

# FIRST/ ~~SECOND~~ SEMESTER 2023-2024

Course Handout Part II

Date: 11-08-2023

In addition to part I (general handout for all courses appended to the timetable) this portion gives further specific details regarding the course.

Course no : MEF217

Course title : APPLIED THERMODYNAMICS Instructor in charge : MORAPAKALA SRINIVAS

Tutorial Instructors : R Parameshwaran, Shine jude hamilton , M. Srinivas, Santanu Prasad Datta, Shaik Gouse Ahammad, KRC Murthy

Practical Instructors : Joshua Kumar Saladi, K Monika, S S Deshmukh, Meduri Sitaram, Shaik Gouse Ahammad, Satish K Dubey, Shine jude Hamilton, Sibin V Mathew,

# Course Description

Thermodynamics relations, gas and vapor cycles, combined power generation cycles, gas mixtures, refrigeration cycles, psychometrics and heat load calculations, gas turbine cycles, compressors, boilers, and accessories; Experiments related to applied thermodynamics and fluid mechanics courses.

# Scope and objective

The course is an extension of the classical thermodynamics learnt earlier and is intended to learn how to apply the thermodynamics principles to several thermal systems mechanical engineers come across. The classical and state-of-the art aspects required to design and analyze different power producing, power absorbing and allied systems would be discussed in the course. The broad topics include gas & vapor power cycles, combined power generation cycles, gas turbine cycles, refrigeration cycles, psychrometry & basic air conditioning concepts, thermodynamic relations, gas mixtures besides other supplementary topics required to understand these. The theory learnt is complimented by experiments related to applied thermodynamics and fluid mechanics. At the end of the course the student would be able to apply the principles learnt to design and analyze different thermal systems using thermodynamics principles.

# Text book

* 1. Yunus A. Cengel, Michael A. Boles, [Mehmet Kanoglu,](https://www.amazon.in/s/ref%3Ddp_byline_sr_book_3?ie=UTF8&field-author=Mehmet%2BKanoglu&search-alias=stripbooks) Thermodynamics – An Engineering Approach, 9th Edition, McGrawhill India, 2019

# Reference books

* 1. P.K. Nag, “Engineering Thermodynamics” – Tata McGraw-Hill Publishing Company Ltd., 4th Ed., 2008
  2. T. D. Eastop & A. McConkey, “Applied Thermodynamics” – Pearson Education, 5th Ed., 2008.
  3. Claus Borgnakke & Richard E. Sonntag, “Fundamentals of Thermodynamics”, John Wiley & Sons, 7th Ed., 2009.

# Course plan

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| **Lecture** | **Learning objective** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Reviewing of basic concepts | Importance of thermodynamics and its applications, review of first and second law concepts, heat engines and refrigeration systems | Excerpts from 1-8 |
| 2-8 | Understand and analyse Gas power cycles | Basic considerations and assumptions, Otto cycle, Diesel cycle, Stirling and Ericsson cycles, Brayton cycle – simple, with Intercooling, reheating and regeneration | 9 |
| 9-17 | Understand and analyse Vapor power cycles | Carnot vapor and Ideal Rankine cycle, Actual vapor cycle, Reheat, Regenerative Rankine cycles, Co-generation, combined gas-vapor power cycles | 10 |

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| **Lecture** | **Learning objective** | **Topics to be covered** | **Chapter in the Text Book** |
| 18-22 | Understand and analyse Refrigeration cycles | Refrigerators and heat pumps, reversed Carnot cycle, Ideal and actual vapour compression refrigeration cycles, Gas refrigeration cycles, Absorption refrigeration systems | 11 |
| 23-25 | Understand the basic concepts of Gas mixtures | Gas mixtures: Composition, P-v-T behavior, properties of ideal and real gases | 13 |
| 26-20 | Apply Gas-vapor mixtures concepts to air conditioning processes | Dry and atmospheric air, Specific and relative humidity of air, Dew point, adiabatic saturation and wet bulb temperatures, Human comfort and air conditioning, air conditioning processes | 14 |
| 31-34 | Understand the Thermodynamic aspects of Gas compressors | Single-stage and Multi-Stage Compression, Volumetric efficiency. Rotary compressor | Class notes & Chapter 18 in RB1 |
| 35-39 | Understand and use Thermodynamics property relations | Quick review of partial derivatives, Maxwell relations, the Claypeyron equation, relations for changes in IE, enthalpy, entropy, specific heat relations, Joule-Thomson coefficient, relations for real gases | 12 |
| 40-42 | Understand the thermodynamic aspects behind working of Boilers and accessories | Boiler classification, Functions, Nomenclature, Mountings and accessories, Circulation | Class notes |

**List of Experiments:**

* 1. Calibrating the venturi meter and orifice meter
  2. Estimating the frictional loss in a pipe flow
  3. Estimating the losses due to various pipe fittings
  4. Estimating the force exerted when a jet imping a flat and curved plates
  5. Verification of Bernoulli's theorem
  6. Study and Performance test on Vapor Compression Refrigeration System.
  7. Study and Performance test on Vapor Absorption Refrigeration System
  8. Study and Performance test on Heat Pump Test Rig
  9. Study and Performance test on Window A/C Test Rig
  10. Study and Performance test on Reciprocating Compressor Test Rig
  11. Study experiment on Steam Power Plant
  12. Study experiment on Air-pre conditioner to mimic different psychrometric conditions

# Evaluation Scheme:

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| **Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of**  **Component** |
| Mid semester Test | 90 Minutes | 30 | 13/10 - 2.00 - 3.30PM | CB |
| Surprize tests/quizzes\* | 10 Minutes | 10 | Surprise in nature. See the footnote for details | OB |
| Lab work@ | Take home | 20 | See the footnote for details | OB |
| Comprehensive Examination | 180 Minutes | 40 | 19/12 FN | CB |

\* Shall be conducted in Tutorial classes. Best 4 out of 6 will be considered. Other details would be communicated separately.

@ Lab work consists of reports (for every experiment) and viva or quiz (at appropriate intervals), with 10% weightage each. Other details would be communicated separately.

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** All notices concerning this course shall be displayed on the CMS (the Institute’s web based course management system). Students are advised to visit regularly CMS for latest updates.

**Make-up Policy:** Make-up shall be given only to the genuine cases with prior confirmation. Request for the make-up tests, duly signed

by the students, should reach the under signed well before the scheduled test.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

# Instructor-in-Charge