The Hong Kong University of Science and Technology

UG Course Syllabus Template

Course Title	Introduction to Intelligent Building Systems
Course Code	MECH4360
No. of Credits	3
Any pre-/co-requisites	MECH2310 and MECH 3610
Instructor:	Baoling Huang
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Office Hours:	

Course Description

This course introduces fundamentals of intelligent building and the relevant subsystems. It involves the following contents: intelligent building assessment, building automation, communication, safety and security systems; modeling and control of noise, illumination, mechanical transportation, electrical, electronic, fire safety subsystems; system integration and optimization with the building envelope; code of practice in design, operational characteristics and performance specifications.

The course is delivered via lectures and laboratories that combine concept introduction, mathematic derivation, physical interpretation, and real-world practice. Students will complete homework assignments to develop analytical problem-solving skills and conduct case studies. Students will develop the understanding of intelligent building and its assessment, capabilities in design and evaluate lift, lighting and fire safety systems in simple building scenarios, and skills in building energy system assessment and optimization.

Intended Learning Outcomes (ILOs)

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

1. Explain the intelligent building and subsystem design principles and working mechanisms
2. Evaluate the intelligent building index in various categories
3. Analyze the energy efficiency and opportunity in the design of building and its subsystems
4. Provide solutions for lift, lighting, air conditioning and safety systems in typical scenarios

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
Mid-Term	35%	October 27, 2026

In-course assignments	20%	One week after announcement
Final examination	45%	Final examination period

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

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Homework assignments	ILO 1, ILO 2, ILO 3, ILO 4	Homework assignment assesse students' ability to explain the intelligent building and subsystem design principles and working mechanisms (ILO 1), evaluate the intelligent building index in various categories (ILO 2), critically analyze the opportunities in the building and subsystem designs (ILO 3), and solve problems involving vertical transportation, lighting and firesafety (ILO 4).
Midterm and final Examinations	ILO 1, ILO 2, ILO 3, ILO 4	The midterm and final examination is cumulative and assesses individual achievement of the core conceptual and analytical learning outcomes of the course. Students are required to apply fundamentals of intelligent building and subsystems including lift, lighting, air conditioning, fire safety and security to different building design problems (ILO 1), evaluate the performance of different designs (ILO 2), analyze and optimize designs for different subsystems (ILO 3), provide solutions to lift, lighting, air conditioning and safety systems in typical scenarios (ILO 4).

Grading Rubrics

Criteria	Excellent	Good	Satisfactory	Marginal	Fail	Map to Course ILOs
Conceptual understanding	Demonstrates clear and accurate understanding of the relevant intelligent building technology concepts. Correctly explains the functions of different subsystems.	Shows good understanding of the main concepts, with only minor omissions or imprecision.	Shows adequate understanding of basic concepts but may lack depth or contain some conceptual gaps.	Shows limited understand-ing; explanations are incomplete or partially incorrect.	Shows little or no under-standing of the relevant intelligent building concepts.	ILO 1, ILO 2, ILO 3, ILO 4
Application of Design principles	Selects and applies appropriate design methods for the vertical transport, lighting and fire safety as well as security subsystems.	Applies appropriate methods with mostly correct	Applies standard methods to familiar	Attempts to apply relevant methods but	Fails to apply appropriate aerodynamic	ILO 1, ILO 2, ILO 3, ILO 4

		reasoning and only minor errors.	problems but may require clearer justification or contain some procedural errors.	with significant errors or weak justification.	methods or uses irrelevant approaches.	
Mathematical accuracy and problem solving	Solutions are mathematically sound, logically organized, and lead to correct results with appropriate units and notation.	Solutions are generally correct, with minor algebraic, numerical, or unit errors.	Solutions show reasonable effort and partial correctness but include some significant errors.	Solutions are incomplete or contain major mathematical errors.	Solutions are largely absent, incorrect, or not submitted.	ILO 1, ILO 2, ILO 3, ILO 4
Physical interpretation of results	Provides clear interpretation of results, including aerodynamic 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 aerodynamic behavior.	Provides limited or superficial in-terpretation.	Provides no meaningful interpreta-tion of results.	ILO 1, ILO 2, ILO 3, ILO 4

Rubric for <u>Examinations</u>

Criteria	**Excellent**	**Good**	**Satisfactory**	**Marginal**	**Fail**	**Map to Course ILOs**
Conceptual understanding	Demonstrates clear and accurate understanding of the relevant intelligent building technology concepts. Correctly explains the functions of different subsystems.	Shows good understanding of the main concepts, with only minor omissions or imprecision.	Shows adequate understanding of basic concepts but may lack depth or contain some conceptual gaps.	Shows limited understanding; explanations are incomplete or partially incorrect.	Shows little or no under-standing of the relevant intelligent building concepts.	ILO 1, ILO 2, ILO 3, ILO 4
Application of Design principles	Selects and applies appropriate design methods for the vertical transport, lighting and fire safety as well as security subsystems.	Applies appropriate methods with mostly correct reasoning and only minor errors.	Applies standard methods to familiar problems but may require clearer justification or contain some	Attempts to apply relevant methods but with significant errors or weak justification.	Fails to apply appropriate aerodynamic methods or uses irrelevant approaches.	ILO 1, ILO 2, ILO 3, ILO 4

Mathematical accuracy and problem solving	Solutions are mathematically sound, logically organized, and lead to correct results with appropriate units and notation.	Solutions are generally correct, with minor algebraic, numerical, or unit errors.	Solutions show reasonable effort and partial correctness but include some significant errors.	Solutions are incomplete or contain major mathematical errors.	Solutions are largely absent, incorrect, or not submitted.	ILO 1, ILO 2, ILO 3, ILO 4

Criteria	Excellent	Good	Satisfactory	Marginal	Fail	Map to Course ILOs
Mathematical accuracy, organization, and clarity	Work is accurate, logically structured, clearly presented, and uses appropriate equations, units, notation, and physical reasoning under examination conditions.	Work is generally clear and accurate, with minor errors.	Work is understandable but may contain errors, omissions, or lack organization.	Work is poorly organized or contains major errors.	Work is incoherent, largely incorrect, 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 intelligent building and its subsystems, expertise in solving problems for intelligent building design and evaluation, and significant creativity in thinking. Exhibits a high capacity for scholarship and collaboration, going beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of intelligent building and its subsystems, competence in problem-solving, and the ability to analyze and evaluate building energy systems and safety systems. Displays high motivation to learn and the ability to work effectively with others.
C	Satisfactory Performance	Possesses adequate knowledge of intelligent building and its subsystems, 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	Demonstrates threshold knowledge of intelligent building, potential to achieve key professional skills, and the ability to make basic judgments of building energy systems. Benefits from the course and has the potential to develop in the discipline.
F	Fail	Demonstrates insufficient understanding of the intelligent building systems 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 and project 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 and midterm examinations, the use of AI tools is not permitted.

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.

Later submission Policy

To ensure fairness to students who submit work on time, late submissions for homework and project components will be subject to a penalty of 20% of the attained mark, unless prior approval has been granted by the instructor or valid supporting documentation is provided. No later submission is allowed if the submission is more than 3 days later.

Required Texts and Materials

Reference Books:

1. CIBSE Guide (Transportation Systems in Buildings)
2. ASHRAE Handbook
3. NFP Code
4. Gassmann O. and Meixner H., "Sensors in Intelligent Buildings"
5. Underwood C. P., "HVAC Control Systems, Modelling Analysis and Design"
6. SFPE, "Fire Protection Engineering"
7. Marc Schiler, "Simplified Design of Building Lighting"
8. ASHRAE Standard 135-2016 (BACnet)
9. Asia Institute of Intelligent Buildings, "Intelligent Building Index Manual" Ver. 5
10. Albert So and Wai Lok Chan "Intelligent Building Systems"

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.

Students may discuss course concepts, homework strategies, and project ideas with classmates, the instructor, and teaching assistants. However, submitted work must be the student's own unless a task is explicitly designated as group work.

Please refer to Academic Integrity | HKUST – Academic Registry for the University's definition of plagiarism and ways to avoid cheating and plagiarism.

Course Outline:

1. **Introduction to Intelligent Building Systems:** Introduction, definition of Intelligent Building, how to evaluate Intelligent Building, Intelligent Building Index (1.0 Week)
2. **Mechanical Transport and Safety:** Elevator technology, basic structure of lifts and escalators. Safety devices and operating principles. Lift traffic analysis. Lift hoist and escalator drives. Local regulations on lifts and escalators. New development in elevator technology (2.5 weeks)

3. **Thermal Comfort and Intelligent Control Systems:** Human sensations and thermal comfort; Control components in heating and air-conditioning systems; Characteristics of sensors, controllers and actuators. Block diagram of typical systems, control schematics, elementary ladder diagrams, control stability and microprocessor applications. (3.5 week)
4. **Fire Detection and Protection:** Fire process; fire properties of materials; Smoke, production, measurement, toxicity; active protection system and components; local fire safety regulations (2.0 weeks)
5. **Design of Building Lighting:** Fundamentals of illumination, lighting sources, lighting calculations, daylight strategies, daylight calculation, design practices, CADLink Building Services Software. (1.0 Week Lecture + 1.0 Week Computer Lab)
6. **Safety and Security in Buildings:** Intelligent sensors in life safety and security systems. "Life safety" includes fire alarm, gas alarm, extinguishing and evacuation systems. "Security" refers to intruder alarm, access control and CCTV systems. (1.0 week)
7. **Energy Efficiency Labeling Scheme in Hong Kong:** Description and Analysis of Energy Efficiency Labels for Air Conditioners, Refrigerators and Dehumidifiers in Buildings (1 Week)**.**