NANYANG TECHNOLOGICAL UNIVERSITY

COURSE CONTENT

Academic Year	2021/2022	**Semester**	2
Course Coordinator	Assoc Prof. Liu Quan		
Course Code	BG4214		
Course Title	Biomedical Optics (Core Elective)		
Pre-requisites	Nil		
No of AUs	3		
Contact Hours	39 hours lecture, 0 hours tutorial		
Proposal Date	8 Dec 2020		

Course Aims

This course aims to provide you with the basic optics principles, the understanding of typical interactions between light and biological matter and the survey of common optical spectroscopy and imaging techniques in biomedical optics. The knowledge will be useful if you will be involved in any biomedical industry or academic tasks requiring the use of optical techniques.

Intended Learning Outcomes (ILO)

After completing the course, the students should be able to

1. discuss the basic optics principles;
2. discuss the typical interactions between light and biological matter
3. evaluate common optical spectroscopy and imaging techniques in respective applications.

Course Content

- Introduction to biomedical optics
- Light basics
- EM wave theory basics
- Polarization basics
- Interference
- Diffraction
- Light sources
- Optical fiber
- Geometrical optics basics
- Optical spectroscopy and spectral imaging
- Guest topics about biomedical optics techniques

Assessment (includes both continuous and summative assessment)

Component	Course LO Tested	Related Programme LO or Graduate Attributes	Weighting	Team /Individual	Assessment rubrics
1. Continuous Assessment 1 (30%) Quiz 1	1,	EAB, SLO, a, b	30%	Individual	Refer to appendix 1
2. Continuous Assessment 2 (40%) Mini-projects	1, 2, 3	EAB, SLO, c, d, e	40%	Individual	Refer to appendix 1
3. Continuous Assessment 3 (30%) Quiz 2	1, 2, 3	EAB, SLO, a, b, c	30%	Individual	Refer to appendix 1
Total			100%		

Mapping of Course ILOs to EAB Graduate Attributes

Course Intended Learning Outcomes		Cat	EAB's 12 Graduate Attributes*											
			(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
		Core	◐		◐		◐							
1.	Discuss the basic optics principles;												a,b,d	
2.	Discuss the typical interactions between light and biological matter												a,b	
3.	Evaluate common optical techniques in respective applications.												a,c,e	

Legend:

●	Fully consistent (contributes to more than 75% of Intended Learning Outcomes)
◐	Partially consistent (contributes to about 50% of Intended Learning Outcomes)
š	Weakly consistent (contributes to about 25% of Intended Learning Outcomes)
Blank	Not related to Student Learning Outcomes

Formative feedback

Examination results;
Marker's report on overall examination performance will be uploaded to NTUlearn;
Quiz answers will be discussed in class

Learning and Teaching approach

Approach	How does this approach support students in achieving the learning outcomes?
Lecture	Demonstrate how to carry out a procedure such as working through a problem, use incomplete handouts which enabling students participating in class.
Tutorial	TBL classroom discussion sessions on tutorial questions and related topics

Reading and References

1. Eugene Hecht, Optics, 4th ed., Addison Wesley, 2002.
2. Introduction to Biophotonics

Copyright © 2003 John Wiley & Sons, Inc.
Author(s): Paras N. Prasad
Published Online: 21 JAN 2004.
Link (requiring NTU ID and password to log in):
http://ezlibproxy1.ntu.edu.sg/login?url=http://dx.doi.org/10.1002/0471465380
3. Biomedical Optics: Principles and Imaging
Copyright © 2007 John Wiley & Sons, Inc. All rights reserved.
Author(s): Lihong V. Wang, Hsin-I Wu

Course Policies and Student Responsibilities

General: Students are expected to complete all online activities and take all scheduled assignments and tests by due dates. Students are expected to take responsibility to follow up with course notes, assignments and course related announcements. Students are expected to participate in all tutorial discussions and activities.
Continuous assessments: Students are required to attend all continuous assessments.
Absenteeism: Continuous assessments make up a significant portion of students' course grade. Absence from continuous assessments without officially approved leave will result in no marks and affect students' overall course grade.

Academic Integrity

Good academic work depends on honesty and ethical behaviour. The quality of your work as a student relies on adhering to the principles of academic integrity and to the NTU Honour Code, a set of values shared by the whole university community. Truth, Trust and Justice are at the core of NTU's shared values.

As a student, it is important that you recognize your responsibilities in understanding and applying the principles of academic integrity in all the work you do at NTU. Not knowing what is involved in maintaining academic integrity does not excuse academic dishonesty. You need to actively equip yourself with strategies to avoid all forms of academic dishonesty, including plagiarism, academic fraud, collusion and cheating. If you are uncertain of the definitions of any of these terms, you should go to the academic integrity website for more information. Consult your instructor(s) if you need any clarification about the requirements of academic integrity in the course.

Course Instructors

Instructor	Office Location	Phone	Email
Liu Quan	N1.3 B2-10	6316 8748	guanliu@ntu.edu.sg

Planned Weekly Schedule

Week	Topic	Course LO	Readings/ Activities
1	Introduction to biomedical optics	1,2,3	Face to face lecture
2	Light basics	1	Face to face lecture
3	EM wave theory basics	1	Face to face lecture
4	Polarization basics	1	Face to face lecture
5	Interference	1	Face to face lecture
6	Diffraction	1	Face to face lecture
7	Light sources -- Laser	1	Face to face lecture
8	Optical fiber	1	Face to face lecture
9	Geometrical optics basics	1	Face to face lecture
10	Optical spectroscopy and spectral imaging	2,3	Face to face lecture
11	Guest topic 1 (e.g. Optical microscopy)	1,2,3	Face to face lecture
12	Guest topic 2 (e.g. Optical coherence tomography)	1,2,3	Face to face lecture
13	Review	1,2,3	Face to face lecture

Appendix 1: Assessment Criteria

Criteria	Unsatisfactory: <40%	Borderline: 40% to 49%	Satisfactory: 50% to 69%	Very good: 70% to 89%	Exemplary: >90%
Knowledge Discuss the basic optics principles;	Poor familiarity of the basic optics principles	Below average familiarity of the basic optics principles	Average familiarity of the basic optics principles	Good familiarity of the basic optics principles	Very good familiarity of the basic optics principles
Comprehension Discuss the typical interactions between light and biological matter	Poor understanding of the basic optics principles and light-tissue interaction	Below average understanding of the basic optics principles and light-tissue interaction	Average understanding of the basic optics principles and light-tissue interaction	Good understanding of the basic optics principles and light-tissue interaction	Thorough understanding of the basic optics principles and light-tissue interaction
Application Evaluate common optical spectroscopy and imaging techniques in respective applications.	Poor understanding of pros and cons of common optical techniques; Unable to select proper optical techniques for practical problems at all	Below average understanding of pros and cons of common optical techniques; Excellent ability to select proper optical techniques for practical problems with possibly major issues	Average understanding of pros and cons of common optical techniques; Average ability to select proper optical techniques for practical problems with some noticeable issues	Good understanding of pros and cons of common optical techniques; Good ability to select proper optical techniques for practical problems with minor issues	Thorough understanding of pros and cons of common optical techniques; Excellent ability to select proper optical techniques for practical problems

Appendix 2: The EAB (Engineering Accreditation Board) Accreditation SLOs (Student Learning Outcomes)

a) **Engineering knowledge:** Apply the knowledge of mathematics, natural science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems
b) **Problem Analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c) **Design/development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
d) **Investigation:** Conduct investigations of complex problems using research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e) **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations
f) **The engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g) **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for the sustainable development.
h) **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i) **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams and in multidisciplinary settings.
j) **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k) **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and economic decision-making, and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l) **Life-long Learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change