ELEC9355
Optical Communication Systems

Course Outline – Semester 2, 2015

Never Stand Still | Faculty of Engineering | School of Electrical Engineering and Telecommunications

Course Staff

Course Convener:	Prof. Gang-Ding Peng,	Room EE332, G.Peng@unsw.edu.au
Tutor:	Prof. Gang-Ding Peng,	Room EE332, G.Peng@unsw.edu.au
Laboratory Contact:	Dr. Yanhua Luo,	Room EEG15, yanhua.luo1@unsw.edu.au

Consultations: The preferred consultation time for this course is after lectures and during the tutorial. Please feel free for any additional consultation at the start or end of lectures, tutorials or laboratory sessions.

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, a 1-hour tutorial every fortnight and a 2-hour laboratory session each fortnight.

Context and Aims

This course will provide an in-depth overview of the fundamentals as well as modern techniques of optical fibre communication systems.

A wide range of topics will be covered in this course, including

- Optical sources and detectors
- Optical fibre lasers and amplifiers
- Photonic components
- Multiplexing techniques and systems
- Analog and digital optical communication systems
- Signal-to-noise ratio in optical communication systems
- Nonlinear optical effects in optical fibres
- Photonic Network technologies and issues
  - *network topologies and architectures, components and protocols*
- Current issues & topics of optical fibre systems

Indicative Schedule

Week	Lecture	Tut	Lab
0			
1	Introduction & Review Refs: Lecture note; Senior: Ch.1-2, Keiser Ch.1-3, Ch.13: Ramaswami Ch.2-3		
2	Optical Fibre Lasers and Amplifiers Refs: Lecture note; Senior: Ch.6 & Ch.10, Keiser Ch.11, Ch.4; Ramaswami Ch.3	1	
3	Optical sources and detectors Refs: Lecture note; Senior: Ch.6-9, Keiser Ch.4, Ch.6; Ramaswami Ch.3		O1-O8
4	Analog Optical Communication Systems Refs: Lecture note; Senior: Ch.11, Keiser Ch.9; Ramaswami Ch.4-5	2	E1-E8
5	Digital Optical Communication Systems Refs: Lecture note; Senior: Ch.11, Keiser Ch.8; Ramaswami Ch.2-3		O1-O8
6	SNR in Optical Communication Systems Refs: Lecture note; Senior: Ch.11, Keiser Ch.7; Ramaswami Ch.2-3	3	E1-E8
7	Midterm Exam – Wednesday, 10 September 2014		O1-O8
8	System Considerations. Photonic Networks Refs:Lecture note; Senior: Ch.14, Keiser Ch.12; Ramaswami Ch.6-7, Ch.9-14	4	E1-E8
9	Wavelength Division Multiplexing Refs: Lecture note; Senior: Ch.11, Keiser Ch.10; Ramaswami Ch.7-8		O1-O8
10	Nonlinear Optical Effects in Optical Fibres (Dr I. Skinner) Refs: Lecture note; Ramaswami Ch.2	5	E1-E8
11	Other Multiplexing Systems Refs: Lecture note; Senior: Ch.11; Ramaswami Ch.7-8		
12	Photonic Components Refs: Lecture note; Senior: Ch.5-10, Keiser Ch.10, Ch.4-5; Ramaswami Ch.3		

Note on Laboratory:

1. The lab notes will be distributed by the lecturer or the lab demonstrator.
2. Lab allocations will be finalised in Week 2.
3. All the lab sessions will be fixed. Should you need to change your lab time, please contact your lecturer or lab demonstrator.
4. The assessable labs start in week 3 and end in week 11, and must be attended every second week.

Course Details

Syllabus

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

Credits

The course is a 6 UoC course。 The expected workload is 10 hours per week throughout the 13 week session.

Relationship to Other Courses

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

At the conclusion of this course, the students will have solid knowledge of:

1. *Fundamental principles & techniques of optical fibre systems*
2. *Photonic components in optical communication systems*
3. *Optical analogue and digital modulation and demodulation techniques*
4. *Noise and signal analysis of optical communication systems*
5. *Design & application of various optical communication systems*
6. *Basic aspects of optical networks*
7. *Current topics & issues in optical communication systems*

This course will contribute to the building up of a number of core UNSW graduate attributes.

Assessment

Laboratory work: The student will be assessed by a lab demonstrator on the preparation, performance and completion of the experiments, and on the experimental reports. Students will work in groups but be assessed individually.

Assignment: There will be 3 assignments to be worked out throughout the session. *Late reports will attract a penalty of 10% per day* (including weekends).

Mid-term examination: The middle-term exam will be closed-book 1.5 hour written examination. University approved calculators are allowed. The examination tests general understanding of the course materials covered up to the middle-term.

Final examination: The exam in this course is a standard closed-book 3 hours 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, unless specifically indicated otherwise by the lecture staff.

Summary of assessment

Laboratory work:	20%
Mid-term examination:	20%
Assignments:	10%
Final examination:	50%
Total	**100%**

Relationship of Assessment Methods to Learning Outcomes

Assessment	**Learning outcomes**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Laboratory work & reports	✓	✓	✓	✓	✓	-	-
Mid-term exam	✓	✓	✓	✓	-	-	-
Assignment	✓	✓	✓	✓	✓	✓	✓
Final exam	✓	✓	✓	✓	✓	✓	✓

Teaching Strategies

The teaching of the course is delivered through a combination of lectures, tutorials, and laboratory work.

Lectures: The lectures provide the students with the explanation of the core materials in the course. The lectures will be delivered 2 hour per week with corresponding lecture notes.

Tutorials: The tutorials enable students to apply various methods to qualitatively and quantitatively analyse and interpret the fundamentals of optical communication systems. No solution will be provided but hints on how to solve the problems will be provided. This course is for senior and postgraduate students that the attendance of tutorial session is not compulsory. But it is essential that they are able to solve all the tutorial questions. They are encouraged to attempt the tutorial questions by themselves, individually or in small groups.

Assignments: The assignments enable students to apply various methods to qualitatively and quantitatively analyse and interpret the fundamentals of optical communication systems. The assignments will be marked and returned as feedback to students for assessing their progress in understanding and learning course materials. Note that the assignments are compulsory and contribute to 15% of the final marks.

Laboratory work: The laboratories provide the student with 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 Wavelength Division Multiplex System

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. The attendance of each laboratory session will be recorded by the lab demonstrator. 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 is submitted at the time you do the next experiment or by the end of Week 13.

Note that the laboratory component contributes to 20% of the final marks. All labs are weighted equally. ***There will be no lab exemptions granted***.

The course delivery methods and course content address a number of core UNSW graduate attributes; these include:

a. The capacity for analytical and critical thinking and for creative problem-solving, which is addressed by the tutorial exercises, assignments and laboratory work.

b. The ability to engage in independent and reflective learning, which is addressed by lectures, tutorial exercises together with self-directed study.

Course Resources

Reference books

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

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.

Other Matters

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 Course and Teaching Evaluation and Improvement Process. 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.

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:
http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures
https://my.unsw.edu.au/student/atoz/ABC.html