

## MME209: 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:

- Identify and use units and notations in thermodynamics.
- State and illustrate the first and second laws of thermodynamics.
- Identify and explain the concepts of entropy, enthalpy, specific energy, reversibility, exergy and irreversibility.
- To acquire the knowledge of thermodynamic relations and its use.
- To understand the analysis of powers cycles and refrigeration cycles.
- To understand the concept of gas mixtures and psychrometry.

**Prerequisite 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., 4<sup>th</sup> Edition, 1992.
2. **P K Nag**, "*Power Plant Engineering*" – Tata McGraw –Hill Pub. Co. Ltd. 3<sup>rd</sup> ed., 2008.
3. **C.P. Arora**, "*Engineering Thermodynamics*", Tata McGraw Hill Publications
4. **Rayner J.** "*Basic Engineering Thermodynamics*" – Addison Wesley, 5<sup>th</sup> Edition.
5. **Sonntag R.E., Borgnakke C. Van Wylen G.J.** "*Fundamental of thermodynamics*", 6<sup>th</sup> 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:

<b>CO1</b>	Able to understand the fundamentals of thermodynamics and its Laws.
<b>CO2</b>	Able to identify and describe energy exchange processes with their effectiveness
<b>CO3</b>	Able to understand the thermodynamic relations and its application to various systems.
<b>CO4</b>	Able to understand introductory concept of gas power cycles and calculate the performance parameters e.g. efficiencies, coefficients of performance etc.
<b>CO5</b>	Able to understand introductory concept of refrigeration cycles and calculate the performance parameters e.g. coefficients of performance etc. and use the gas mixture & psychrometry relations

UNITS	COURSE TOPIC	Hours
<b>UNIT 1</b>	<b>INTRODUCTION TO THERMODYNAMICS</b>	<b>6</b>
	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	
<b>UNIT 2</b>	<b>ENTROPY, AVAILABILITY AND IRREVERSIBILITY</b>	<b>6</b>
	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	
<b>UNIT 3</b>	<b>THERMODYNAMIC RELATIONS</b>	<b>4</b>
	Maxwell's equation, T-ds equations and heat capacities, Energy equation, Joule Kelvin effect, Clapeyron equation.	
<b>UNIT 4</b>	<b>VAPOUR POWER CYCLES</b>	<b>6</b>
	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	
<b>UNIT 5</b>	<b>BOILERS AND ACCESSORIES</b>	<b>2</b>
	Classification of boilers, Fire and water tube boilers, Boiler mountings and accessories, Economiser, Superheater & Reheater, Air preheater.	
<b>UNIT 6</b>	<b>GAS POWER CYCLES</b>	<b>4</b>
	Carnot, Sterling, Ericsson, Otto cycle, Diesel cycle, Dual cycle, Comparison of A.S.C.	
<b>UNIT 7</b>	<b>GAS TURBINE AND JET PROPULSION SYSTEM</b>	<b>5</b>
	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	
<b>UNIT 8</b>	<b>REFRIGERATION CYCLES</b>	<b>4</b>
	Reversed heat engine cycles, Gas cycle refrigeration, Vapour compression cycle, Refrigerants, Absorption cycle	
<b>UNIT 9</b>	<b>GAS MIXTURES AND PSYCHROMETRICS</b>	<b>3</b>
	Properties of gas mixtures, Basic concept of psychrometry, Psychrometric processes and air conditioning	

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**Evaluation Methods:**

<b>Item</b>	<b>Weightage (%)</b>
Quiz 1	10
Quiz 2	10
Mid-Term exam	30
End Term exam	50

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