

**Course Number: ME631**

**Approval: 10<sup>th</sup> senate meeting**

**Course Name:** Heat Transfer and Fluid Flow in Energy Systems

**Credits:** 3-0-0-3

**Prerequisites:** Instructor's consent

**Intended for:** M. Tech / UG/MS/PhD

**Distribution:** Core for M. Tech, elective for / UG/MS/PhD

**Semester:** Odd/Even

**Preamble:** The objective of this course is to acquaint the students with fluid and thermal phenomena in the context of systems and subsystems used in energy engineering.

**Course Outline:** This course starts with the basics of transport phenomena and equations to evolve into the role of fluid flow and heat transfer in various important devices in energy systems. The application part is divided in two sections to cover the fluid and heat transfer phenomena. This course is quantitative in nature and it is expected that, at the end of course, students would be able to do calculations for the analysis and design of energy systems involving fluid flow and heat transfer.

**Course Modules:**

**Module 1:**

Overview of transport phenomena, Vectors and tensors, types/uses of control volume, notion of conservation principles and constitutive relations (4 L)

**Module 2:**

Analysis of flow through pipes, Major and Minor losses, Hydraulic gradient and total energy line – pipe in series and parallel, hydraulic transmission of power, Turbulent flow in pipes, Smooth and rough boundaries, water hammer phenomena, Flow through fluidized and packed bed combustor, flow through nozzle and diffusers, cascade theory, flow through reciprocating, centrifugal and axial pumps, compressors and turbines, Cavitation phenomena. (28 L)

**Module 3:**

Heat transfer phenomena in pipes, combustion chambers, fluidized and packed bed combustors, Analysis of heat exchangers, heat and fluid phenomena in boilers. (10 L)

**References:**

1. Design of Fluid and Thermal Systems, William S. Janna, 4th Edition
2. Thermal Energy Systems: Design and Analysis, Steven G. Penoncello, CRC Press.
3. Transport phenomena, R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, 2<sup>nd</sup> edition, Wiley, 2001.
4. Advanced transport phenomena, J.C. Slattery, Cambridge University Press, New York, 1999.
5. Fundamentals of momentum, heat and mass transport, Welty J.R, Wicks J.E, Wilson R.E, Rorrer G, 4<sup>th</sup> edition, Wiley, 2001.