M.Tech. IN MECHANICAL ENGINEERING (ENERGY TECHNOLOGY)

CURRICULUM AND SYLLABUS

(Effect from the Academic Year 2007 – 08)

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605014.
M. TECH. IN MECHANICAL ENGINEERING (ENERGY TECHNOLOGY)

CURRICULUM AND SCHEME OF EXAMINATION

(Total number of credit required for the completion of the programme – 72)

ELIGIBILITY:

M.Tech. in Mechanical Engineering (Energy Technology): Candidates for admission to the first semester of the four semester M.Tech. Course in Mechanical Engineering with specialisation in Energy Technology should have passed B.E/B.Tech in Mechanical / Chemical / Electrical Engineering (with Thermodynamics and Heat & Mass Transfer as electives) (or) an examination of any University or Authority accepted by the Pondicherry University as equivalent thereto, with at least 55% marks in the degree examination or equivalent CGPA.

SEMESTER – I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Credit(s)</th>
<th>Evaluation (marks)</th>
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Total: 20  250  350  600
## SEMESTER – II

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<td>11.</td>
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<td>Nuclear Power Engineering</td>
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<td>Utilization of Solar Energy</td>
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<td>13.</td>
<td>ME 934</td>
<td>Utilization of Wind and Hydrogen Energies</td>
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ME 901 ADVANCED THERMODYNAMICS AND HEAT TRANSFER

Unit - I

Unit - II

Unit - III
Conduction - steady state and transient heat conduction – non-uniform conductivity – heat transfer from extended surface. Convection - free and forced convection - concept of boundary layer thickness - hydro dynamic and thermal boundary layer – momentum and energy transfer through boundary layer – energy equations – exact solutions.

Unit - IV

Unit - V
Liquid metal heat transfer – heat transfer in rotating machinery – heat transfer in space power plants systems – heat transfer in solar applications.

Reference Books
ME 902 ENERGY CONVERSION SYSTEMS

Unit - I


Unit - II

Production of thermal energy using bio-mass, fossil fuels, nuclear fuels, solar energy – Conversion of thermal energy, electrical energy, electromagnetic energy and hydraulic energy into mechanical energy – Energy conversion system: steam turbines, hydraulic turbines and wind turbines – Energy conversion system cycles.

Unit - III


Unit - IV

Production of electrical energy using non-conventional sources: solar energy, wind energy, wave energy, tidal energy and ocean thermal energy. Solar thermal energy conversion system – photovoltaic conversion – optical effects of p-n junction – analysis of PV cells – wave energy conversion system – tidal energy conversion system – wind energy conversion system.

Unit - V


Reference Books

ME 903 OPTIMIZATION TECHNIQUES

Unit - I


Unit - II


Unit - III


Unit - IV


Unit - V

Genetic algorithms (GAs): working principle – difference between GAs and traditional methods – GAs for constrained optimization – Simulated annealing – Global optimization: using steepest descent method and GA.

Reference Books

1. Deb, K., Optimization for engineering design, Prentice Hall of India, 2005
ME 904 ENERGY CONSERVATION AND MANAGEMENT

Unit - I

Unit - II

Unit - III

Unit - IV
Energy conservation in industries - energy conservation in pumps, fans, compressed air systems, refrigeration & air conditioning systems, emergency DG sets, illumination, electrical motors – energy efficient motors and variable speed motors. Case studies for energy conservation in various industries such as cement, iron and steel, glass, fertilizer, food processing, refinery etc.

Unit - V

Reference books
11. Tyagi, A. K., Handbook of energy audits and management, TERI
12. PCRA Booklets.
ME 905 DESIGN OF THERMAL EQUIPMENT

Unit - I

Unit - II
Double pipe heat exchangers – applications and design parameters – types available. Shell and tube heat exchangers with single phase flow – design procedure – flow arrangement for increased heat recovery.

Unit - III
Types of condensers and their selection – design procedures – types of evaporators – shell and tube reboilers – types and thermal design.

Unit - IV

Unit - V
Types of cooling towers – packing region – features of natural and mechanical draft towers – thermal performance of natural and forced draft cooling towers.

Reference Books

ME 906 COMPUTATIONAL FLUID DYNAMICS

Unit - I

Unit - II

Unit - III

Unit - IV

Unit - V

Reference books
7. Hoffmann, K. A., Computational Fluid Dynamics for Engineers, Engineering Education system, Wichita, Kansas, USA, 1993
11. Fletcher, J. H., Computational Techniques for Fluid dynamics, Spring-Verlag, Berlin, 1999
ME 907 COMPUTATIONAL TECHNIQUES LABORATORY

(Programs are to be done in FORTRAN/ C)

1. Solution to linear algebraic equations using Gauss-Seidel method
2. Solution to linear algebraic equations using Conjugate Gradient method
3. Solution to linear algebraic equations using GMRES method
4. Solution to linear algebraic equations using LU decomposition method
5. Solution to nonlinear algebraic equations using Newton method
6. Determining Eigen value and Eigen vector for a system of equations
7. Finding roots of an equation using Newton-Raphson method
8. Solution to ODEs using Runge-Kutta method
9. Solution to ODEs through Finite Element method
10. Solution to Poisson’s equation with Dirichlet and Convective boundary conditions
11. Solution to 2D transient conduction equation using implicit method
12. Solution to one dimensional wave equation
13. Solution to 2D problem using Fluent
1. Determination of heating/cooling load for the given space to be air-conditioned.

2. Performance test on Air Conditioning/Refrigeration system.

3. Aerodynamic study on Aerofoil and Cylinder (Pressure and Velocity distribution)

4. Energy balance test on given Steam Boiler.

5. Energy balance test on given Petrol engine.


7. Fuel and flue gas analysis using Gas – Chromograph.


ME 921 ADVANCED FLUID MECHANICS

Unit - I

Unit - II

Unit - III
Laminar boundary layer - laminar boundary layer equation – similarity solution for steady two dimensional flow – approximate integral method – numerical solutions - boundary layer control.

Unit - IV

Unit - V
Compressible flow - fundamental equation of flow of compressible viscous and inviscid fluid – plane couette flow – exact solution – steady flow through constant area pipe – laminar boundary layer equation in compressible flow – boundary layer with pressure gradient and with zero pressure gradient – application of moment integral equation to boundary layers – turbulent boundary layer equations in compressible flow – compressible turbulent flow past a flat plate.

Reference Books
ME 922 ALTERNATIVE FUELS AND THEIR APPLICATIONS

UNIT I

UNIT II

UNIT III

UNIT IV

UNIT V

Reference books.

Unit - I


Unit - II

Biomass pyrolysis – pyrolysis – types, slow fast – manufacture of charcoal, methods, yields and application – manufacture of pyrolytic oils and gases, yields and applications.

Unit - III

Biomass gasification – gasifiers – fixed bed system – downdraft and updraft gasifiers – fluidized bed gasifiers – design, construction and operation – gasifier burner arrangement for thermal heating – gasifier engine arrangement and electrical power – equilibrium and kinetic consideration in gasifier operation.

Unit - IV

Biomass combustion – biomass stoves – improved chullahs, types, some exotic designs – fixed bed combustors – types, inclined grate combustors – fluidized bed combustors – design, construction and operation and operation of all the above biomass combustors.

Unit - V


Reference books

ME 924 CO-GENERATION AND ITS APPLICATIONS

Unit - I

Concept of Cogeneration – review on Thermodynamics of conventional power producing plants. Selecting cogeneration technologies.

Unit - II

Thermodynamics of Cogeneration power plants – performance criteria and effect of irreversibility.

Unit - III


Unit - IV

Design of Cogeneration plant for varying plant heat to power ratio – fuel savings from installation of cogeneration plant.

Unit - V

Economic assessment of Cogeneration schemes. Applications of cogeneration technology to various process plants.

Reference books

ME 925 CRYOGENIC ENGINEERING

Unit - I

Unit - II

Unit - III
Cryogenic systems – Claude system – Linde Hampson system – Heylandt system – Stirling cryocooler – Gifford McMahon cryocooler – thermodynamic analysis of above systems.

Unit - IV

Unit - V

Reference Books
ME 926 DESIGN OF EXPERIMENTS

Unit – I


Unit – II


Unit – III


Unit – IV


Unit – V

Optimization of cost and quality – Artificial Neural Network – Genetic Algorithms – Particle Swam optimization – Simulated Annealing Algorithm – Ant Colony Algorithm – Fuzzy logic approach

Reference Books

1. Douglos C Montgomery, Design and Analysis of Experiments, John Wiley & Sons, 1984,
6. Deb, K., Optimization for engineering design, Prentice Hall of India, 2005
ME 927 DIRECT ENERGY CONVERSION

Unit - I


Unit - II


Unit - III

Photovoltaic conversion – optical effects of p-n junction – design and analysis of PV cells – PV cell fabrication – system design.

Unit - IV


Unit - V


Reference Books

3. Angrist, S. W., Direct Energy Conversion, Allyn and Bacon, Boston, 1982.
ME 928 ENERGY CONVERSION AND ENVIRONMENTAL POLLUTION

Unit - I

Environmental aspects of energy utilization, energy market, sources of world energy, exhaustible and inexhaustible sources.

Unit - II

Principle fuels for energy conversion, synthetic and other fuels, energy utilization, reserve and economics.

Unit - III

Environmental considerations, types of air pollution, effects of air pollution on men and on environment.

Unit - IV

Formation of air pollutants from combustion of fossil fuels and parameters controlling their formation, pollution from automobiles and its control, pollution by industrial and municipal wastes and their treatment.

Unit - V

Pollution from thermal power plants and nuclear power plants sources and control methods and instrumentation for pollution control. Water pollution from tanneries, other industries, and their control.

References Books

ME 929 ENERGY MANAGEMENT IN BUILDINGS

Unit - I

Overview of the significance of energy use and energy processes in building, indoor activities and environmental control, internal and external factors on energy use and the attributes of the factors, characteristics of energy use and its management, macro aspect of energy use in dwellings and its implications.

Unit - II

Indoor environmental requirement and management, thermal comfort, ventilation and air quality, air-conditioning requirement, visual perception, illumination requirement, auditory requirement.

Unit - III

Climate, solar radiation and their influences, the sun-earth relationship and the energy balance on the earth's surface, climate, wind, solar radiation, and temperature, sun shading and solar radiation on surfaces, energy impact on the shape and orientation of buildings.

Unit - IV

End-use, energy utilization and requirements, lighting and day lighting, end-use energy requirements, status of energy use in buildings, estimation of energy use in a building. Heat gain and thermal performance of building envelope, steady and non steady heat transfer through the glazed window and the wall, standards for thermal performance of building envelope, evaluation of the overall thermal transfer.

Unit - V

Energy management options, energy audit and energy targeting, technological options for energy management.

Reference Books

Unit - I


Unit - II

Fluidized bed heat transfer - heat transfer mechanisms in bubbling fluidized and circulating fluidized beds – heat transfer at elevated temperatures – heat transfer in multiphase flows.

Unit - III


Unit - IV


Unit - V


References Books

ME 931 MODELLING AND SIMULATION OF ENERGY SYSTEMS

Unit – I


Unit – II


Unit – III


Unit – IV


Unit – V


Reference Books

ME 932 NUCLEAR POWER ENGINEERING

Unit - I


Unit - II


Unit - III


Unit - IV


Unit - V

Heat generation in reactors – thermal constraints – heat transfer to coolants – thermal design of reactor.

Reference Books

ME 933 UTILISATION OF SOLAR ENERGY

Unit - I


Unit - II


Unit - III


Unit - IV


Unit - V


Reference Books

ME 934 UTILIZATION OF WIND AND HYDROGEN ENERGIES

Unit – I Wind Energy Conversion


Unit – II Theory of Wind Energy Conversion System


Unit – III Design of Wind Energy Converters


Unit – IV Hydrogen Energy


Unit – V Hydrogen Energy Storage, Transportation and Applications


Reference Books

2. Spera, d. a., Wind Turbine Technology: Fundamental concepts of wind turbine engineering, ASME Press
ME 961 Directed study

Each candidate is required to make a study on a relevant topic connected with the field of specialization. The topic shall be chosen in consultation with the concerned Faculty Guide and Head of the Department. It would be such as to develop investigative and creative ability of the candidate. A presentation shall be given after a thorough investigation of the literature and other data relevant to the topic.
ME 909 MAJOR PROJECT (PHASE – I)

The project work is to acquaint the student in the analysis of problems posed to him, in
the method of conducting a detailed literature survey and reviewing the state of art in
the area of the problem. If the major project (Phase–I) which is not purely theoretical,
student is also expected to design, conduct and develop skills of experimental work, in
some of them and to analyse the results obtained. An Internal Examiner will examine
the project report written at a viva-voce.
ME 910 MAJOR PROJECT (PHASE – II)

The student will take up the Major Project (Phase–II) in the fourth semester. This is aimed at exposing the students to analyze independently his project work. The work may be purely analytical or completely experimental or combination of both. In few cases, the project can also involve a sophisticated design work. The major project report is expected to show clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill. The dissertation work should be of relevant nature for the current and the future needs of the country. The dissertation report will be examined at the time of viva-voce.