Universidad de Alcalá

TEACHING GUIDE

Optical Communications

Degree in
Telecommunication Technologies Engineering (GITT)
Telecommunication Systems Engineering (GIST)

Universidad de Alcalá

Academic Year 2025/2026

4th Year - 1st Semester (GITT)

3rd Year - 2nd Semester (GIST)

Approved by the EPS School Board on June 16th, 2025

Universidad de Alcalá

TEACHING GUIDE

Course Name:	**Optical Communications**
Code:	**350033 (GITT)** **390004 (GIST)**
Degree in:	**Telecommunication Technologies Engineering (GITT)** **Telecommunication Systems Engineering (GIST)**
Department and area:	**Teoría de la Señal y Comunicaciones** **Signal Theory and Communications**
Type:	**Optional (Specialized) (GITT)** **Compulsory (GIST)**
ECTS Credits:	**6.0**
Year and semester:	**4th Year - 1st Semester (GITT)** **3rd Year - 2nd Semester (GIST)**
Teachers:	Coordinator: Pablo López Espí
Tutoring schedule:	To be known at the beginning of the term.
Language:	Spanish/English friendly

1. COURSE SUMMARY

Optical Communications is a subject focused on the integration and application of the previously delivered contents in Communications Theory and Digital Communications in the modern optical communication systems. The subject is also organized taking into account the evolution of the optical networks from the 70 up to the present.

The individual study of each element in the optical system is given firstly, and finally the overall behavior as well as the required planning processes form the signal quality and capacity are studied.

It is strongly recommended that the student has previously passed the subjects related to Digital Communications, Communication Theory, Fundamentals of Physics and Electronic Devices. The subject is also highly related with Telecommunication Systems.

2. SKILLS

Basic, Generic and Cross Curricular Skills.

This course contributes to acquire the following generic skills, which are defined in the Section 3 of the Annex to the Orden CIN/352/2009:

en_TR1 - Knowledge, understanding and ability to apply the necessary legislation during the development of the profession of Technical Engineer of Telecommunication and ease of handling specifications, regulations and mandatory rules.

en_TR2 - Knowledge of basic subjects and technologies that enables to learn new methods and technologies, as well as to provide versatility that allows adaptation to new situations.

en_TR3 - Aptitude to solve problems with initiative, decision making, creativity, and to communicate and to transmit knowledge, skills and workmanship, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.

en_TR4 - Knowledge for the achievement of measurements, calculations, evaluations, appraisals, examinations, studies, reports, planning of tasks and other similar works in its specific ambience of the telecommunication.

en_TR8 - Capacity of working in a multidisciplinary and multilingual team and of communicating, both in spoken and written language, knowledge, procedures, results and ideas related to telecommunications and electronics.

Professional Skills

This course contributes to acquire the following professional skills, which are defined in the Section 5 of the Annex to the Orden CIN/352/2009:

en_CST1 - Ability to build, operate and manage telecommunications networks, services, processes and applications, understood as systems for capturing, transporting, representing, processing, storing, managing and presenting multimedia information, from the point of view of transmission systems .

en_CST2 - Ability to apply the techniques on which telecommunication networks, services and applications are based, both in fixed and mobile environments, personal, local or at a great distance, with different bandwidths, including telephony, broadcasting, television and data, from the point of view of transmission systems.

Learning Outcomes

After succeeding in this subject the students will be able to:

RA1. Describe the light guidance in an optical fibber, its transmission properties and the local and International regulations and recommendations.

RA2. Identify the main components of an optical communication system and their specifications.

RA3. Describe the light emission, detection and processing technologies.

RA4. Characterize the passive optical components and their properties and advantages.

RA5. Be able to calculate an optical communications system in a wavelength multiplexing and optical amplification case.

RA6. Have the theoretical and practical basis about the measurement of optical devices and networks.

3. CONTENTS

Contents Blocks	Total number of hours
Module 1: Optical guides. Cabling and connections Fibber optic communications advantages. Properties of the optical fibbers. Light Propagation: ray and modal theories. Attenuation and dispersion. Optical Windows. Manufacturing and cabling optical fibbers. Connectors and splices.	8
Module 2: Optical emitters and detectors Light and matter interactions. Semiconductors band theory. Semiconductor light sources. LED and Laser diodes. Properties of the laser emitters. Single-mode lasers. Fundamentals of light absorption. Photo detection using diodes. PIN and APD diodes. Efficiency and Bandwidth.	6
Module 3: Photonic devices Properties of the passive devices: Attenuators, couplers, optical dividers, dispersion compensators and optical modulators.	6
Module 4: Optical amplification and WDM Two levels optical amplifier. Erbium Doped fibber Amplifier: gain and noise figure. ITU Wavelength Division Multiplexing grid. Parts of a DWDM system.	6
Module 5. Design of an optical communication system. Typical structure of an optical communication system. Power and rise time budgets. WDM design. GPON networks.	2

Laboratory Program	Hours
P1. Light emitters characterization. Misalignment in connections.	2
P2. Couplers and dividers properties. WDM fundamentals	2
P3. Optical splices	2
P4. Optical measurements using and OTDR.	2
P5. Communications between PC using optical fibber. Rise time Budget.	2
P6. Light sources measurement	2

Students must done laboratory exercises on the basis of 2-3 student per group.

Problem Lessons

Problem solving lesson will be delivered to small groups. After theoretical lessons, 16 hours for problems are scheduled, mainly focused on module 5 topics.

4. TEACHING - LEARNING METHODOLOGIES. FORMATIVE ACTIVITIES.

4.1. Credits Distribution

Number of on-site hours:	58 hours (56 hours on-site +2 exams hours): 28 hours for Theory Lessons 12 hours for laboratory experiments 16 hours for problem solving lessons 2 hours for assessments.
Number of hours of student work:	92
Total hours	150

4.2. Methodological strategies, teaching materials and resources

The teaching strategy of the course is divided into 3 sections: classroom learning, learning in small groups and finally the working sessions in the laboratory.

Sessions of large group in the classroom:

Working sessions in the classroom, in large groups, will consist of lectures where the main concepts of the theory of circuits will be presented. The aim is to introduce students to the theoretical foundations of circuit analysis in a guided and reflective way. The understanding of these concepts will culminate with the use of them in both the laboratory and the problem solving sessions in small groups.

Teaching materials will be essential to create reflective learning environments, where students and teachers can undertake a critical analysis that allows the student to autonomously relate concepts.

The order of presentation of the contents will evolve from the simple to the complex, in order to avoid a high degree of abstraction that might cause a student lack of interest in the course. In any case, it is very convenient, during the working sessions in the classroom, to establish linkages with other subjects in the curriculum, and to provide possible experience on the contents, which will help to attract students' attention and will encourage their interest in the subject.

Sessions of small groups in the classroom:

These small group solving problems lessons are focused on giving the students the tools to face the resolution of optical communications planning problems.

Student participation is a key factor. The lessons intend to create a systematic approach to solve this kind of problems: previous study, best solution planning and discussion of the problem solution.

Sessions of small groups in the Laboratory:

Laboratory practice will be organized into groups. The objective is that the student may test, using the experiments and lab guides, the main theoretical ideas of the subject.

Lab guide should be studied before and some previous questions may be answered by the students.

After the lab experiment, every team must give to the teacher a report about the practice development and conclusions.

5. ASSESSMENT: procedures, evaluation and grading criteria

Preferably, students will be offered a continuous assessment model that has characteristics of formative assessment in a way that serves as feedback in the teaching-learning process.

5.1. PROCEDURES

The evaluation must be inspired by the criteria of continuous evaluation (Learning Assesment Guidelines, LAG, art 3). However, in compliance with the regulations of the University of Alcalá, an alternative process of final evaluation is made available to the student in accordance with the Learning Assesment Guidelines as indicated in Article 10, students will have a period of fifteen days from the start of the course to request in writing to the Director of the Polytechnic School their intention to take the non-continuous evaluation model adducing the reasons that they deem convenient. The evaluation of the learning process of all students who do not apply for it or are denied it will be done, by default, according to the continuous assessment model. The student has two calls to pass the subject, one ordinary and one extraordinary.

Ordinary Call

Continuous Assessment:

Full details about contents and scheduling will be given in the subject presentation. The main assessment tools will be:

1. Intermediate evaluation assessment (PEI): Multiple choice and short questions about the different topics.
2. Laboratory skills (PL): Group reports and questions about laboratory experiments.
3. Final evaluation assessment (PEF): Problem resolution about optical systems planning.

Students must attend 100% of the laboratory sessions and deliver the corresponding reports to all laboratory practices. Recovery sessions will be enabled for those students who have not attended any of the sessions and justify it documentary.

The students, as a group, will deliver the reports of the laboratory practices following the established schedule. These practices will be evaluated by the professor responsible for the laboratory group, to assess if the objectives indicated in the script of the same have been met.

Assessment through final exam:

In the case of evaluation by means of a final exam, the evaluation elements to be used will be the following:

Final evaluation assessment including problem resolution about optical systems planning and theory and practical assessment about measurement techniques and results interpretation.

Extraordinary Call

The procedure will be the same as that described for the assessment by means of a final exam in the ordinary call.

5.2. EVALUATION

EVALUATION CRITERIA

The assessment criteria measure the level in which the competences have been acquired by the student. For that purpose, the following are defined::

CE1. Knowledge of the light guidance and the transmission properties as well as the national and International recommendations and Laws

CE2. Knowledge of the different devices that an optical communication system comprises and their main properties.

CE3. Knowledge of the light emission and detection methods, technologies, and devices.

CE4. Knowledge of the design, development and maintenance techniques and methods in optical systems using WDM and Optical Amplification.

CE5. Knowledge of the measurement devices and techniques of optical networks and components.

GRADING TOOLS

The work of the student is graded in terms of the assessment criteria above, through the following tools:

1. Ordinary call

- Intermediate Evaluation Assessment (PEI): 35%
- Laboratory Skills (PL): 35%.
    - Experiment Reports: 15%
    - Laboratory Assessment 20%.
- Final Evaluation Assessment (PEF): 30%.

2. Extraordinary call.

- Laboratory question Assessment (20%)
- Final assessment (PEF) (80%)

GRADING CRITERIA

In the ordinary call-continuous assessment the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR1-TR3, CST1,2	RA1-RA5	CE1-CE4	PEF	30%
TR1-TR3, CST1,2	RA1-RA5	CE1-CE4	PEI	35%
TR4,TR8, CST1,2	RA6	CE5	PL	35%

In the ordinary call-final evaluation and in the extraordinary call, the relationship between the competences, learning outcomes, criteria and evaluation instruments is as follows.

Skill	Learning Outcomes	Evaluation criteria	Grading Tool	Contribution to the final mark
TR1-TR3, CST1,2	RA1-RA5	CE1-CE4	PEF	80%
TR4,TR8, CST1,2	RA6	CE5	PL	20%

Extraordinary call

In the case of the extraordinary call, the same percentages that have been established in the case of the evaluation by means of a final exam will be maintained, giving the option of making the PL or maintaining the mark obtained in the EL (continuous evaluation). In any case, the PL will be made by those students who have not done it in the final exam option in the ordinary call.

The teaching-learning methodology and the evaluation process will be adjusted when necessary, with the guidance of the Diversity Support Unit, to apply curricular adaptations for students with specific needs.

6. BIBLIOGRAPHY

6.1. Basic Bibliography

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6.2. Additional Bibliography

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Disclosure Note

During the evaluation tests, the guidelines set out in the Regulations establishing the Rules of Coexistence of the University of Alcalá must be followed, as well as the possible implications of the irregularities committed during said tests, including the consequences for committing academic fraud according to the Regulation of Disciplinary Regime of the Students of the University of Alcalá.