Approval: 10th senate Meeting

Course Number: ME 633

Course Name: Design of Energy Systems

Credits: 3-0-0-3

Prerequisites: - Instructor Consent

Intended for: B. Tech. /M. Tech./ MS/ PhD

Distribution: Compulsory for M. Tech in Mechanical Engineering with specialization in Energy Systems, and Elective for others

Semester: Odd/Even

Preamble: Starting from the background of foundation courses regarding energy systems this core course will focus on detailed design of conventional systems and of those emerging technologies based on solar, wind and other renewable sources - their system components and integration. Functionality of components, design requirement and challenges will be covered in detail.

Course Outline: The objective of the course is to provide the students an understanding of the fundamental concepts and techniques used in the design, performance analysis, and implementation in current energy systems leading to the development of the renewable and nonrenewable energy conversion devices of the future.

Course Modules:

Module – 1:
Introduction to energy systems, Introduction to critical components for design in energy system, thermal stresses, material selections (**4L**)

Module – 2:
Turbine blade design, overview of design criteria and certification guidelines, aerodynamic design, structural design, design and choice of sub-systems and components, design of blades for gas turbines, consideration of blade cooling in design of gas turbine blades, blades for hydro and wind turbines (**12L**)

Module – 3:
Design of critical, supercritical and ultra-supercritical boilers, Stresses in pressure storage sections, Autofrettage, Thermal stresses, Design of various boiler components such as shell, heads, nozzles, flanges as per ASME & IS codes, Buckling (**8L**)

Module – 4:
Design of high pressure power plant piping systems, flow characteristics, material selection, thermal analysis of pipe and joints, thermal insulations (**4L**)

Module – 5:

Design of heat transfer equipments, Boilers: classification, selection, Heat exchangers: classification, selection, flow friction and pressure drop analysis, basic thermal design, e-NTU, p-NTU, MTD methods. Shell and tube heat exchanger, construction and thermal features, thermal design procedure, Kern method, Bell Delaware method (**8L**)

Module – 6:

Thermal design of regenerators, classifications, design parameters. Design of compact heat exchangers, plate and fin, fin-tube and plate and frame heat exchangers, fouling and corrosion in heat exchangers (**6L**)

Reference Books:

1. J. F. Harvey, *Theory and Design of Pressure Vessels*, CBS Publishers and Distributors, 1987.
2. S. Walas, *Chemical Process Equipment, Selection and Design*, Buterworths Sr. in Chemical Engineering.
3. L. Brownell, E. Young, *Process Equipment Design*, John Wiley and Sons.
4. D. Kern, *Process Heat Transfer*, Tata McGraw-Hill, 2000.
5. Fraas, *Heat Exchanger Design*, Second Edition, John Wiley & Sons, 1989.
6. J. Manwell, J. McGowan, A. Rogers, *Wind Energy Explained*, Theory, Design and Application, Wiley, 2012.
7. R. Kulwiec, *Materials Handling Handbook*, ASME, John Wiley and Sons.
8. W. Stoecker, *Design of thermal systems*, Tata McGraw-Hill Education, 3rd Edition.