The Hong Kong University of Science and Technology

UG Course Syllabus

Microwave Theory and Applications

ELEC 4010S

4 Credits

Pre-requisite: ELEC 2400

Name: Liuqing GAO

Email: eelgao@ust.hk

Office Hours: By email appointments

Course Description

This is a lecture and laboratory elective course on the foundations of RF/microwave engineering. Main topics include transmission-line theory and impedance matching, Smith chart, S-parameters, waveguides, amplifier design, gain, stability, compression and power limits, noise figure, intermodulation distortion. The laboratory component provides hands-on experience in designing, simulating, and testing microwave transistor amplifiers discussed in the lectures. Students in microelectronics and integrated circuits will be prepared to undertake advanced courses on RF/microwave theories, circuits, and microsystems (e.g. ELEC 5180).

Intended Learning Outcomes (ILOs)

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

ILO1: Understand RF/Microwave Engineering Principles: Explain the fundamental concepts of RF/microwave engineering, including transmission-line theory, impedance matching, and the use of Smith charts.

ILO2: Analyze RF Circuit Parameters: Interpret and apply key RF parameters such as S-parameters, waveguides, gain, stability, compression and power limits, noise figure, and intermodulation distortion.

ILO3: Design and Simulate Microwave Circuits: Use appropriate design methodologies and computer-aided simulation tools to design RF/microwave circuits.

ILO4: Perform Laboratory Experiments: Conduct hands-on experiments to test and validate the performance of microwave devices, correlating theoretical predictions with experimental results.

ILO5: Problem-Solve Real-World RF Issues: Identify and address practical challenges in RF/microwave engineering by applying theoretical concepts and laboratory experience.

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
Homework assignments	10%	Week 3,5,7,10,13
Laboratory experiments	30%	Week 6, 9, 13
Mid-Term	20%	Week 8
Final examination	40%	During Spring Term Examinations (will be arranged later in the semester).

* 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 and exams	ILO1, ILO2, ILO3	This task assesses students' ability to: understand and apply the foundational concepts of RF/microwave engineering (ILO1), analyze RF circuit parameters, such as impedance matching and S-parameters, through problem-solving exercises (ILO2), design basic microwave circuits (ILO3).
Laboratory experiments	ILO3, ILO4, ILO5	This task assesses students' ability to: design and test microwave devices, reinforcing their ability to translate theory into practical applications (ILO3), solve practical RF engineering problems, such as matching circuit parameters to achieve desired performance, by applying analytical and hands-on skills (ILO4), develop foundational knowledge and skills that prepare them for more advanced RF/microwave courses, enabling seamless progression in their academic and professional journey (ILO5).

Grading Rubrics

ELEC 4010S Lab Report Grading Rubrics

Acknowledgment - This rubric is adopted and modified from the INQUIRY AND ANALYSIS VALUE RUBRIC by Association of American Colleges and Universities. Number in bracket shows the corresponding marks for that level of performance.

	Milestones	Benchmark	Below Benchmark
Completeness of the experiment Max: 8	Complete all the experiments described in the lab manual. (8)	Complete part of the experiments described by the lab manual. (4)	Not able to complete any part of the experiments described by the lab manual. (0)
Experimental Result Max: 4	Able to follow all the lab manuals and get accurate experimental results. (4)	Able to finish part of the lab manual and get some experimental results. (2)	Not able to follow any part of the lab manuals to get experimental results. (0)

Design Justification Max: 4	Able to justify the design in the lab report. (4)	Able to partially justify the design in the lab report. (2)	Not able to justify the design in the lab report. (0)
Writing Quality Max: 4	Clear and well-organized report of the complete lab including theory, design justification, and experimental results. (4)	Able to describe some part of the laboratory experiment, but not complete or organized. (2)	Not able to present the theory, design justification, and lab result of the laboratory experiments. (0)

Final Grade Descriptors:

Grades	Short Description	Elaboration on subject grading description
A	Excellent Performance	Demonstrates a comprehensive grasp of course materials, and expertise in problem-solving and laboratory experiments. Exhibits exceptional problem-solving skills, efficient collaboration, and effective leadership abilities in the laboratory that goes beyond core requirements to achieve learning goals.
B	Good Performance	Shows good knowledge and understanding of the main course materials, competence in problem-solving, and the ability to analyze and evaluate issues. Displays high motivation to learn and the ability to work effectively with lab mates in the laboratory.
C	Satisfactory Performance	Possesses an adequate understanding of core course materials, competence in dealing with familiar problems, and satisfactory performance in laboratory experiments in problem-solving and collaboration.
D	Marginal Pass	Has limited understanding of core course materials, partially completed laboratory experiments, and the ability to make basic judgments for microwave engineering problems. Meets the threshold requirements of the course.
F	Fail	Demonstrates insufficient understanding of the course materials, lacks the necessary problem-solving skills, and does not complete any part of the laboratory experiments. Shows limited ability to analyze microwave engineering problems and exhibits minimal effort toward achieving learning goals. Does not meet the threshold requirements for professional practice or development in the discipline.

Course AI Policy

The use of Generative AI in lab reports is permitted with proper acknowledgment.

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

Late Submission Policy (homework assignment and lab report)

To ensure fairness for students who submit assignments on time, a penalty for late submission is listed as follows:

• Late submission within 12 hours, a 25% penalty will be applied.

• Late submission between 12 to 24 hours, a 50% penalty will be applied.

• Late submission for more than 24 hours will not be accepted.

Required Texts and Materials

1. David M. Pozar, Microwave Engineering, Wiley, 4th Edition, 2011.
2. N. N. Rao, Elements of Engineering Electromagnetics, 6th Edition, Pearson, 2006.

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.