THERMODYNAMICS

PROF. ANAND T. N. C
Department of Mechanical Engineering
IIT Palakkad

INTENDED AUDIENCE : Any interested Learners
INDUSTRIES APPLICABLE TO : Any companies working in areas of thermal engineering

COURSE OUTLINE :
This is a first-level course in thermodynamics, aimed at UG first and second year students. The syllabus closely follows the AICTE model syllabus in thermodynamics. At the end of the course, students would be expected to be able to demonstrate an understanding of the laws of thermodynamics and solve problems involving heat and work interactions, with various working substances.

ABOUT INSTRUCTOR :
Prof. Anand T.N.C. is an Associate Professor in the Department of Mechanical Engineering at IIT Palakkad, on leave from IIT Madras. He has been teaching various courses related to thermal engineering for over 10 years.

COURSE PLAN :

Week 1 : Fundamentals - System; Control volume; Property, State; Process; Exact; Inexact differentials; Work - Thermodynamic definition of work; examples;
Week 2 : Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.
Week 3 : Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems
Week 4 : First Law for Cyclic; Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property;Various modes of energy, Internal energy and Enthalpy
Week 5 : Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts
Week 6 : Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states determination of properties, Mollier's chart.
Week 7 : First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteadyl law applications for system and control volume.
Week 8 : Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility;
Week 9 : Carnot cycle; Absolute temperature scale. Clausius inequality; Definition of entropy S ; Demonstration that entropy S is a property; Evaluation of S for solids,liquids, ideal gases and ideal gas mixtures undergoing various processes;Determination of s from steam tables
Week 10 : Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for compressors,turbines and nozzles- Irreversibility and Availability
Week 11 : Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for acontrol volume. Exergy balance equation and Exergy analysis.
Week 12 : Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.