The Hong Kong University of Science and Technology

UG Course Syllabus

Introduction to Electro-Robot Design

ELEC 1100

4 Credits

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Office Hours: By email appointments

Course Description

The course introduces the fundamental knowledge of the design, implementation and evaluation of a robot and its sub-systems. It covers the basic principles of analog and digital circuits as well as robot sensing and control mechanisms. Students will need to apply the knowledge and principles learned to design and build a functional robot by the end of the course. Students who have completed ELEC 2200, ELEC 2350, ELEC 2400, ELEC 2420, or ELEC 3310, must obtain instructor's approval to take this course.

Intended Learning Outcomes (ILOs)

Through hands-on labs and term project, completed with lectures and tutorials, by the end of this course, students should be able to:

- ILO1: Recognize the history and development of major ECE fields.
- ILO2: Apply the fundamental circuit concepts to compute the output of basic electronic circuits.
- ILO3: Analyze, design, and debug simple analog circuits, and design and program for simple digital control strategies.
- ILO4: Build a real engineering system following a hierarchical design principle.
- ILO5: Work in a team environment, learn and practice effective project management.
- ILO6: Execute a complete project from problem formulation, design/implementation, up to verification and documentation.

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.

- Labs: 6 Lab Assignments (29% total; first 5 labs 5% each, final lab 4%).
- Quizzes: Pop-Up In-Tutorial Quizzes (open book, 3% total). These quizzes will be conducted during tutorial classes and will consist of a total of 8 questions. They will be submitted online via iPRS. To earn the full 3%, you must answer at least 6 questions correctly.
- Exams: Lab Exam (close book, 20%) and Written Exam (close book, 25%).
- Project: Project Demo (20%) and Report (3%).

Summary Table:

Assessment Task	Contribution to Overall Course grade (%)	Due date
Quiz	3%	Week 3 – 10 at tutorial class
Laboratory experiments	29%	Week 3 – 10
Lab Exam	20%	Weeks 8 at lab class
Written Exam	25%	Week 9
Final Project Demo	20%	Weeks 11 – 13
Project Report	3%	Week 13

Mapping of Course ILOs to Assessment Tasks

Assessed Task	Mapped ILOs	Explanation
Quiz, and Written Exam	ILO1, ILO2	These assessments evaluate students' understanding of fundamental electronic concepts (ILO1) and their ability to apply calculations accurately in circuit analysis (ILO2).
Lab Exam	ILO2, ILO3	Lab Exam tests students' capability to analyze circuit diagrams, perform calculations (ILO2), and troubleshoot issues in both theoretical and practical scenarios (ILO3).
Laboratory experiments	ILO3, ILO4, ILO5	These lab tasks assess students' ability to use lab equipment, conduct experiments, and analyze data to verify electronic principles (ILO3). They also evaluate students' skills in troubleshooting circuit issues step by step, from basic to complex elements, ensuring proper functionality (ILO4). Collaboration is key as students work together to diagnose problems, brainstorm solutions, and make effective adjustments. This structured teamwork enhances problem-solving, communication, and practical knowledge in electronic circuit design and troubleshooting (ILO5).
Final Project Demo, Project Report	ILO5, ILO6	The final project encourages teamwork, creativity, and problem-solving skills as students collaborate to design, build, test, and optimize their electro robot car. By completing this hands-on project, students gain practical experience in applying electronic concepts to real-world applications and enhance their skills in project management, innovation, and

		technical implementation. This assessment also evaluates students' ability to document experimental procedures, record measurements accurately, and present results in a clear and organized manner (ILO5 and ILO6).

Grading Rubrics

Assessed Task	A (Excellent Performance)	B (Good Performance)	C (Satisfactory Performance)	D (Marginal Pass)	F (Fail)
Quiz	Demonstrates exceptional grasp of fundamental electronic concepts, consistently answers quiz questions correctly, and provides clear, well-reasoned calculations.	Shows good understanding of electronic concepts, answers most quiz questions correctly, with minor errors in reasoning or calculations.	Adequately understands core electronic concepts, answers some quiz questions correctly, but with noticeable mistakes in reasoning or calculations.	Displays minimal understanding of electronic concepts, answers few quiz questions correctly, and struggles with reasoning or calculations.	Fails to demonstrate understanding of electronic concepts, answers most quiz questions incorrectly, and provides poor or no reasoning.
Written Exam	Exhibits exceptional comprehension of electronic principles, provides accurate and well-reasoned answers, and demonstrates creativity in solving complex problems.	Displays good understanding of electronic principles, provides mostly accurate answers, and solves problems effectively with minor errors.	Shows adequate understanding of electronic principles, but answers are partially correct or lack depth in reasoning.	Demonstrates minimal understanding of electronic principles, struggles with problem-solving, and provides mostly incorrect answers.	Fails to demonstrate understanding of electronic principles and problem-solving skills; answers are mostly or completely incorrect.
Lab Exam	Demonstrates thorough understanding of circuit analysis and design, performs calculations accurately, and effectively troubleshoots theoretical and practical issues.	Shows strong understanding of circuit analysis and design, with minor calculation or troubleshootin g errors.	Exhibits basic understanding of circuit analysis and design, with noticeable errors in calculations or troubleshooting .	Displays limited understanding of circuit analysis and design, struggles with calculations and troubleshooting .	Fails to demonstrate understanding of circuit analysis and design, with significant errors in calculations and no ability to troubleshoot issues.

Laboratory Experiments	Demonstrates excellent practical skills in circuit building, data analysis, and troubleshooting; produces well-documented lab reports with thorough explanations and accurate results.	Shows good practical skills in circuit building and data analysis; lab reports are clear with minor mistakes in explanation or results.	Displays adequate skills in building circuits and analyzing data; lab reports are functional but lack depth in explanations or contain some errors.	Shows limited skills in circuit building and data analysis; lab reports are poorly written, with explanations and results that lack clarity or accuracy.	Fails to demonstrate practical skills in circuit building and data analysis; lab reports are incomplete, inaccurate, or missing.
Final Project Demo*	Successfully designs, builds, and programs a robot car that completes all tasks in a single trial; demonstrates creativity and innovation in implementation and optimization.	Successfully designs, builds, and programs a robot car that completes most tasks; demonstrates good implementation and optimization skills with minor issues.	Designs, builds, and programs a robot car that completes some tasks but leaves significant room for improvement in implementation and optimization.	Designs, builds, and programs a robot car with limited functionality; struggles to complete tasks and shows minimal optimization effort.	Fails to design, build, or program a functional robot car; tasks are incomplete or poorly executed.
Project Report	Provides a detailed, well-organized, and accurate report with clear documentation of procedures, results, and analysis, demonstrating excellent technical communication skills.	Produces a good report with clear documentation of procedures, results, and analysis, but with minor organizational or content errors.	Submits a satisfactory report with basic documentation of procedures and results, but lacks depth in analysis or contains noticeable errors.	Submits a report with minimal documentation and analysis, showing poor organization and limited technical communication skills.	Fails to submit a report or submits an incomplete or plagiarized report with missing or incoherent documentation and analysis.

*Notes on the Final Project Demo: In the final project, student groups are required to program a robot car to navigate an obstacle course from START to END. The course consists of a white line on a black surface with challenging stretches and a white wall. Groups can conduct multiple demo trials, and their project demo score will be based on the highest performance achieved across all trials.

For a 'perfect run,' the robot car must successfully complete all given tasks within one trial. If the tasks are not completed, the demo score will be determined by 'how far your car can go' in each trial. The objective is to earn as many points as possible.

Please note that the specific demo track and tasks will vary each semester. Detailed grading rubrics, including the points awarding scheme, will be provided later in the semester as part of the 'Project Guide' documentation.

Final Grade Descriptors:

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

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Exhibits an exceptional grasp of basic electronic components, their applications, and calculations in laboratory experiments and written assessments. Consistently delivers high-quality work with precise measurements, accurate analysis, and thorough explanations. Demonstrates advanced problem-solving skills, showcases creativity in circuit design, and displays mastery of electronic concepts in exams and quizzes.
B	Good Performance	Displays a solid understanding of basic electronic components, their applications, and calculations in laboratory experiments, projects, exams, and quizzes. Produces work of good quality with clear explanations, accurate results, and proficient calculations. Shows competency in circuit design, analysis, and troubleshooting in both practical and theoretical assessments.
C	Satisfactory Performance	Shows a basic understanding of basic electronic components, their applications, and calculations in laboratory experiments, projects, exams, and quizzes. Meets most of the requirements with satisfactory work, functional circuits, and adequate calculations. Demonstrates some ability to analyze circuits, perform calculations, and troubleshoot issues in practical and theoretical assessments.
D	Marginal Pass	Demonstrates efforts to understand basic electronic components, their applications, and calculations in laboratory experiments, projects, exams, and quizzes. Shows potential for improvement in accuracy, precision, and calculations. Displays some proficiency in circuit design, analysis, and troubleshooting in both practical and theoretical assessments.
F	Fail	Lacks a solid understanding of basic electronic components, their applications, and calculations in laboratory experiments, projects, exams, and quizzes. Fails to meet the requirements, with work that falls below the acceptable standard, lacks accuracy in calculations, and demonstrates significant difficulties in circuit design, analysis, and troubleshooting in both practical and theoretical assessments.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Students seeking clarification or additional feedback, including marks, should consult the instructor/teaching team within one week of receiving the feedback or as specified in the email.

Late Submission Policy

- Late submissions will not be accepted.

Make-up Policy

- If you miss a grading session for a justified reason, you may submit the proof within one week to arrange a make-up session.
- All requests for special accommodation for medical reasons must be accompanied by the hard copy of the original medical certificate.

Required Texts and Materials

No specific textbook, mainly use hand-outs provided by the instructors.

Reference Books/Materials:

- L. Richard Carley and Pradeep Khosla, "Introduction to Electrical and Computer Engineering – taught in Context", The McGraw-Hill Companies, Inc.
- G. Rizzoni, "Principles and Applications of Electrical Engineering," 5th edition, McGraw Hill, 2007
- D. V. Kerns and J. D. Irwin, "Essentials of Electrical and Computer Engineering", Pearson, 2004
- M. M. Mano, C. R. Kime, "Logic and Computer Design Fundamentals", 3rd edition, Prentice-hall, 2004

Additional Resources

Tinkercad Online Circuit Simulator: https://www.tinkercad.com/

Arduino Home page: https://www.arduino.cc/

Course AI Policy

In the course project, you are allowed to use any kind of tools (including Generative AI), sources, and references to aid you. However, your demo code and project report should be your own work and not copied from elsewhere. Both your code and report will be used to conduct the plagiarism check. Copying from others will result in a mark penalty or failing this course.

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.