

Department of Mechanical Engineering  
Indian Institute of Technology New Delhi

II Semester -- 2022 – 2023

**MCL142 Thermal Science for Electrical Engineers**  
**(3-0-0)**

Introduction to applications. Basic concepts and definitions – system, boundary, equilibrium, steady state and others. Thermodynamic properties of a pure substance – saturated and other states. Work and heat – definition and applications. 1st Law – internal energy and enthalpy, applications to non-flow/closed and flow/open systems (SSSF and USUF). 2nd Law – corollaries, Clausius inequality, entropy.

Carnot cycle. Basics of gas-vapor mixtures. Vapor power cycles – Rankine cycle and its modifications. Steam generation and its use – power plants, co-generation, combined cycles. Introduction to various equipment in thermal power plant.

Introduction to transport phenomena: various modes of transport of momentum and energy - diffusion and advective transport. Modes of heat transfer in various applications. Conduction: Heat diffusion equation, 1-D steady state conduction in extended surfaces, infinite and semi-infinite walls, heat generation, lumped capacitance.

Convection: Forced and free convection - mass, momentum and energy conservation equations, non-dimensional numbers, hydrodynamic and thermal boundary layers, basics of heat transfer in external and internal laminar and turbulent flows, and use of correlations.

Radiation: properties, Laws, 3-surface network for diffusegray surfaces. Familiarization with heat exchangers. Application area example: cooling of electronics.

Books & References:

Fundamentals of Thermal-Fluid Sciences-- Y A Cengel & R H Turner

[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiEkerLsc\\_uAhUPA3IKHca2DB4QFjAAegQIAhAC&url=http%3A%2F%2Fdl.konkur.in%2Fpost%2FBook%2FMechanic%2FFundamentals-of-Thermal-Fluid-Sciences-Cengel-5th-Edition-%255Bkonkur.in%255D.pdf&usg=AOvVaw0\\_-rCLLzq66paL8cJ8nN1k](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiEkerLsc_uAhUPA3IKHca2DB4QFjAAegQIAhAC&url=http%3A%2F%2Fdl.konkur.in%2Fpost%2FBook%2FMechanic%2FFundamentals-of-Thermal-Fluid-Sciences-Cengel-5th-Edition-%255Bkonkur.in%255D.pdf&usg=AOvVaw0_-rCLLzq66paL8cJ8nN1k)

## **Application Areas of Thermal-Fluid Sciences**

[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiEkerLsc\\_uAhUPA3IKHca2DB4QFjABegQIAxAC&url=http%3A%2F%2Fkaizenha.com%2Fcdn%2Ffiles%2FThermal%2520and%2520Fluid%2520Sciences%2FFundamentals%2520of%2520Thermal%2520Fluid%2520Sciences%2520\(Yunus%2520Cengel%2520%26%2520Robert%2520Turner\).pdf&usg=AOvVaw0H7-0P-jmc52pWrhowqD1e](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiEkerLsc_uAhUPA3IKHca2DB4QFjABegQIAxAC&url=http%3A%2F%2Fkaizenha.com%2Fcdn%2Ffiles%2FThermal%2520and%2520Fluid%2520Sciences%2FFundamentals%2520of%2520Thermal%2520Fluid%2520Sciences%2520(Yunus%2520Cengel%2520%26%2520Robert%2520Turner).pdf&usg=AOvVaw0H7-0P-jmc52pWrhowqD1e)

- Fundamentals of Thermodynamics -- Sonntag R.E., Borgnakke C. & Van Wylen C. J.
- Fundamentals of Engineering Thermodynamics -- Moran M. J. & Shapiro H. N.
- Fundamentals of Heat and Mass Transfer – Frank P. Incropera