The Hong Kong University of Science and Technology

UG Course Syllabus

Course Title	Medical Imaging
Course Code	ELEC4820
No. of Credits	3
Pre-requisites	ELEC2100 AND MATH 2011 AND MATH 2111

Instructor Name:	YU Weichuan
Email:	eeyu@ust.hk
Office Hours:	Fridays 4-5PM, Room 2428

Course Description

This course introduces medical imaging methods to senior undergraduate and graduate students. It covers the following topics: radiation, radiography, computer tomography, radioisotope imaging, diagnostic ultrasound imaging, magnetic resonance imaging, and applications of different imaging modalities.

This course requires basic knowledge of linear algebra, calculus, and geometry. Familiarity with a programming language such as MATLAB is needed.

Intended Learning Outcomes (ILOs)

ELEC4820 is about five common imaging modalities. By the end of this course, students should be able to:

1. Calculate radiation and attenuation of X-ray in body and explain the working principle of X-ray imaging.
2. Carry out Fourier transform and Radon transform to objects with different geometric shapes (such as circle and ellipse), and apply Fourier slice theorem and filtered back projection to reconstruct the CT images of objects from parallel projection and fan projection.
3. Calculate the mass defect and the corresponding energy, explain the radioactive decay law, and describe the image formation process of nuclear imaging using mathematical formula.
4. Solve the plane wave equation and the spherical wave equation, and mathematically describe the ultrasound imaging process.
5. Explain the nuclear magnetic resonance (NMR) at both microscopic level and macroscopic level, describe the key difference between NMR and magnetic resonance imaging (MRI), draw the timing diagram of MRI pulse sequences and describe the principles of controlling gradients.

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	20%	Please see the time table*
Mid-Term	30%	October 16, 2025 *
Final examination	50%	Please see the time table

* 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	ILO1, ILO2, ILO3, ILO4, ILO5	All five ILOs will be assessed through five homework assignments.
Mid-term	ILO1, ILO2	Midterm will focus on assessing the first two ILOs.
Final exam	ILO3, ILO4, ILO5	Final exam will focus on assessing the next three ILOs.

Grading Rubrics

The homework questions and exam questions will have standard answers.

Final Grade Descriptors:

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

It is fine to use AI tools for homework assignments. But AI tools are not allowed during the midterm and final exams.

Communication and Feedback

Assessment marks for individual assessed tasks will be communicated via Canvas within two weeks of submission. Students who have further questions about the feedback including marks should consult the instructor or TA within five working days after the feedback is received.

Late Submission and Resubmission Policy

Late submissions of homework will face 20% penalty per day. Resubmission is not allowed.

Required Text Book:

Medical Imaging: Signals and Systems, by Jerry Prince and Jonathan Links,
Pearson Prentice Hall, ISBN 0-13-065353-5

Additional Resources

1. The Essential physics of Medical Imaging, 2nd Edition
   J. T. Bushberg, J. A. Seibert, E. M. Leidholdt, and J. M. Boone,
   Lippencott Williams & Wilkins, 2002
2. The physics of Medical Imaging
   Steve Webb (ed.), Institute of physics publishing, 1988
3. The Basics of MRI --- online book with many video clips
   Joseph P. Hornak http://www.cis.rit.edu/htbooks/mri/
4. Diagnostic Ultrasound Imaging: Inside Out
   Thomas L. Szabo, Elsevier Science, 2004

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.