KL UNIVERISTY
FIRST SEMESTER 2010-11
Course Handout
Academic Division

Dated: 07-07-2010

Course No. : **ME C204**
Course Title : **Engineering Thermodynamics**
Course Structure : **3-0-0**
Course coordinator : **K Venkateswarlu**
Instructors : **Y V Hanumantha Rao, O Venkateswara Rao**

1. Course Description:

Engineering Thermodynamics is intended to be a course that will give students a necessary foundation for a comprehensive understanding of energy and other engineering systems. Energy systems are fundamental not only in energy production but in many other important aspects of engineering including the manufacturing of materials. It introduces students to real world energy systems and systematically develops analysis techniques for such systems.

The course starts with zeroth of law thermodynamics for temperature measurement and first law and its applications to the calculations of heat involved in various processes such as flow and non flow processes. Second law of thermodynamics and the concept of entropy are then introduced. Various thermodynamic potentials are defined to determine the equilibrium of a system under various thermodynamic conditions. The relationships among thermodynamic properties are derived using the Maxwell relations.

2. Scope and Objective of the Course:

After thorough learning of the Engineering Thermodynamics, the student will

1. Understand the basic principles of classical thermodynamics
2. Apply these principles in analysis and design of thermodynamic systems
3. Analyze the engineering applications in energy conversion, refrigeration, and combustion systems, fluid mechanics, heat transfer, energy technologies and propulsion.
4. Will apply thermodynamics in engineering practice, and to promote awareness of impact of engineering solutions

3. Books:

(i) Textbook:

a. Thermodynamics an Engineering Approach-Younus A Cengel & Michael Boles, 6 th Edition Tata McGraw Hill, New Delhi.

(ii) Reference Book:

a. Engineering Thermodynamics- P.K.Nag, 4th Edition Tata McGraw Hill, New Delhi.
b. FundamentalsofThermodynamics,G.J.VanWylen., Sonntag(6thEdition),Wiley India publications.
c. Thermodynamics, J.P.Holman, (3rd Edition) McGraw Hill International Edition.
d. Fundamentals of Engineering Thermodynamics,

E. Rathakrishnan, (2nd Edition), Prentice Hall of India.

4. Syllabus:

UNIT-I

FUNDAMENTAL CONCEPTS AND DEFINITIONS: Thermodynamic system and control volume, Macroscopic and Microscopic points of view. Thermodynamic properties, processes, state, path, cycle. Thermodynamic equilibrium and Quasi-static process. Reversible and Irreversible processes, Zeroth law, concept of temperature.

WORK AND HEAT: Definition of work, units, work done at the moving boundary of system, work done in various non-flow processes, definition of heat, units, comparison of heat and work.

UNIT-II

FIRST LAW FOR NON-FLOW SYSTEMS: First law of thermodynamics for a closed system undergoing a cycle and for change of state, energy-a property of system, internal energy and enthalpy. Specific heat at constant volume and constant pressure. PMM1 and Converse of PMM1.

FIRST LAW FOR FLOW SYSTEMS: Control mass and control volume, First law of thermodynamics for a control volume, Steady state steady flow energy equation and applications to engineering equipment.

UNIT-III

SECOND LAW OF THERMODYNAMICS: Thermal reservoirs, Kelvin-plank and clausius statements of second law of thermodynamics, Equivalence of Kelvin-Plank and Clausius statements, Carnot cycle, Reversed heat engine, Carnot's theorem, Corollary of carnot's theorem, Absolute thermodynamic temperature scale, problems.

UNIT-IV

ENTROPY: Definition of entropy, clausius theorem, entropy change in reversible process, Temperature-entropy plot, Inequality of claussius, entropy change in an irreversible process, principle of increase of entropy, Applications of entropy principle, entropy change of an ideal gas, Availability and Irreversibility.

UNIT-V

THERMODYNAMIC RELATIONS: Maxwell's equations, TDS equations, Difference in heat capacities, Ratio of heat capacities, energy equation, and clausius-clapeyron equation

GAS POWER CYCLES: Air standard cycles: Otto, Diesel, Dual and Brayton. Air standard efficiency and MEP. Comparison of Otto, Diesel and dual cycles.

5.Course Plan:

Course plan is meant as a guideline. There may probably be changes.

Lec No.	Learning Objective	Topics to be covered	Reference
1	Different thermodynamic systems	Thermodynamic system, control volume	T1-P10
2		Macroscopic and Microscopic points of view	R1-P1
3		Thermodynamic properties, processes, state, path, cycle.	T1-P15
4	Thermodynamic equilibrium	Thermodynamic equilibrium and Quasi-static process.	T1-P14
5	Various Thermodynamic processes	Reversible and Irreversible processes	T1-P300
6	Zeroth law and temperature	Zeroth law, concept of temperature.	T1-P17
7	Thermodynamic work-one form of energy	Definition of work, units, work done at the moving boundary of system	T1-P62
8	work done in processes	work done in various non-flow processes	R1- P42,43
9	Heat-one form of energy	definition of heat,units, comparison of heat and work.	T1-P60
10	First law of thermodynamics	First law of thermodynamics for a closed system undergoing a cycle and for change of state	T1-P70
11	energy	energy-a property of system	R1-P72
12		internal energy and enthalpy	R2-P130
13	Specific heat	Specific heat at constant volume and constant pressure. PMM1 and Converse of PMM1	R2-P133
14		Control mass and control volume	R1-P72
15	First law of thermodynamics for applications	First law of thermodynamics for a control volume	R2-P175
16	steady flow energy equation	Steady state steady flow energy equation	T1-P232
17	steady flow energy equation applications	steady flow energy equation and applications to engineering equipment	T1-P235-46
18	First law of thermodynamics	First law of thermodynamics for a closed system undergoing a cycle and for change of state	T1-P70
19	Concept of heat engine	Thermal reservoirs	T1-P285
20	second law of thermodynamics	Kelvin-plank and clausius statements of second law of thermodynamics	T1-P291,296
21	Equivalence of second law statements	Equivalence of Kelvin-Plank and Clausius statements	T1-P296
22	ideal cycle for heat engines	Carnot cycle	T1-P303
23	Reversed Carnot cycle	Reversed heat engine	T1-P305
24		Carnot’s theorem	T1-P305
25		Corollary of carnot’s theorem	R1-P122

26-27	Absolute temperature	Absolute thermodynamic temperature scale, problems.	R1-P122
28	Entropy	Definition of entropy	T-P338
29	entropy change in various processes	clausius theorem	R1-P143
30		entropy change in reversible process, Temperature-entropy plot	R2-P259
31		Inequality of claussius	R1-P148
32	entropy change for processes	entropy change in an irreversible process, principle of increase of entropy	R2-P264
33	Applications of entropy	Applications of entropy principle	T1-P341
34		entropy change of an ideal gas	T1-P360
35	Quality of energy	Availability	R1-P191,206
36	Loss of Quality of energy	Irreversibility	R1-P210
37	Thermodynamic relations	Maxwell's equations, TDS equations	T1-P674,356
38	heat capacities	Difference in heat capacities, Ratio of heat capacities	R1-P347,349
39		energy equation, clausius-clapeyron equation	T1-P676
40	Air standard cycles	Air standard cycles	T1-P502,503
41	Cycles for petrol& diesel engines	Otto, Diesel	T1-P504,510
42	Mixed cycle &Cycle for gas turbine	Dual and Brayton	T1-P517
43	Efficiency calculations	Air standard efficiency and MEP	R1-P454,455
44-45	Comparison of cycles	Comparison of Otto, Diesel and dual cycles.	R1-P461

6.Self learning material:

Unit	Topic	Source
I	a). Thermodynamic properties b). Comparison of heat and work	a)http://www.roymech.co.uk/Related/ Thermos/Thermos_Specific_heat.html b) http://www.engineersedge.com/ thermodynamics/heat_work.htm
II	a).internal energy and enthalpy b). PMM1 and Converse of PMM1	a).http://www.physicsforums.com/ showthread.php?t=134008 b) Reference-I, Page no:66
III	a). Corollary of Carnot's theorem b). Absolute thermodynamic temperature scale	a)http://en.wikipedia.org/wiki/Carnot_heat_engine b).http://en.wikipedia.org/wiki/Thermodynamic_temperature
IV	a). Applications of entropy principle b). Irreversibility	a). http://www.mitpressjournals.org//abs/10.1162/neco.1997.9.8.1627 b) http://www.jstor.org/pss/2727613

V	a). Ratio of heat capacities b). Comparison of Otto, Diesel and dual cycles	a). http://www.chemistry.mcmaster.ca /~ayers/chem2PA3/labs/2PA35.pdf b) http://www.transtutors.com/homework-help/Mechanical+Engineering/ /Thermodynamic+Cycles/otto-diesel-and-dual-cycle-comparison.aspx

7.Evaluation Scheme:

Component	Duration (minutes)	% Weightage	Marks	Date & Time	Venue
Test-1	50 Min	10	10	11-08-2010 9.30 to 10.20 A.M	CSE005,101,104, 105,106,201,202, 204,205,209,301, 309,502,509
Test-2	50 Min	10	10	15-09-2010 9.30 to 10.20 A.M	CSE005,101,104, 105,106,201,202, 204,205,209,301, 309,502,509
Assignement submission		5	5	Continuous	
Assignment Test	50 Min	5	5	27-10-2010 9.00 to 10.20 A.M	CSE005,101,104, 105,106,201,202, 204,205,209,301, 309,502,509
Quiz	30 Min	5	5	27-10-2010 9.00 to 10.20 A.M	CSE005,101,104, 105,106,201,202, 204,205,209,301, 309,502,509
Regular Lab Evaluation	Continuous	0	0		
Comprehensive Lab Exam	3 Hrs	0	0		
Comprehensive Exam	3 Hrs	60	60		
Attendance for Theory & Tutorial		5	5	Continuous	
Attendance for Lab		0	0	Continuous	

8. Chamber consultation hour: Informed in the class in first week.

9. Notices: All notices regarding the course will be put in E-learning website.

Course Coordinator