16AG203 PRINCIPLES OF THERMODYNAMICS

Hours Per Week :

L	T	P	C
2	-	2	3

Total Hours :

L	T	P	WA/RA	SSH/HSH	CS	SA	S	BS
30	-	30	2	40	2	8	2	2

Course Description and Objectives :

This course deals with the theory and applications of classical thermodynamics, thermodynamic properties, equations of state and methods used to describe and predict phase equilibria. The objective of this course is to offer the analysis and evaluation of various thermodynamic cycles used for energy production - work and heat, within the natural limits of conversion.

Course Outcomes:

The student will be able to:

- apply the fundamental concepts of thermodynamics to engineering applications.
- define heat, work and thermal efficiencies.
- differentiate between various forms of energy.
- use otto and diesel cycles in steam engines.
- estimate thermodynamic properties of substances in gas and liquid states.
- determine thermodynamic efficiency of various energy related processes.

SKILLS:

- ✓ *Discuss various systems and basic laws of thermodynamics for engineering applications.*
- ✓ *Use the concept of entropy and Carnot cycle for different processes.*
- ✓ *Identify various types of boilers and their use for various applications.*
- ✓ *Understand the influence of various parameters on steam generation.*

ACTIVITIES:

o *Development of layout of heat engine and heat pump by application of basic laws in live engineering models.*

o *Development of PVT profile for same engineering models (IC engine, air condition system etc.).*

o *Modelling of energy requirement for different boilers with same capacity.*

o *Simulation of refrigeration and air conditioning systems for storage.*

o *Calculation of I.P and B.P. of given model of IC engine.*

UNIT - 1   **L-06**

INTRODUCTION AND BASIC LAWS : Thermodynamics properties, Closed and open system, Flow and non-flow processes, Gas laws, Laws of thermodynamics, Internal energy; Application of first law in heating and expansion of gases in non-flow processes, First law applied to steady flow processes, Kelvin-Planck and Claussius statements.

UNIT - 2   **L-06**

ENTROPY AND PROCESSES: Reversible processes, Carnot cycle, Carnot theorem, Entropy, Physical concept of entropy, Change of entropy of gases in thermodynamics processes, Difference between gas and vapor, Change of phase during constant pressure process.

UNIT - 3   **L-06**

STEAM GENERATION : Generation of steam, Triple point and critical point, Internal energy and entropy of steam, Use of steam tables and Mollier chart, Heating and expansion of vapor in non-flow processes, Measurement of dryness fraction.

UNIT - 4   **L-06**

BOILER : Classification of steam boilers, Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers. Boiler mountings and accessories, Desirable properties of working fluid used for power plants, Rankine cycle, Expansive and non-expansive working, Saturation curve and missing quantity, Governing, Calculations of cylinder dimensions.

UNIT - 5   **L-06**

STEAM ENGINES: Introduction to compound steam engines, Air Standard efficiency, Other engine efficiencies and terms, Otto, diesel and dual cycles, Calculation of efficiency, Mean effective pressure and their comparison, Measurement of IP, BP and heat balance calculations (not involving combustion), Engine efficiencies and performance.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS   **Time: 30hours**

1. Study of boilers.
2. Various mountings and accessories of boilers.
3. Study of steam engine.
4. To measure dryness fraction of steam.
5. Performance test of steam engine.
6. Study of I.C. engines.
7. Valve-timing diagram of 2-stroke engines.
8. Valve timing diagram of 4-stroke engines.
9. Performance test on 2- cylinder diesel engines.
10. Performance and heat balance tests on a four cylinder horizontal diesel engine.
11. Comparison of different temperature measuring methods.

TEXT BOOKS:

1. Y. A. Cengel and M. A. Boles, "Thermodynamics, an Engineering Approach", 7th edition, Tata McGraw-Hill, 2012.
2. P.K. Nag, "Engineering Thermodynamics", 5th edition, Tata McGraw-Hill, 2013.

REFERENCE BOOKS:

1. J.P. Holman, "Thermodynamics", 10th edition, Tata McGraw-Hill, 2011.
2. E. H. Lewitt, "Thermodynamics applied to Heat Engines", 5th edition, Sir Isaac Pitman & Sons Ltd, London, 1957.

WEB LINK:

1. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=126017