The Hong Kong University of Science and Technology (Guangzhou)

UG Course Syllabus

[Course Title] **Smart Manufacturing Lab - I**

[Course Code] **SMMG 3810**

[No. of Credits] **2**

[Any pre-/co-requisites]: **NO**

Name of Instructor: Kaihao Zhang

Email: kaihaozhang@hkust-gz.edu.cn

Lecture Time and Day: 9:00AM – 11:50 AM, Wednesday

Class Venue: Newton Lab (E3-231C)

Office Hours: Friday 4:00-5:00PM @ W2-604

Course Description

This is an introductory laboratory course to provide students with training in experimental techniques and laboratory procedures, data acquisition, analysis, and presentation. This course series aims at offering students an opportunity to face real problems in real manufacturing environments through the application of smart manufacturing methods to support the engineering and management of high-value-added products, the continuous innovation of products and processes, the sustainability of products and production systems along their lifecycle.

Intended Learning Outcomes (ILOs)

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

1. Design and simulate a lightweight component with specific mechanical properties/functionalities using CAD/CAE software, e.g. Solidworks and COMSOL Multiphysics.

2. Fabricate a component using both additive and subtractive processes, e.g. Laser powder bed fusion and carbon fiber printing.

3. Test mechanical performance and analyze results against design predictions.

4. Propose designed iterations to optimize performance and manufacturability.

Weekly Schedule and Weekly ILOs

Weekly topics	Date	Venue	Weekly ILOs

• Intro and 3D modeling-1
  ○ Lab course arrangement
  ○ 3D modeling introduction
	2025-09-03	Newton Lab (E3-231C)	Demonstrate foundational SolidWorks proficiency by creating a fully defined 3D solid model from a 2D sketch and

(Solidworks tutorial)			explaining the core principles of parametric modeling.
• TCT Shenzhen for 3D printing ○ Field trip study to learn 3D printing industry	2025-09-10	Shenzhen, SZCEC, Hall3	Analyze industrial additive manufacturing trends by evaluating specific 3D-printed components to hypothesize their design rationale and economic viability.

• Material selection – hardness, compression test
  ○ Micro-indentation test
  ○ Universal mechanical tester
	2025-09-17	RBMS @ W3-101	Characterize material mechanical properties by performing hardness and compression tests and interpreting the resulting data to determine key properties like yield strength.

• Material selection – tensile test and stress-strain curve
  ○ Micro-indentation test
  ○ Universal mechanical tester
	2025-09-24	RBMS @ W3-101	Determine fundamental tensile properties and fracture characteristics of a material by conducting a tensile test to failure and analyzing the resulting stress-strain curve.

• Additive manufacturing – 1 ○ Laser powder bed fusion + carbon fiber → turbocharger printing	2025-10-11	AAM Lab & CFT Lab @ W2-L3 & L6	• Prepare a digital model for manufacturing by applying knowledge of Laser Powder Bed Fusion (LPBF) and Continuous Carbon Fiber (CCF) processes, including orientation, supports, and slicing. • Execute the fabrication of a hybrid metal-composite component by operating LPBF and CCF printers and justifying the design choices for a specific application.
• Additive manufacturing – 2 ○ Laser powder bed fusion + carbon fiber → turbocharger printing	2025-10-15	AAM Lab & CFT Lab @ W2-L3 & L6	
• Machining – 1 ○ Introduction to CNC and fine machining of LPBF printed parts	2025-10-22	RBMS @ E2-101	• Prepare an AM-printed part for post-processing by explaining CNC milling fundamentals and developing a basic CAM toolpath for a finishing operation. • Evaluate the effectiveness of CNC finishing by safely executing a toolpath on an AM-printed part and verifying the achieved dimensional accuracy and surface quality.
• Machining – 2 ○ Fine machining of LPBF/CCF printed parts	2025-10-29	RBMS @ E2-101	
• COMSOL – 1(basic intro + case study: compression/tension)	2025-11-05	Newton Lab (E3-231C)	• Apply finite element analysis (FEA) principles by setting up, running, and interpreting a basic structural simulation to validate digital models against physical test data. • Generate a lightweight, manufacturable design by configuring and interpreting a topology optimization study to meet specific structural performance objectives.
• COMSOL – 2(case study: topology optimization)	2025-11-12	Newton Lab (E3-231C)	
• Course project preparation ○ Lightweight design and simulation	2025-11-19	Newton Lab & RBMS & AAM Lab	Showcase the smart manufacturing process by presenting a finished prototype and quantitatively evaluating

• Course project preparation ○ Prototyping via 3D printing and machining	2025-11-26		its performance against the initial design goals.
• Final and roadshow	2025-12-03		

Recommended reading:

1. Lecture slides (will be posted on Canvas before class)
2. Kalpasjian and Schmid, "Manufacturing Engineering and Technology", 7th edition, 2014
3. M.F. Ashby, "Materials Selection in Mechanical Design", 4th edition, 2011: https://lbdiscover.hkust.edu.hk/bib/991002656239703412

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:

[List specific assessed tasks, exams, quizzes, their weightage, and due dates; perhaps, add a summary table as below, to precede the details for each assessment.]

Assessment Task	Contribution to Overall Course grade (%)	Due date
Lab report	40%	Before the next lab section
Course project	40%	2025-12-03
Class attendance	10%	-
In-class quiz	10%	Will be announced before the class

* Assessment marks for individual assessed tasks will be released within two weeks of the due date.

Grading Rubrics

Detailed rubrics for each assignment will be provided on Canvas. These rubrics clearly outline the criteria used for evaluation. Students can refer to these rubrics to understand how their work will be assessed.

Final Grade Descriptors:

[As appropriate to the course and aligned with university standards]

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	[Example: Demonstrates a comprehensive grasp of subject matter, expertise in problem-solving, and significant creativity in thinking. Exhibits a high capacity for scholarship and collaboration, going beyond core requirements to achieve learning goals.]

B	Good Performance	[Example: 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	[Example: 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	[Example: 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	[Example: Demonstrates insufficient understanding of the subject matter 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

1. In in-class quiz session, use of any tools including but not limited to AI tools, internet, software, etc. is **strictly prohibited.**

2. In all other parts of the course, use of tools is **not prohibited.**

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Feedback on assignments will include specific details, e.g., strengths, areas for improvement. Students who have further questions about the feedback including marks should consult the instructor within five working days after the feedback is received.

Resubmission Policy

All lab reports will be due at the date/time specified by the instructor. Late work will be penalized 20% per day.

Academic Integrity

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