The Hong Kong University of Science and Technology

UG Course Syllabus

Course Title: Thermodynamics

Course Code: MECH2310

No. of Credits: 3

Any pre-/co-requisites: MATH 1012 or MATH 1013 or MATH 1020 or MATH 1023

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Course Description

Fundamental Concepts; Pure substance; Work and heat; Control volume; Ideal and real gases; First and second laws of thermodynamics; Entropy; Elementary power and refrigeration cycles.

Intended Learning Outcomes (ILOs)

By the end of this course, students should be able to:

1. Explain fundamental thermodynamic concepts and describe the first and second laws of thermodynamics.
2. Perform basic thermodynamic analysis on a given system or device using the first or second law of thermodynamics.
3. Evaluate the performance of common energy systems.
4. Evaluate the influence of energy technologies on the environment and human society.

Assessment and Grading

This course will be assessed using criterion-referencing. Grades will not be assigned using a curve. Student performance will be evaluated according to their demonstrated achievement of the intended learning outcomes (ILOs) via homework assignments, a midterm examination, and a final examination. Rubrics and grade descriptors are provided below to clarify the criteria used for evaluation.

Assessment Task	Contribution to Overall Course grade (%)	Due date
Homework assignments	15%	Throughout the term
Midterm examination	35%	Around week 7-10
Final examination	50%	Final examination period

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework assignments	ILO-1, ILO-2, ILO-3, ILO-4	This task assesses students' ability to understand the fundamental thermodynamic concepts and describe the first and second laws of thermodynamics (ILO 1), perform basic thermodynamic analysis on a given system or device using the first or second law of thermodynamics (ILO 2), evaluate the performance of common energy systems (ILO 3), and evaluate the influence of energy technologies on the environment and human society (ILO 4).
Midterm examination	ILO-1, ILO-2	The midterm examination assesses students' ability to understand the fundamental thermodynamic concepts and describe the first and second laws of thermodynamics (ILO 1), perform basic thermodynamic analysis on a given system or device using the first or second law of thermodynamics (ILO 2).
Final examination	ILO-1, ILO-2, ILO-3, ILO-4	The final examination is cumulative and assesses individual achievement of the core conceptual and analytical learning outcomes of the whole course (ILO-1, ILO-2, ILO-3, ILO-4).

Grading Rubrics

The following rubrics describe the general criteria used to assess the major assessment components in this course. More detailed task-specific marking schemes may be provided for individual homework assignments, fundamental understandings, and examination questions.

Criteria	Excellent	Good	Satisfactory	Marginal	Fail	Map to the course ILOs
Conceptual understanding	Demonstrates clear and accurate understanding of the relevant concepts and physical mechanisms. Correctly explains the assumptions and limitations of thermodynamics.	Show good understanding of the main concepts, with only minor omissions or imprecision.	Show adequate understanding of basic concepts but lack depth or contain some conceptual gaps.	Show limited understanding; explanations are incomplete or partially incorrect.	Show little or no understanding of the relevant concepts	ILO-1, ILO-2, ILO-3, ILO-4
Mathematical accuracy and problem solving	Solutions are mathematically sound, logically organized, and	Solutions are generally correct, with minor	Solutions show reasonable effort and partial	Solutions are incomplete or contain major	Solutions are largely absent, incorrect, or	ILO-1, ILO-2, ILO-3, ILO-4

	lead to correct results with appropriate units and notation.	algebraic, numerical, or unit errors.	correctness but include some significant errors.	mathematical errors.	not submitted.	
Physical interpretation of results	Provides clear interpretation of results, including green technologies trends, limiting cases, model assumptions, and engineering significance.	Provides reasonable interpretation, though some details may be missing.	Provides basic interpretation but may not fully connect results to physical behavior.	Provides limited or superficial interpretation.	Provides no meaningful interpretation of results.	ILO-1, ILO-2, ILO-3, ILO-4
Clarity of presentation	Work is clear, well structured, legible, and easy to follow, with appropriate equations, diagrams, and explanations.	Work is mostly clear and organized.	Work is understandable but may be disorganized or difficult to follow in places.	Work is poorly organized or hard to follow.	Work is illegible, incoherent, or missing.	ILO-1, ILO-2, ILO-3, ILO-4

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of green technologies, expertise in problem-solving, and significant creativity in solving the thermal- and energy-related problems based on basic conceptual understandings such as first-, second-law of thermodynamics, entropy and temperature scale. Exhibits a high capacity for problem solving and collaboration, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of thermal- and energy-related problems, competence in problem-solving, and the ability to analyze and evaluate issues. Displays high motivation to learn and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of thermal- and energy-related problems, competence in dealing with familiar problems, and some capacity for analysis and critical thinking. Shows persistence and effort to achieve broadly defined learning goals.
D	Marginal Pass	Has threshold knowledge of thermal- and energy-related problems, potential to achieve key professional skills, and the ability to make basic judgments. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of thermal- and energy-related problems and lacks the necessary problem-solving skills. Shows limited ability to think critically or analytically and exhibits minimal effort towards achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

The use of artificial intelligence (AI) tools is permitted in this course for learning support, brainstorming, checking understanding, improving writing clarity, and assisting with coding or software related tasks. However, students remain fully responsible for the accuracy, originality, and integrity of all submitted work.

For homework submissions, students may use AI tools to support their learning, but they must ensure that the final submitted work reflects their own understanding and reasoning. Students should not submit AI-generated solutions without verification, explanation, and independent. judgement. Any use of AI that contributes substantively to submitted work should be acknowledged where appropriate.

During the final examination, the use of AI tools is not permitted.

Communication and Feedback

Assessment marks for individual assessed tasks will normally be communicated via Canvas within two weeks of submission. Feedback may include written comments, annotated solutions, marking rubrics, sample solutions, in-class or tutorial discussion, or verbal feedback during experiment-related activities.

Homework feedback will focus on the correctness of methods, mathematical execution, physical interpretation, and clarity of presentation. Project feedback will address the quality of analysis, use of analytical, numerical, and experimental methods, interpretation of results, and technical communication.

Students who have questions about feedback or marks should contact the instructor or teaching team within two weeks after the feedback is released..

Late submission Policy

To ensure fairness to students who submit work on time, late submissions for homework components will be subject to a penalty of 10% of the attained mark per day, unless prior approval has been granted by the instructor or valid supporting documentation is provided.

Required Texts and Materials

The main textbook for this course:

- *Thermodynamics – An Engineering Approach,* 8th Edition in SI Units, McGraw Hill, 2015 by Y.A. Cengel, M.A. Boles and Mehmet Kanoglu.

The textbook is available online via the HKUST Library. Students may use any of the listed editions, as the core material is broadly consistent across these editions.

Academic Integrity

Students are expected to adhere to the university's academic integrity policy. Students are expected to uphold HKUST's Academic Honor Code and to maintain the highest standards of academic integrity. The University has zero tolerance of academic misconduct. Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Course outline

Week 1: Introduction - Some basic concepts

Week 2: Introduction - Energy Analysis

Week 3:	Introduction - Energy Analysis
Week 4:	Properties of Pure Substance
Week 5:	Properties of Pure Substance
Week 6:	Work and heat
Week 7:	First law of thermodynamics
Week 8:	First law of thermodynamics and Mid Term Exam
Week 9:	Second law of thermodynamics
Week 10:	Second law of thermodynamics
Week 11:	Entropy
Week 12:	Entropy and more on Irreversibility
Week 13:	Review