GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code : ME02000581

Subject Name: Exergy Analysis of Thermal Systems

w. e. f. Academic Year:	2024-25
Semester:	2
Category of the Course:	Professional Elective Course

Prerequisite:	Nil
Rationale:	The course is design to impart detailed study of exergy analysis of various thermal systems and exergy-economics.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Make calculations of exergy and lost work for heat engine, refrigeration and heat pump cycle.	Apply
2	Analyze different thermal process with exergy view point.	Analyze
3	Appraise exergy analysis of different power plant cycles.	Evaluate
4	Appraise exergy analysis of different refrigeration cycles and evaporating cooling.	Evaluate
5	Compute exergy-economics costing of thermal components	Apply

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	**Exergy Destruction:** Lost available work referred to heat engine cycle, refrigeration cycle, heat pump cycle, non-flow and steady flow processes, exergy concept for closed and open systems, mechanism of exergy destruction, modified Gouy-Stodola theorem, concept of effective temperature	05	12

2.	**Exergy Analysis of Simple Processes**: Mixing and separation process of fluids of different temperature, heat transfer across a temperature difference, expansion and compression process, combustion process	10	22
3.	**Exergy Analysis of Power Plant Cycles:** Maximum power subject to size constraint with fixed heat input and its application to Brayton cycle, Steam turbine power plants: External and internal irreversibility, superheater, reheater, vacuum condenser, regenerative feed water heating, combined feed water heating and reheating, Gas turbine power plant: External and internal irreversibility, regeration, reheater, and intercooler, combined steam and gas turbine power plant	15	32
4.	**Exergy analysis of Refrigeration cycle:** Joule-Thomson Expansion, Work-Producing Expansion, Brayton Cycle, Optimal Intermediate Cooling, Exergy analysis of Air-conditioning applications: Mixtures of air and water vapor, total flow exergy of humid air and liquid water, Evaporative cooling process and other aspects	09	20
5.	**Exergy-economic Analysis:** Fundamental of exergy-economics, exergy costing of different thermal components and systems like steam or gas turbine, boiler, cogeneration system etc.	06	14
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
-	**20**	**30**	**20**	**30**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Advanced Engineering Thermodynamics by Adrian Bejan, John Wiley & Sons, Inc.
2. The Exergy Method of Thermal Plant Analysis by T J Kotas, Krieger Publishing Company
3. Thermal Design and Optimization by Adrian Bejan, George Tsatsaronis, Michael Moran, John Wiley & Sons, Inc.
4. Advance Thermodynamics for Engineers by Winterbore D E, Arnold Publication
5. Advanced Thermodynamics for Engineers by Kenneth Wark, McGraw Hill Publishing Co. Ltd.
6. Fundamentals of Engineering Thermodynamics by Michel J Moran, Howard N Shapiro, Daisie D Boettner, Margaret B Bailey, John Wiley & Sons, Inc.

(b) Open-source software and website:

1. Students should refer to video lectures available on the websites including NPTEL.

2. Students should refer to the CDs which are available with some reference books for the solution of problems using software/spreadsheets.

Suggested Course Practical List: During practical sessions, students may be asked to solve problems including open ended problems. Students may also be asked to develop and run computer programs for analysis level of problems. If available at the institute, students may develop the programs using software like EES, Mathcad etc.

Suggested Activities for Students: Students are required to download 3-5 research papers from reputed international journals on the recent advancement in the areas of exergy analysis of thermal systems. They need to go through the same and prepare a review for the research papers. The review should have three parts: Summary, Critical Evaluation and Creative synthesize

* * * * * * *