Engineering Thermodynamics

Programme: B. Tech (MME) **Year: Second Year** **Semester: III**

Course: core **Credits: L-3+T-1= 4** **Hours: 40(L)+14(T)**

Objectives:

- To learn and use basic concepts of thermodynamics and understand and apply various laws to real life problems.
- To identify and explain the concepts of entropy, enthalpy, specific energy, reversibility, exergy and irreversibility.
- To acquire the knowledge of thermodynamic relations and its use with various applications.
- To understand and analyze vapor power cycles with calculation of performance parameters.
- To understand and analyze gas power cycles, gas turbines and jet propulsion with calculation of performance parameters.
- To understand and analyze refrigration cycles with calculation of performance parameters.

Prerequisites Courses: Nil

References:

Text Book:

- **P.K.Nag,** "*Basic and Applied Thermodynamics*" –Tata McGraw- Hill Pub.Co. Ltd.
- **Y. Cengel & Boles,** "Thermodynamics – An Engineering Approach", Tata McGraw Hill Publications

Reference Books:

1. **Roger G.F.C. and Mayhew Y.R.,** "*Engineering Thermodynamics*" – Pearson Education Ltd., 4th Edition, 1992.
2. **P K Nag,** "*Power Plant Engineering*" – Tata McGraw –Hill Pub. Co. Ltd. 3rd ed., 2008.
3. **C.P. Arora**, " Engineering Thermodynamics", Tata McGraw Hill Publications
4. **Rayner J.** "*Basic Engineering Thermodynamics*" – Addison Wesley, 5th Edition.
5. **Sonntag R.E.,Borgnakkec C. Van Wylen G.**J. "Fundamental of thermodynamics" , 6th Edition
6. **P. Chattopadhyay**,"Engineering Thermodynamics" Oxford Press

Additional Resources: NPTEL, MIT Video Lectures, Web resources etc.

Course Outcomes (COs): On completion of this course, the students will be:

CO1	Able to understand the fundamentals of thermodynamics and its Laws and to apply it to real life thermal systems	Unit 1

CO2	Able to identify and describe energy exchange processes with their effectiveness	Unit 2
CO3	Able to understand the thermodynamic relations and its application to various systems	Unit 3
CO4	Able to understand introductory concept of vapor power cycles and calculate the performance parameters e.g. power output, efficiencies etc.	Unit 4
CO5	Able to understand introductory concept of gas power cycles, gas turbine & jet propulsion and to calculate the performance parameters of gas turbines e.g. power output, efficiencies etc.	Unit 5 and 6
CO6	Able to understand introductory concept of refrigeration cycles and calculate the performance parameters e.g. cooling capacity, coefficients of performance etc.	Unit 7

UNITS	**COURSE TOPIC**	**Hours**	**Student development**
UNIT1	**INTRODUCTION TO THERMODYNAMICS**	**8**	Employability
	Introduction of thermodynamics, Review of basic definitions, Thermodynamic properties and their units, Zeroth law of thermodynamics, Macro and Microscopic Approach, First law of thermodynamics, Steady flow energy equation and its application to different devices. Limitations of First law, Second Law of thermodynamics, Equivalence of Clausius and Kelvin Plank Statement, Entropy		
UNIT 2	**ENTROPY, AVAILABILITY AND IRREVERSIBILITY**	**7**	Employability
	Clausius inequality, concept of entropy, entropy change in different processes, Tds equation, principle of increase in entropy, T-S diagram, statement of third law of thermodynamics, entropy and disorder, concept of exergy, available and unavailable energy, availability and irreversibility, second law efficiency		
UNIT 3	**THERMODYNAMIC RELATIONS**	**4**	Employability
	Maxwell's equation, T-ds equations and heat capacities, Energy equation, Joule Kelvin effect, Clapeyron equation.		
UNIT 4	**VAPOUR POWER CYCLES**	**6**	

	Properties of pure substances, Rankine cycle, Actual Vapour power cycle and comparison with Carnot cycle, Mean temperature of heat addition, Reheat cycles, Ideal Regenerative cycles, Regenerative cycles, Reheat- Regenerative cycles including feed water heaters, Binary vapour cycles, Process heat and byproduct power		Employability and Skill development
UNIT 5	**GAS POWER CYCLES**	**5**	Employability and Skill development
	Carnot, Sterling, Erricson, Otto cycle, Diesel cycle, Dual cycle, Comparison of A.S.C.		
UNIT 6	**GAS TURBINE AND JET PROPULSION SYSTEM**	**6**	Employability and Skill development
	Closed cycle, open cycle, Brayton cycle, Effect of Pressure ratio on Brayton cycle, Intercooling, Reheating, and Regeneration, Advantage and disadvantage of GT plants, Analysis of GT plant, closed cycle Gas turbine, Semi-closed cycle GT plant, performance of GT plant, Components of GT plant; Jet propulsion cycle, Rocket propulsion, Turbojet engine, Ramjets and pulsejets		
UNIT 7	**REFRIGERATION CYCLES**	**4**	Employability and Skill development
	Reversed heat engine cycles, Gas cycle refrigeration, Vapour compression cycle, Refrigerants, Absorption cycle		

Evaluation Methods:

Item	**Weightage**
Quiz(s)	10
Assignment	10
Mid-term exam	30
End term exam	50

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