Department of Mechanical Engineering
Indian Institute of Technology New Delhi
I Semester -- 2014 – 2015

MCL 140 ENGINEERING THERMODYNAMICS

Course Contents

- **Introduction**

Role of Thermodynamics in Engineering and Science -- Applications of Thermodynamics :
Power Generation, Thermal Environment Control, Cooling of Electrical Systems and Electronic
Devices, Analysis of Manufacturing Processes, Study of Biological Systems, Pollution Control -
-Founders of Thermodynamics.

- **Basic Definitions and Units**

The Thermodynamic System and The Control Volume -- Surroundings -- Concept of Universe -
- Macroscopic and Microscopic Analysis -- Definition of Substance -- Properties of Substance :
Intensive and Extensive -- Mathematical Representation of Property -- State of substance --
Thermodynamic Equilibrium -- Concept of Quasi-- Equilibrium -- Process and Cycle --
Fundamental Units -- Units of Force, Energy, Specific Volume, Pressure etc. -- Equality of
Temperature -- The Zeroeth Law of Thermodynamics -- Temperature Scales -- The International
Scale of 1990.

- **The Pure Substance**

Definition of Pure Substance -- Facts about Pure Substances -- Vapor -- liquid -- solid Phase
Equilibrium -- Equation of State for the Vapor Phase : Simple substance, Ideal Gase
Characterization, Ideal Gas Equation,Compressibility Effects and Resulting Equations of State --
Real Gases.

- **Heat and Work**

Definition of Thermodynamic Work -- Units for Work -- Forms of Work – Definition of Heat --
Inter Convertibility of Heat/work into Work/heat -- Governing Principles -- Sign Convention.

- **First Law of Thermodynamics**

Statement of First Law of Thermodynamics : First Law for Cyclic Process, First Law for Change
of State of A System : Internal Energy, A New Thermodynamic Property -- Enthalpy -- The

Constant Volume and Constant Pressure Specific Heats -- The internal Energy, Enthalpy and Specific Heats of An Ideal Gas – First Law as a Rate Equation -- First Law Applied to a Control Volume -- The SSSF and USUF Processes.

- **The Second Law of Thermodynamics**

Definition of Heat Engine and Reservoirs -- Kelvin-Planck and Clausius Statements of the Second Law -- Reversible and Irreversible Engines and processes -- Causes of Irreversibility -- Internal and External Irreversibility.

- **The Carnot Cycle**

The Efficiency of a Carnot Cycle -- The Thermodynamic Temperature Scale -- The Ideal Gas Temperature Scale.

- **Entropy**

Clausius Inequality -- Entropy -- A Property of A System -- The Entropy of A Pure Substance -- Entropy Change in Reversible Process -- The Thermodynamic Property Relation -- Calculation of Change in Entropy -- Second Law Analysis of A Control Volume -- Principle of Increase of Entropy.

- **Exergy Analysis**

Definition of Exergy -- Exergy Analysis of System and Control volume -- Exergetic efficiency -- Thermoecomics.

- **Analysis of Power Generation Cycles**

Air-standard Power Cycles -- Concept -- Carnot Cycle -- Otto Cycles -- Diesel Cycle -- Dual Cycle -- Brayton Cycle -- Efficiency and Mean Effective Pressure and Temperature -- Vapor Power Cycles -- Concept -- Carnot Cycle -- The Rankine Cycle -- Effect of Temperature and Pressure on The Rankine Cycle -- The Superheat Cycle --The Reheat Cycle -- The Regenerative Cycle -- Deviation of Actual Cycle from Ideal Cycles.

- **Analysis of Refrigeration Cycles**

Air-standard Cycles -- Joule Cycle. Introduction to Refrigeration Systems -- Vapor-compression Refrigeration Cycle -- Vapor-absorption Cycle.

Books/References

- Fundamentals of Thermodynamics -- Sonntag R.E., Borgnakke C. & Van Wylen C. J.
- Fundamentals of Engineering Thermodynamics -- Moran M. J. & Shapiro H. N.
- Fundamentals of Thermal-Fluid Sciences-- Y A Cengel & R H Turner.
- Applied Thermodynamics -- Eastop T.D. & Mc conkey A.
- Engineering Thermodynamics -- Rogers G.F.C. & Mayhew Y.R.
- Fundamentals of Engineering Thermodynamics -- Howell J.R.
- Engineering Thermodynamics -- An Introductory Test -- Spalding D.B. and Cole E.H.
- Thermodynamics : Fundamentals for Applications – J P O'connell & J M Jaile.