School of Electrical Engineering and Telecommunications

Semester 2, 2017
Course Outline

PHTN4662
Photonic Networks

COURSE STAFF

Course Convener: Dr. Leonardo Silvestri, Room MSEB720, l.silvestri@unsw.edu.au
Tutor: Dr. Leonardo Silvestri
Laboratory Contact: Dr. Yanhua Luo, Room EEG15, yanhua.luo1@unsw.edu.au

Consultations: You are encouraged to ask questions on the course material after the lecture class times and during tutorials in the first instance, rather than via email. When this is not possible, you can email the tutor or laboratory demonstrator. ALL email enquiries should be made from your student email address with PHTN4662 in the subject line; otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

COURSE SUMMARY

Contact Hours

The course consists of 2 hours of lectures every week, a 1-hour tutorial every fortnight starting from week 2 and a 2-hour laboratory session every fortnight starting from week 3.

	Day	**Time**	**Location**
Lectures	Tuesday	3pm – 5pm	CivEng G1
Tutorials	Tuesday (w3,5,6,9,11,13)	1pm – 2pm	Law 203
	Tuesday (w2,4,6,8,10,12)	5pm – 6pm	CivEng 701

Context and Aims

This course will provide an in-depth overview of the fundamentals as well as the modern techniques of optical fibre communication systems. A wide range of topics will be covered in this course, including:

- Propagation of light in optical fibres
- Optical sources and detectors
- Analog and digital optical communication systems
- Optical amplifiers and photonic components
- Multiplexing techniques
- Signal-to-noise ratio in optical communication systems
- Photonic Network technologies and issues
- Network topologies and architectures, components and protocols

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction and course overview
Week 2	Optical fibres I: principles
Week 3	Optical fibres II: signal attenuation
Week 4	Optical fibres III: signal distortion
Week 5	Optical sources: LEDs and lasers
Week 6	Photodetectors and receivers
Week 7	*Mid-semester Exam*
Week 8	Digital and analog optical fibre systems
Week 9	Point-to-point link and wavelength division multiplexing
Break	
Week 10	System design considerations
Week 11	Photonic networks
Week 12	Guest lecture: “The NBN”
Week 13	Overall review

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 3	Session 1 for groups O1 to O7
Week 4	Session 1 for groups E1 to E7
Week 5	Session 2 for groups O1 to O7
Week 6	Session 2 for groups E1 to E7
Week 7	Session 3 for groups O1 to O7
Week 8	Session 3 for groups E1 to E7
Week 9	Session 4 for groups O1 to O7
Break	
Week 10	Session 4 for groups E1 to E7

Assessment

Laboratory Assessment (compulsory)	20%
Mid-Semester Exam	30%
Final Exam (2 hours)	50%
Total	100%

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 10 to 12 hours per week throughout the 13 week semester.

Relationship to Other Courses

This is a 4th year elective course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge

Pre-requisite for the course: TELE3113, PHTN4661 or ELEC3115.
It is essential that the students have shown competency in fundamental courses such as mathematics, physics, electronics, signals and systems. They are strongly advised to review previous courses materials of TELE3113, PHTN4661 or ELEC3115.

Learning outcomes

After successful completion of this course, you should be able to:

1. Understand the fundamental principles underpinning optical point-to-point links
2. Be familiar with the main optical components of optical networks
3. Understand analog and digital optical communication systems
4. Be able to design optical point-to-point links
5. Understand the basic aspects of optical networks

This course is designed to provide the above learning outcomes which arise from targeted graduate capabilities listed in ***Appendix A***. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in ***Appendix B***). This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix C***.

Syllabus

All-optical & hybrid networks, topologies; WDM; optical switching & routing, SONET; dispersion management, Bit error Rate (BER) & sources of noise, power budgets; phase modulation effects & nonlinear scattering in optical links; safety, regulations & standards.

TEACHING STRATEGIES

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal face-to-face lectures, which provide you with a focus on the core material in the course;
- Tutorials, which enable students to apply various methods to analyse, both qualitatively and quantitatively, the fundamentals of optical communication systems;
- Laboratory sessions, which support the formal lecture material and also provide you with hands-on experience in optical communication techniques and systems.

Learning in this course

You are expected to attend all lectures, tutorials, labs, and mid-semester exams in order to maximise learning. You must prepare well for your laboratory classes and your lab work will be assessed. In addition to the lecture notes, you should read relevant sections of the recommended text. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending face-to-face classes throughout the course.

Tutorial classes

During tutorial classes students will be asked to solve problems on the topics covered by the previous lectures under the supervision of a tutor. The importance of adequate preparation prior to each tutorial cannot be overemphasized, as the effectiveness and usefulness of the tutorial depends to a large extent on this preparation.

Group learning is encouraged. Answers to the problems will be discussed during the tutorial class. These solutions may not be made available on the web, so it is worthwhile for you to attend your tutorial classes to gain maximum benefit from this course.

Laboratory program

The laboratory schedule is designed to provide hands-on experience in optical communication techniques and systems. The following four experiments will be done by each student during the course of study:

1. Measurement of laser characteristics
2. Measurement of avalanche photodiode characteristics
3. Optical receiver measurement
4. Measurement on a wavelength division multiplexed system

You are required to attend laboratory from Week 3 to Week 10, one session per fortnight. Laboratory attendance WILL be recorded by the lab demonstrator, and you MUST attend all labs. The laboratory schedule and the student groups will be decided before the lab work starts. A lab risk assessment form (to be given later) is to be completed and signed before the start of your first experiment.

Laboratory Exemption

There is no laboratory exemption for this course. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled in this course must take the labs. If, for medical reasons, (note that a valid medical certificate must be provided) you are unable to attend a lab, you will need to apply for a catch-up lab during another lab time, as agreed by the laboratory coordinator.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the lab assessments and the mid-semester exam.

Laboratory Assessment

Laboratories are primarily about learning, and the laboratory assessment is designed mainly to check your knowledge as you progress through the course.

Students will be assessed by a lab demonstrator on the preparation, performance and completion of the experiments, and on the quality of the experimental reports. Students will work in groups but will be assessed individually. Students are expected to carefully prepare for each of the laboratory experiments, prior to coming into the lab. Every student is required to keep an individual record of all the experiments, preferably in the form of a bound book. Lab reports must be submitted by each student. You need to attach a signed covering sheet to each of your reports. Your lab report must be submitted within 14 days of the completion of the experiment. Late reports will attract a penalty of 10% per day (including weekends). Note that the laboratory component contributes to 20% of the final marks. All labs are weighted equally.

Mid-Semester Exam

The middle-term exam will be a standard closed-book 1.5-hour written examination and will take place in week 7. University approved calculators are allowed. The mid-session examination tests your general understanding of the course material, and is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any course material up to the end of week 6. It may contain questions requiring some (not extensive) knowledge of laboratory material, and will definitely contain numerical and analytical questions. Marks will be assigned according to the correctness of the responses. The mid-semester exam contributes to 30% of the final marks.

Final Exam

The exam in this course is a standard closed-book 2-hour written examination. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course (including laboratory), unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses. The final exam contributes to 50% of the final marks. *Please note that you must pass the final exam in order to pass the course.*

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes				
Assessment	**1**	**2**	**3**	**4**	**5**
Laboratory assessment	✓	✓	✓	✓	-
Mid-semester exam	✓	✓	-	-	-
Final exam	✓	✓	✓	✓	✓

COURSE RESOURCES

Textbooks

Reference books

- J. Senior, "*Optical Fibre Communications: Principles and Practice"*
- R. Ramaswami and K. N. Sivarajan, "*Optical Networks: A Practical Perspective"*
- G. Keiser, "*Optical Fibre Communications"*

On-line resources

Moodle

As a part of the teaching component, Moodle will be used to disseminate teaching materials, host forums and occasionally quizzes. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

OTHER MATTERS

Dates to note

Important Dates available at: https://student.unsw.edu.au/dates

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/guide), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult https://student.unsw.edu.au/special-consideration.

Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the online student survey myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:
https://student.unsw.edu.au/guide
https://www.engineering.unsw.edu.au/electrical-engineering/resources

APPENDICES

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and assessed through lab reports.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	PE1.4 Discernment of knowledge development and research directions	✓
	PE1.5 Knowledge of engineering design practice	✓
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	✓
	PE2.2 Fluent application of engineering techniques, tools and resources	✓
	PE2.3 Application of systematic engineering synthesis and design processes	✓
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	
	PE3.2 Effective oral and written communication (professional and lay domains)	
	PE3.3 Creative, innovative and pro-active demeanour	
	PE3.4 Professional use and management of information	
	PE3.5 Orderly management of self, and professional conduct	✓
	PE3.6 Effective team membership and team leadership	✓