legislations.
- To detail on the sources of air, water and noise pollution and possible solutions for mitigating their degradation.
- To elaborate on the technologies available for generating energy from waste.

UNIT I INTRODUCTION

UNIT II AIR POLLUTION
Pollutants - sources and effect – air pollution meteorology – atmospheric dispersion – indoor air quality - control methods and equipments - issues in air pollution control – air sampling and measurement.

UNIT III WATER POLLUTION
Water resources - water pollutants - characteristics – quality - water treatment systems – waste water treatment - treatment, utilization and disposal of sludge - monitoring compliance with standards.

UNIT IV WASTE MANAGEMENT

UNIT V OTHER TYPES OF POLLUTION FROM INDUSTRIES

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES
UNIT I  BASIC EQUATIONS OF FLOW  6

UNIT II  REYNOLD’S ANALYSIS and BOUNDARY LAYER CONCEPT  13

UNIT III  TRANSPORTATION OF FLUIDS, INTERPHASE AND MULTIPHASE MOMENTUM TRANSFER  12
Types of centrifugal and reciprocating pumps – Comparison of centrifugal and reciprocating pumps – Industrial pipe system – Selection of fans, blowers, pumps and compressors – Efficiency prediction – Pressure drop characteristics – Friction factor, fluid – Fluid system flow patterns in vertical and horizontal pipes – Formation of bubbles and drops and their size distribution, solid – Fluid systems – Forces acting on stagnant and moving solids – Flow through porous medium – Capillary tube model and its applications for packed bed and filters, fluidized bed, solid fluid conveying settling and sedimentation.

UNIT IV  INTERPHASE TRANSPORT IN NON – ISOTHERMAL SYSTEMS AND RADIATION HEAT TRANSFER  6
Heat transfer co-efficient, Forced convection in tubes, around submerged objects, through packed beds. heat transfer by free convection, film type and drop wise condensation equations for heat transfer coefficients for both, heat transfer in boiling liquids

UNIT V  INTERPHASE MASS TRANSPORT AND MACROSCOPIC BALANCES FOR MULTI COMPONENT SYSTEM  8
Mass transfer coefficient in one and two phases at low and high mass transfer rates, film theory penetration theory, boundary layer theory, fixed bed catalytic, reactor, macroscopic balances to solve steady and unsteady state problems.

TOTAL: 45 PERIODS

TEXT BOOKS
REFERENCES

EM9011 PROCESS MODELING, SIMULATION AND OPTIMIZATION  L T P C
3 0 0 3

UNIT I BASIC MODELLING

UNIT II MATRIX MODELS

UNIT III LUMPED PARAMETER MODEL

UNIT IV DISTRIBUTED PARAMETER MODEL
Formation and solution of one dimensional state problem in heat transfer and mass transfer systems – Multi dimensional problems – Application in heat and mass transfer equipments.

UNIT V OPTIMISATION AND SIMULATIONS

TOTAL: 45 PERIODS
TEXT BOOKS

REFERENCES

EM9012 WASTE MANAGEMENT AND ENERGY CONVERSION TECHNOLOGIES

UNIT I SOLID WASTE

UNIT II WASTE TREATMENT
Size reduction – Aerobic composting – Incineration – Furnace type and design, medical / pharmaceutical waste incineration – Environmental impacts – Measures of mitigate environmental effects due to incineration.

UNIT III WASTE DISPOSAL

UNIT IV HAZARDOUS WASTE MANAGEMENT

UNIT V ENERGY GENERATION FROM WASTE

TOTAL: 45 PERIODS
IC9262    COMPUTATIONAL FLUID DYNAMICS     L T P C
                      3 0 0 3
AIM
This course aims to introduce numerical modeling and its role in the field of heat and fluid flow, it will enable the students to understand the various discretisation methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.

OBJECTIVE:
• To develop finite difference and finite volume discretized forms of the CFD equations.
• To formulate explicit & implicit algorithms for solving the Euler Eqns & Navier Stokes Eqns.

UNIT I  GOVERNING DIFFERENTIAL EQUATION AND FINITE DIFFERENCE METHOD  10
Classification, Initial and Boundary conditions – Initial and Boundary Value problems – Finite difference method, Central, Forward, Backward difference, Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test.

UNIT II  CONDUCTION HEAT TRANSFER  10
Steady one-dimensional conduction, Two and three dimensional steady state problems, Transient one-dimensional problem, Two-dimensional Transient Problems.

UNIT III  INCOMPRESSIBLE FLUID FLOW  10

UNIT IV  CONVECTION HEAT TRANSFER AND FEM  10
UNIT V  TURBULENCE MODELS
Algebraic Models – One equation model, K – ε Models, Standard and High and Low Reynolds number models, Prediction of fluid flow and heat transfer using standard codes.

REFERENCES:

TE9272  FLUIDIZED BED SYSTEMS  L  T  P  C
3 0 0  3

AIM:
To inspire the students with the theories of fluidization, heat transfer and design for various applications.

OBJECTIVES:
- To introduce the concepts of fluidization and heat transfer in fluidized beds.
- To understand the design principles and apply the same for industrial applications.

UNIT I  FLUIDIZED BED BEHAVIOUR

UNIT II  HEAT TRANSFER
UNIT III  COMBUSTION AND GASIFICATION  6

UNIT IV  DESIGN CONSIDERATIONS  9

UNIT V  INDUSTRIAL APPLICATIONS  12
Physical operations like transportation, mixing of fine powders, heat exchange, coating, drying and sizing. Cracking and reforming of hydrocarbons, carbonization, combustion and gasification. Sulphur retention and oxides of nitrogen emission Control.

TOTAL: 45 PERIODS

TEXT BOOKS:

REFERENCES:

EM9014  ELECTRICAL ENERGY TECHNOLOGY  L T P C
UNIT I  ELECTRIC ENERGY CONVERSION DEVICES  3 0 0 3
Transformers – Parallel operation – Auto transformers DC machines – Performance equation – Generator characteristics – Motor characteristics – Applications synchronous machines – Permanent magnet alternators – Induction machines.

UNIT II  POWER SYSTEM FUNDAMENTALS  9
Transmission line representation – Power flow study – Power factor improvement – Faults on power systems – Symmetrical components – Introduction to HVDC systems – Basic ideas about insulation coordination.

UNIT III  SOLID STATE POWER CONVERTERS  9
Controlled rectifiers – Choppers – Inverters – Voltage regulators and cycloconverters.

UNIT IV  SOLID STATE DC AND AC DRIVES  9
UNIT V  EMBEDDED GENERATION  
Wind-driven induction generators – Grid connected Photo-voltaic systems – Steady state performance – Integration issues – Principles of energy auditing

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

EM9015 TECHNOLOGY MANAGEMENT L T P C 3 0 0 3

UNIT I  STRATEGIC MANAGEMENT (SM)  

UNIT II  INTELLECTUAL PROPERTY RIGHTS (IPR)  

UNIT III  TECHNOLOGY MANAGEMENT (TM)  

UNIT IV  TECHNOLOGY AQUISITION AND MARKETING (TAM)  
UNIT V    TECHNOLOGY FORECASTING (TF)         9
Exploratory method of TF – Delphy technique – Cross impact matrix – Curve fitting
– Morphological methods – Trend extrapolation – Regression analysis – Economic
models – Normative methods of TF – Operational research models and simulation –
Network techniques, Relevance trees, system dynamics – Qualitative methods and
futurology.

TOTAL: 45 PERIODS

TEXT BOOKS
  1. Coates, V.T., “A Handbook of Technology Assessment”, U.S. Department of
  2. Wright, Peter, Kroll, Mark J. and John, P.A., “Strategic Management Concepts

REFERENCES
     Scientists, Technologies and Other Users, TIFAC / CSIR, 1993.

EM9016    DEMAND SIDE MANAGEMENT OF POWER       L T P C
              3 0 0 3

UNIT I     BASICS OF ELECTRICAL ENERGY CONSERVATION       9
Units of measurement – Measurement of Various Electrical parameters – Electrical
Indicating Instruments – Concept of electrical energy audit – Improvement of power
management.

UNIT II    POWER DISTRIBUTION SECTOR                   9
Types of Distribution systems – A/C single phase and 3 distributions – Kelvin’s law
of power distribution – Limitations – Types of Sub-stations and their functions – Load
optimization in distribution systems – Recent developments.

UNIT III    INDUSTRIAL SECTOR                         9
Types of Motors fore Industrial Applications, Characteristics – transient and steady
state, speed control, load equalization, heating applications – Resistance furnace,
Arc furnace and Induction furnace – performance and energy efficiency, Welding
Applications – resistance and arc type – performance analysis, recent developments.

UNIT IV     TRACTION, ILLUMINATION                    9
Types of traction motors – Speed control – Requirements of Ideal traction systems
Braking – Law of Illumination – Luminous efficacy – Photometry – Calculation of
lumen of flux – Lighting calculations – Types of Illumination equipment – Design of
chokes and capacitors – Optimization of Illumination loads – Recent developments.
UNIT V AGRICULTURAL SECTOR

Importance of Agricultural and rural loads – Types of agricultural loads – Load characteristics of pumps – Role of alternate energy sources in agricultural and rural energy requirements.

TOTAL: 45 PERIODS

TEXT BOOK

REFERENCE

EM9017 SAFETY AND HAZARDS CONTROL IN INDUSTRIES L T P C
3 0 0 3

UNIT I GENERAL
9

UNIT II HAZARDS AND ITS EFFECTS
9

UNIT III FIRES AND EXPLOSIONS
9

UNIT IV HAZARDS / RISK ASSESSMENT
9
UNIT V  WASTE MANAGEMENT AND ECONOMICS  9

TOTAL: 45 PERIODS

TEXT BOOKS

REFERENCES

EY9011  POWER GENERATIONS, TRANSMISSION AND UTILIZATION  L T P C  3 0 0 3

UNIT I  CONVENTIONAL POWER GENERATION  10

UNIT II  NON CONVENTIONAL POWER GENERATION  8

UNIT III  ECONOMICS OF POWER GENERATION  8
Daily load curves – Load factor – Diversity factor – Load deviation curve – Load management – number and size of generating unit cost of electrical energy – Tariff-power factor improvement

UNIT IV  ELECTRICAL POWER TRANSMISSION  9

UNIT V  UTILISATION OF ELECTRICAL ENERGY  10

TOTAL: 45 PERIODS
REFERENCES: