# GUJARAT TECHNOLOGICAL UNIVERSITY

**Master of Engineering**
**Subject Code: 3732108**
**Semester – III**
Exergy Analysis of Thermal Systems

**Type of course:** Program Elective

**Prerequisite:** Nil

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

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|
| | | | | Theory Marks | | Practical Marks | | |
| L | T | P | C | ESE (E) | PA (M) | ESE (V) | PA (I) | |
| 3 | 0 | 0 | 3 | 70 | 30 | 0 | 0 | 100 |

**Content:**

| Sr. No. | Content | Total Hrs |
|---|---|---|
| 1 | **Exergy Destruction:** Lost available work referred to heat engine cycle, refrigeration cycle, heat pump cycle, non-flow and steady flow processes, Mechanism of exergy destruction, modified Gouy-Stodola theorem, concept of effective temperature | 5 |
| 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 | 9 |
| 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 | 14 |
| 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 vapour, total flow exergy of humid air and liquid water, Evaporative cooling process and other aspects | 8 |
| 5 | **Exergy-economic Analysis:** Fundamental of exergy-economics, exergy costing of different thermal components: steam or gas turbine, boiler, cogeneration system | 6 |

**Suggested Specification table with Marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **10** | **20** | **20** | **20** | **20** | **10** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference 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.

**Course Outcomes:**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|
| CO-1 | To make calculations of exergy and lost work for heat engine, refrigeration and heat pump cycle. | 12 |
| CO-2 | To analyze different thermal process with exergy view point. | 22 |
| CO-3 | To appraise exergy analysis of different power plant cycles | 34 |
| CO-4 | To appraise exergy analysis of different refrigeration cycles and evaporating cooling | 18 |
| CO-4 | To compute exergy-economics costing of thermal components | 14 |

**List of Experiments: NA**

**Major Equipment: NA**

**List of Open Source Software/learning website:**

1. Students can refer to video lectures available on the websites including NPTEL.
2. Students can refer to the CDs which are available with some reference books for the solution of problems using software/spreadsheets.