MOHAMED SATHAK A J COLLEGE OF ENGINEERING, Chennai - 603103

LESSON PLAN - THEORY

Department of MECHANICAL ENGINEERING

Name of the Subject	**ENGINEERING THERMODYNAMICS**	**Regulation**	2021
Subject Code	ME 3391	Year / Sem	**II / III**
Acadamic Year	2023-2024	**Batch**	2022-2026

Course Objective

Impart knowledge on the basics and application of zeroth and first law of thermodynamics.

Impart knowledge on the second law of thermodynamics in analysing the performance of thermal devices.

Impart knowledge on availability and applications of second law of thermodynamics

Teach the various properties of steam through steam tables and Mollier chart.

Impart knowledge on the macroscopic properties of ideal and real gases.

Course Outcome

At the end of the course the students would be able to

CO1: Apply the zeroth and first law of thermodynamics by formulating temperature scales and calculating the property changes in closed andopen engineering systems

CO2: Apply the second law of thermodynamics in analysing the performance of thermal devices through energy and entropy calculations.

CO3:Apply the second law of thermodynamics in evaluating the various properties of steam through steam tables and Mollier chart

CO4: Apply the properties of pure substance in computing the macroscopic properties of ideal and real gases using gas laws and appropriate thermodynamic relations

CO5: Apply the properties of gas mixtures in calculating the properties of gas mixtures and applying various thermodynamic relations to calculate property changes.

Lesson Plan

Sl. No.	Topic(s)	T / R* Book	Periods Required	Mode of Teaching (BB / PPT / NPTEL / MOOC / etc)	Blooms Level (L1-L6)	CO	PO
UNIT – I BASICS, ZEROTH AND FIRST LAW							
1	**Review of Basics**	**T2**	**1**	**BB/PPT**	**L1**	1	PO1
2	**Thermodynamic systems**	**T2**	**1**	**BB/PPT**	**L1**	1	PO1
3	**Properties and processes Thermodynamic Equilibrium**	**R1**	**1**	**BB/PPT**	**L1**	1	PO1
4	**Displacement work-P-V diagram**	**T2**	**1**	**BB/PPT**	**L1**	1	PO1, PO2
5	**Thermal equilibrium**	**R1**	**1**	**BB/PPT**	**L2**	1	PO1, PO2
6	**Zeroth law**	**T2**	**1**	**BB/PPT**	**L2**	1	PO1, PO2
7	**Concept of temperature and Temperature Scales**	**T2**	**1**	**BB/PPT**	**L3**	1	PO1, PO2, P12
8	**First law application to closed and open systems**	**T2**	**1**	**BB/PPT**	**L3**	1	PO1, PO2, PO3
9	**First law steady and unsteady flow processes.**	**T2**	**1**	**BB/PPT**	**L3**	1	PO1, PO2, PO3,PO4

Suggested Activity: Tutorials given to the students

Evaluation method
Internal Assesment Test

UNIT II SECOND LAW AND ENTROPY							
10	**Heat Engine – Refrigerator**	**R1**	**1**	**BB/PPT**	**L2**	2	PO1, PO2
11	**Heat pump**	**R1**	**1**	**BB/PPT**	**L2**	2	PO1, PO2,P12
12	**Statements of second law and their equivalence & corollaries.**	**R1**	**2**	**BB/PPT**	**L3**	2	PO1, PO2
13	**Carnot cycle**	**T1,T2**	**1**	**BB/PPT**	**L2**	2	PO1, PO2,

14	Reversed Carnot cycle - Performance	T2	2	BB/PPT	L2	2	PO3,PO4
15	Clausius inequality	R2	1	BB/PPT	L2	2	PO1, PO2
16	Concept of entropy	T1	1	BB/PPT	L2	2	PO1, PO2, PO3
17	T-s diagram - Tds Equations	T2	1	BB/PPT	L3	2	PO1, PO2, PO3
18	Entropy change for a pure substance	R2	1	BB/PPT	L3	2	PO1, PO2, PO3

Suggested Activity: Tuorial given to the students

Evaluation method
*** Tuorial are evaluated marks were given based on the students answer to the question.**

UNIT III AVAILABILITY AND APPLICATIONS OF II LAW

19	Ideal gases undergoing different processes	R3	1	BB/PPT	L2	3	PO1, PO2, P12
20	principle of increase in entropy	R2,T1	1	BB/PPT	L2	3	PO1, PO2, P12
21	Applications of II Law.	T2,R2	1	BB/PPT	L3	3	PO1, PO2. PO9, PSO1,PSO3
22	High grade energy	T2	1	BB/PPT	L3	3	PO1, PO2, PO3
23	Low grade energy	T1	1	BB/PPT	L3	3	PO1, PO2, PO4
24	Availability	R1,T1	1	BB/PPT	L2	3	PO1, PO2, PO3
25	Irreversibility for open system	T2	1	BB/PPT	L2	3	PO1, PO2, PO3
26	Availability and Irreversibility for closed system	R2	2	BB/PPT	L2	3	PO1, PO2, PO4
27	I and II law Efficiency	R4	2	BB/PPT	L2	3	PO1, PO2, PO4

Suggested Activity: Tuorial given to the students

Evaluation method
*** Quiz Counducted and marks are given to team members based on the students answer to the question.**

UNIT IV PROPERTIES OF PURE SUBSTANCES

28	Steam	T1,R1	1	BB/PPT	L1	4	PO1, PO2,P11
29	Formation and its thermodynamic properties	R2	1	BB/PPT	L1	4	PO1, PO2,P11
30	p-v, p-T, T-v	T1	1	BB/PPT	L2	4	PO1, PO2, PO6
31	T-s, h-s diagrams	R3	1	BB/PPT	L2	4	PO1, PO2, PO6
32	PVT surface	R1	1	BB/PPT	L2	4	PO1, PO2, PO6
33	Determination of dryness fraction.	T1,R1,T2	2	BB/PPT	L2	4	PO1, PO2, PO9
34	Calculation of work done and heat transfer in non	T1	2	BB/PPT	L3	4	PO1, PO2, PO3,PO4, P12
35	flow and flow processes	R3,R4	1	BB/PPT	L3	4	PO1, PO2, PSO1, PSO2
36	using Steam Table Mollier chart	R2	2	BB/PPT	L3	4	PO1, PO2, PSO1, PSO2

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any : * Assignment given to the students

Evaluation method
*** assignments are evaluated marks were given based on the students answer to the question.**

UNIT V GAS MIXTURES AND THERMODYNAMIC RELATIONS

38	Properties of Ideal gas, real gas,Equations of state for ideal and real gases	R1,T1	1	BB/PPT	L1	5	PO1, PO2,P11
39	vander Waal's relation - Reduced properties -	R1,T2	1	BB/PPT	L2	5	PO1, PO2, PO6
40	Compressibility factor - Principle of Corresponding states	R2,T2	2	BB/PPT	L2	5	PO1, PO2, PO9
41	Generalized Compressibility Chart.	T2,R3	2	BB/PPT	L3	5	PO1, PO2,PO3,PO4
42	Maxwell relations - TdS Equations	T1,T2	1	BB/PPT	L2	5	PO1, PO2, P12
43	heat capacities relations - Energy equation	R5,T2	1	BB/PPT	L3	5	PO1, PO2,P11
44	Joule- Thomson experiment	T2,R3	1	BB/PPT	L3	5	PO1, PSO1,PSO2
45	Clausius-Clapeyron equation	T1	1	BB/PPT	L3	5	PO1, PO2, PSO3

Suggested Activity: Assignment / Case Studies / Tuorials/ Quiz / Mini Projects / Model Developed/others Planned if any : * Seminar given to the students	
Evaluation method **Presentation.**	*** Marks were given based on the students**
Content Beyond the Syllabus Planned	
1	**atkinson cycle, lenoir cycle**
2	**Water tube boilers.**

Text Books

1	Nag.P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw Hill (2017), New Delhi.
2	Natarajan, E., "Engineering Thermodynamics: Fundamentals and Applications", 2nd Edition (2014), Anuragam Publications, Chennai.

Reference Books

1	**Cengel, Y and M. Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill,9th Edition, 2019.**
2	**Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition Oxford University Press, 2016.**
3	**Rathakrishnan, E., "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006.**
4	**Claus Borgnakke and Richard E. Sonntag, "Fundamentals of Thermodynamics", 10th Edition, Wiley Eastern, 2019.**
5	**Venkatesh. A, "Basic Engineering Thermodynamics", Universities Press (India) Limited, 2007**

Website / URL References

1	https://nptel.ac.in/courses/112/105/112105123/
2	
3	

Blooms Level

Level 1 (L1) : Remembering	Lower Order Thinking	Fixed Hour Exams	**Level 4 (L4) : Analysing**		Higher Order Thinking	Projects / Mini Projects
Level 2 (L2) : Understanding			**Level 5 (L5) : Evaluating**			
Level 3 (L3) : Applying			**Level 6 (L6) : Creating**			

Mapping syllabus with Bloom's Taxonomy LOT and HOT

Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	BASICS, ZEROTH AND FIRST LAW	1	2	3				6	0	6
Unit 2	SECOND LAW AND ENTROPY		2	4				6	0	6
Unit 3	AVAILABILITY AND APPLICATIONS OF II LAW		2	3				5	0	5
Unit 4	PROPERTIES OF PURE SUBSTANCES	1	2	4				7	0	7
Unit 5	GAS MIXTURES AND THERMODYNAMIC RELATIONS		2	4				6	0	6
Total		**2**	**10**	**18**	**0**	**0**	**0**	**30**	**0**	**30**
Total Percentage		**6.67**	**33.33**	**60**	**0**	**0**	**0**	**100**	**0**	**100**

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO08	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								2		
CO2	3	3	2	1								2		
CO3	3	3	2	1					1		1	2	3	3
CO4	3	3	2	1		1			2		1	2	3	2
CO5	3	3	2	1		1			**2**		1	2	3	2
Avg	**3**	**3**	**2**	**1**		**1**			**1.67**		**1**	**2**	**3**	**2.33**

Justification for CO-PO mapping

CO1	PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineering is done
CO2	PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineering is done
CO3	PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineering is done
CO4	PO1: Basic engineering knowledge is required PO2: Problem analysis is required
CO5	PO1: Basic engineering knowledge is required PO2: Problem analysis is required and PO3: Design of complex engineering is done

3	**High level**	**2**	**Moderate level**	**1**	Low level

*Kindly sign with date

Name & Sign of Faculty Incharge :K.Sunil Kumar

Name & Sign of Subject Expert : Mr. Vigneshwaran V

Head of the Department : Dr. Shunmugasundaram M