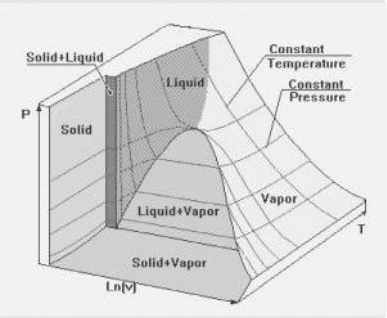

THERMODYNAMICS

Hours Per Week :

L	T	P	C
4	-	-	4

Total Hours :

L	T	P
60	-	-

WA/RA	SSH/HSH	CS	SA	S	BS
15	40	-	-	-	-

Course Description and Objective:

This course offers a basic understanding of heat and work interactions for various thermodynamic processes. The objective of this course is to recognize different forms of energy and restrictions imposed by the first and second law of Thermodynamics on conversion from one form to another.

Course Outcomes:

The student will be able to:

- distinguish various temperature scales.
- understand the fundamentals of the first and second laws of thermodynamics.
- apply steady flow energy equation for various thermodynamic devices.
- identify the possibility of a proposed process.
- evaluate steam properties at various regions on a thermodynamic plot.
- calculate apparent molecular weight and gas constant for a given mixture.
- differentiate air standard cycles from actual cycles.

SKILLS:

Classify thermodynamic systems based on mass and energy interactions.

Apply thermodynamic laws to analyze performance of various devices and cycles.

Evaluate properties of steam for subcooled, super heated and wet steams.

Obtain the thermodynamic property data from various property tables and charts.

Calculate efficiencies of various air standard cycles and compare it with ideal efficiency.

UNIT - 1 **L-12**

BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS: Concept of Continuum, Thermodynamic equilibrium, System, Boundary and surroundings, State, Property, Process, Cycle, Reversibility, Quasi-static Process, Irreversible Process, Causes of Irreversibility, Work and Heat, Point and Path function, Zeroth Law of Thermodynamics, Concept of quality of Temperature, PMM-I, Joule's Experiments, First law of Thermodynamics - Corollaries, First law applied to a Process, Applied to a flow system, Steady Flow Energy Equation.

UNIT - 2 **L-12**

SECOND LAW OF THERMODYNAMICS, ENTROPY AND AVAILABILITY: Limitations of the First Law, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements - Corollaries, PMM-II; Carnot's principle , Carnot cycle, Clausius inequality.
ENTROPY: Principle of entropy increase, Availability and Irreversibility, Thermodynamic Potentials, Gibbs and Helmholtz Functions, Elementary treatment of the Third Law of Thermodynamics.

UNIT - 3 **L-12**

PROPERTIES OF PURE SUBSTANCES: Pure Substances, P-v-T- surfaces, T-S and h-s diagrams, Phase-Transformations, Triple point at critical state properties during change of phase, Dryness Fraction, Mollier charts, Various Thermodynamic processes and energy transfer.

UNIT - 4 **L-12**

IDEAL AND REAL GASES: Perfect Gas Law, Equation of State, Specific and Universal Gas constants, Vander Waals Equation of State - Compressibility charts; Variable specific heats, Gas tables.
GAS MIXTURES - Avagadro's law, Dalton's law of partial pressure; T-dS relations, Maxwell relations, Clausius Clapeyron equations, Joule Thomson Coefficient.

UNIT - 5 **L-12**

POWER CYCLES: Otto, Diesel, Dual, Ericsson, Stirling and Carnot Cycles - Description and representation on P-V and T-S diagram, Thermal Efficiency; Mean Effective Pressures on Air standard basis, Comparison of Cycles.

TEXT BOOKS:

1. P.K Nag, "Engineering Thermodynamics", 3rd edition, Tata McGraw Hill, 2015.
2. Yunus A. Cengel and Micheal A. Boles, "Thermodynamics- An Engineering Approach", 7th edition, Tata McGraw Hill, 2011.

REFERENCE BOOKS:

1. R. Yadav, "Thermodynamics And Heat Engines", 6th edition, Central Publishing House,2012.
2. Bill Poirier, "A Conceptual Guide to Thermodynamics", 2nd edition, Wiley Publishers, 2014.

WEB LINKS:

1. home.iitk.ac.in/~anandh/E-book/Basics_of_Thermodynamics.ppt
2. www4.smsd.org/jakeburkholder/docs/Doc-133494.ppt
3. www.mhhe.com/engcs/mech/cengel/demo/newmedia/.../ppt/pptsource

ACTIVITIES:

- *Design a thermometer using Zeroth Law*
- *Conduct a steady flow energy analysis of a nozzle and diffuser using MS-Excel*
- *Design a manometer for different fluids*
- *Plot P-V and T-S diagrams for different thermodynamic cycles using MATlab*