The Hong Kong University of Science and Technology

UG Course Syllabus

Foundations of Mechanical and Aerospace Engineering

MECH 1910

3 Credits

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Course Description

This course serves as an introduction to Mechanical and Aerospace engineering, covering theoretical concepts and basic core principles across four key sub-areas: (1) aerospace engineering; (2) mechanics and materials; (3) thermo-fluids; (4) design – build – test group project prototype demonstration. It provides a solid foundation for students to develop essential analytical and problem – solving skills, enabling them to approach future major courses with confidence. The curriculum includes topical studies organized into these four domains. Fundamental concepts and principles are demonstrated and visualized through real – life examples. By bridging theory with practical application, the course prepares students to confidently approach advanced major courses and tackle real-world engineering challenges.

Intended Learning Outcomes (ILOs)

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

1. Understand the theoretical concepts in mechanical and aerospace engineering;
2. Be familiar with the basic core principles in mechanical and aerospace engineering and able to explain how they are applied to meet societal needs;
3. Apply the analytical thinking and problem – solving skills;
4. Function with engineering mindset and teamwork spirits in addressing real – world challenges;
5. Recognize the impact of aerospace and mechanical engineering as a profession.

Assessment and Grading

This course will be assessed using criterion-referencing and grades will not be assigned using a curve. Detailed rubrics for each assignment are provided below, outlining the criteria used for evaluation.

Assessments:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Assignments	15%	22/09/2026; 11/10/2026; 24/10/2026
Online Quizzes	9%	24/09/2026; 13/10/2026; 26/10/2026
Mid – Term Exam	36%	29/10/2026

Final Group Project Prototype Demonstration	40%	19/12/2026

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Assignments	ILO1, ILO2, ILO3, ILO5	Assesses students' grasp of core principles (ILO1, ILO2) in mechanical and aerospace engineering fields. Also assesses students' analytical and problem-solving skills (ILO3) in addressing problems in various industrial settings (ILO5).
Online Quizzes	ILO1, ILO2	Evaluates students' foundational understanding of theoretical concepts in mechanical and aerospace engineering and how the core principles are applied in different cases.
Mid – Term Exam	ILO1, ILO2, ILO3	Comprehensively evaluates the total knowledge set acquired across all modules and critical problem-solving capabilities.
Final Group Project Prototype Demonstration	ILO1, ILO2, ILO3, ILO4, ILO5	Through the processes of designing – building – testing each group prototype, assess students' overall performances in understanding the theoretical concepts (math and science behind the prototype), application of the core principles (building of the prototype), real – world problem – solving (make it work), and teamwork spirits.

Grading Rubrics for Assignments, Quizzes and Mid – Term Exam:

The following rubric guides the evaluation of assignments, quizzes, and the mid – term exam:

Performance	Marks	Description
Excellent	≥ 80	Demonstrates complete mastery of core principles, executes calculations accurately, and provides profound understanding of the theories applied in real-world applications
Good	70 – 79	Exhibits strong comprehension of theoretical concepts and generally accurate calculations and analysis in problem-solving.
Satisfactory	60 – 69	Shows basic understanding of the four main engineering sub-areas, but minor errors in calculations and analysis and with noticeable gaps in methodology or application.
Marginal	50 – 59	Displays limited understanding of fundamental concepts, struggles with analytical thinking, and requires significant guidance.
Fail	< 50	Fails to demonstrate basic competency in mechanical and aerospace engineering principles.

Grading Rubrics for Group Project Prototype Demonstration:

Students can refer to these rubrics to understand how their final group projects (100 marks) are assessed in terms of the report, i.e. Engineering Design (15); Build Quality (15); Testing and Calibration (15); Added Features (20); Measurement Accuracy (20); Presentation (15)

Engineering Design (15 Marks)

This section evaluates the team's ability to make sound mechanical design choices, justify key parameters, and ensure that the planimeter is suitable for the intended area-measurement range.

Performance	Marks	Description
Excellent	12 – 15	Presents a well-justified and coherent mechanical design. Arm lengths, wheel diameter, hinge arrangement, materials, and readout method are selected appropriately for the target area range and are supported by clear engineering reasoning.
Good	8 – 11	Presents a sound design with appropriate major component choices. Most parameters are justified, although some design decisions or links to the target measurement range could be explained more fully.
Satisfactory	5 – 7	Presents a basic workable design, but justification of component choices and key parameters is limited, incomplete, or only partly related to the target area range.
Marginal/Fail	0 – 4	Presents an unclear, impractical, or poorly justified design. Key mechanical choices are missing, inappropriate, or not linked to the intended operation and measurement range.

Build Quality (15 Marks)

This section evaluates the team's ability to fabricate and assemble a precise, robust, and smoothly operating prototype.

Performance	Marks	Description
Excellent	12 – 15	Produces a clean, robust, and carefully assembled prototype with tight tolerances. The hinge moves smoothly with minimal play, the measuring wheel rolls reliably, components are securely aligned, and the device operates consistently in the lab.
Good	8 – 11	Produces a functional and generally well-assembled prototype. Most components are aligned and securely fitted, with only minor issues in finish, tolerances, smoothness of motion, or robustness
Satisfactory	5 – 7	Produces a complete prototype that functions at a basic level, but noticeable issues in alignment, fit, assembly quality, friction, or structural robustness affect operation
Marginal/Fail	0 – 4	Produces an incomplete, poorly assembled, fragile, or unreliable prototype. Major fabrication or assembly issues prevent smooth, repeatable operation

Testing and Calibration (15 Marks)

This section evaluates the team's ability to test the prototype systematically, quantify error sources, and document calibration or correction procedures.

Performance	Marks	Description
Excellent	12 – 15	Conducts systematic testing using known-area targets and repeated trials. Clearly quantifies measurement error, identifies important sources of error, applies and documents appropriate calibration or correction factors, and uses findings to improve the prototype.
Good	8 – 11	Conducts suitable testing and calibration with some repeated measurements. Identifies major error sources and documents a generally appropriate correction procedure, although analysis or refinement may lack detail.

Satisfactory	5 – 7	Conducts basic testing against a known target and reports some error. Calibration or error-source analysis is limited, incomplete, or not consistently used to improve performance
Marginal/Fail	0 – 4	Provides little or no meaningful testing or calibration. Error is not quantified, correction factors are absent or unsupported, and the team shows limited understanding of factors affecting accuracy.

Added Features (20 Marks)

This section evaluates the usefulness, engineering quality, and implementation of features that make the planimeter easier to use or more capable than the baseline design.

Performance	Marks	Description
Excellent	16 – 20	Integrates one or more well-executed, clearly useful features that substantially improve usability, capability, versatility, or efficiency. Examples may include an adjustable arm, improved readout, ergonomic stylus, multi-range wheel system, or magnetic pole base. The features are reliable and well justified.
Good	11 – 15	Incorporates useful added feature(s) that improve the device beyond the baseline design. The features are functional and relevant, although their implementation, integration, or demonstrated benefit may have minor limitations.
Satisfactory	6 – 10	Includes a limited or partially implemented added feature. The feature shows some attempt to improve the device but provides only a modest benefit or is not fully demonstrated.
Marginal/Fail	0 – 5	Includes no meaningful added feature, or the proposed feature is non-functional, poorly integrated, unrelated to user needs, or insufficiently demonstrated.

Measurement Accuracy (20 Marks)

This section evaluates the accuracy of the planimeter by comparing measured areas with the CAD ground-truth area of known calibration shapes. Percentage error= [(measured area−CAD ground-truth area) / CAD ground-truth area] × 100%

Performance	Marks	Description
Excellent	16 – 20	Achieves a mean percentage error of **5% or less** across repeated measurements of known-area calibration targets. Results are repeatable and clearly compared with CAD ground truth.
Good	11 – 15	Achieves a mean percentage error of **more than 5% and up to 10%**. Results are generally repeatable, with minor variation between trials.
Satisfactory	6 – 10	Achieves a mean percentage error of **more than 10% and up to 20%**. The prototype measures area but shows noticeable inaccuracy or inconsistent repeatability.
Marginal/Fail	0 – 5	Has a mean percentage error of **more than 20%**, produces highly inconsistent results, or does not provide sufficient valid measurements for comparison with CAD ground truth.

Presentation (15 Marks)

This section evaluates the team's ability to deliver a clear live demonstration and explain the planimeter's theory, design choices, added features, and achieved accuracy.

Performance	Marks	Description
Excellent	12 – 15	Delivers a clear, confident, and well-organized live demonstration. Explains the operating theory, major design decisions, fabrication choices, added features, calibration process, and measured accuracy accurately and professionally. All team members contribute effectively and respond thoughtfully to questions.
Good	8 – 11	Delivers a clear and generally well-organized demonstration. Explains most required elements accurately, although some aspects may lack detail, clarity, balance among team members, or smooth delivery.
Satisfactory	5 – 7	Delivers a basic demonstration and explains some project elements. The presentation may be unclear, incomplete, poorly paced, or limited in its explanation of theory, design, features, or accuracy.
Marginal/Fail	0 – 4	Delivers an unclear, incomplete, or poorly prepared demonstration. Key project elements are missing or inaccurately explained, and the prototype's operation or performance is not convincingly demonstrated.

Final Grade Descriptors:

Grades	**Short Description**	**Elaboration on subject grading description**
A	Excellent Performance	Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Engages with constant effort in all class activities and collaborations, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of the main subject matter, 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 core subject matter, 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 core subject matter, 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	Lacks of engagement in class activities and collaborative work. 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

This course allows students to use generative AI tools to assist understanding of technical concepts, to review course contents, and to summarize literature sources for projects.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments and quizzes includes which answers are wrong and what are the

correct ones. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Required Texts and Materials

NO required textbook.

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.