COURSE OUTLINE

Department of Thermo-Fluids, Faculty of Mechanical Engineering, Universiti Teknologi Malaysia

Course : Thermodynamics I **Code : SME 1413** **Section : 01 (SPACE PENANG)**	**Academic Session : 2011/2012** **Semester : I**

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Synopsis :

Thermodynamics is a basic science that deals with energy. This course introduces students to the basic principles of thermodynamics. It will discuss basic concepts and introduces the various forms of energy and energy transfer as well as properties of pure substances. A general relation for the conservation of energy principle will be developed and applied to closed systems and extended to open systems. The second law of thermodynamics will be introduced and applied to cycles, cyclic devices and processes.

Course Learning Outcomes :

At the end of the course, students should be able to:

1. explain the basic concepts of thermodynamics such as system, state, state postulate, equilibrium, process and cycle

2. explain the concept of energy and forms of energy transfer such as work and heat

3. describe the state and phase change process of pure substances on property diagrams based on the property tables, state equations and charts

4. analyze closed systems involving heat and work interactions for pure substances and ideal gases using the 1st law of Thermodynamics

5. analyze common steady flow devices and uniform flow processes using the principles of mass conservation and the 1st law of thermodynamics

6. analyze performance of reversible and actual heat engines, refrigerator and heat pump cycles based on the first law and Carnot principles

7. analyze the entropy changes that take place during thermodynamic processes and determine isentropic efficiencies of various steady-flow devices

Teaching Methodology :

Lectures and tutorials

Assessment :

1. Quiz/Assignments	10%
2. Test 1	20%
3. Test 2	30%
3. Final Examination	40%
Total	100%

Textbook:

Y.A. Cengel and M.A. Boles, *Thermodynamics: An Engineering Approach*, Seventh Edition in SI Units, McGraw-Hill, Singapore, 2011

References :

1. M.J. Moran and H.N. Shapiro, *Fundamentals of Engineering Thermodynamics*, Fifth Edition, John Wiley & Sons, Inc., United States of America, 2004
2. R.E. Sontag, C. Borgnakke and G.J. Van Wylen, *Fundamentals of Thermodynamics*, Sixth Edition, John Wiley & Sons, Inc., United States of America, 2003

Weekly schedule :

Week	Date/Time	Topic
1	1/10/2011 (Sat) (8:00 – 10:00 pm) 2 hrs	**CHAPTER 1 : Introduction & Basic Concepts** – Definition, Units, Systems & Control Volume, Properties, State, Equilibrium, State Postulate.
	2/10/2011 (Sun) (12:00 – 1:00 pm) (2:00 – 6:00 pm) 5 hrs	Process, Cycle. Temperature and Zeroth Law of Thermodynamics, Pressure. **CHAPTER 2 : Energy & Energy Transfer** – Kinetic, Potential & Internal Energy, Energy Transfer by Heat and Work, Electrical Work, Shaft Work, Spring Work. Boundary Work, The First Law of Thermodynamics.
2	15/10/2011 (Sat) (8:00 – 10:00 pm) 2 hrs	**CHAPTER 3 : Properties of Pure Substance** – Phase of Pure Substances, Phase Change Processes of Pure Substances. Property Diagram for Phase-Change Processes.
	16/10/2011 (Sun) (12:00 – 1:00 pm) (2:00 – 6:00 pm) 5 hrs	Property Tables. Ideal Gas Equation of State. Property Diagram for Ideal Gases, Compressibility Factor, Other Equations of State (Van der Waals, Beattie-Bridgeman and Benedict-Webb-Rubin).
3	29/10/2011 (Sat) (8:00 – 10:00 pm) 2 hrs	**TEST 1** : Chap. 1 – Chap. 3 (1 hour 30 mins)
	30/10/2011 (Sun) (12:00 – 1:00 pm) (2:00 – 6:00 pm) 5 hrs	**CHAPTER 4 : Energy Analysis of Closed System** - Specific Heats, Enthalpy and Specific heats of ideal gases, The First Law of Thermodynamics. Energy Balance for a Closed System undergoing a process, Energy Balance for a Closed System undergoing a cycle.
4	19/11/2011 (Sat) (2:00 – 6:00 pm) 4 hrs	**CHAPTER 5 : Mass and Energy Analysis of Control Volume** - Conservation of Mass, Flow work and the Energy of Flowing Fluid, Energy analysis of Steady-Flow Systems, Steady-Flow Engineering Devices : Nozzle & Diffusers, Turbine & Compressors, Throttling Valves.
	20/11/2011 (Sun) (8:30 – 11:30 am) 3 hrs	Mixing Chambers, Heat Exchangers. Energy Analysis of Unsteady-Flow Processes. **CHAPTER 6: The Second Law of Thermodynamics** - Thermal Energy Reservoirs, Heat Engines, Kelvin-Planck Statement, Reversed Heat Engines : Refrigerators & heat pumps, Coefficient of Performance.
5	3/12/2011 (Sat) (2:00 – 6:00 pm) 4 hrs	Clausius Statement, Reversible & Irreversible Processes.The Carnot Cycle, The Carnot Principles, Thermodynamics (Kelvin) Temperature Scale, The Carnot Heat Engine & Carnot Reversed Heat Engines.
	4/12/2011 (Sun) (8:30 – 11:30 am) 3 hrs	**CHAPTER 7: Entropy –** Definition of Entropy, Clausius Inequality, The Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes
6	17/12/2011 (Sat) (2:00 – 6:00 pm) 4 hrs	Isentropic Efficiencies of Steady-Flow Devices, Entropy Balance, Entropy Generation for Closed & Open Systems. Property Diagrams involving entropy, The T ds Relations, The Entropy Change of Ideal Gas, Reversible Steady-Flow Work.
	18/12/2011 (Sun) (8:30 – 11:30 am) 3 hrs	Revision (1 hour) **Test 11** : Chap. 4 – Chap. 6 (1 hour 30 mins)

Note :
Final Exam Questions :
Question 1 – 1st Law of Thermodynamics – Closed System
Question 2 – 1st Law of Thermodynamics – Open System
Question 3 – 2nd Law of Thermodynamics
Question 4 – Entropy