# COURSE OUTLINE

## (1) GENERAL

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|---|---|---|---|
| **SCHOOL** | OF SCIENCES | | |
| **ACADEMIC UNIT** | PHYSICS DEPARTMENT | | |
| **LEVEL OF STUDIES** | GRADUATE | | |
| **COURSE CODE** | M423 | **SEMESTER** | 2 |
| **COURSE TITLE** | Telecommunication Principles | | |

| **INDEPENDENT TEACHING ACTIVITIES** *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits* | **WEEKLY TEACHING HOURS** | **CREDITS** |
|---|---|---|
| | 5 | 8 |
| | | |
| | | |
| *Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).* | | |

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|---|---|
| **COURSE TYPE** *general background, special background, specialised general knowledge, skills development* | Specialised general knowledge |
| **PREREQUISITE COURSES:** | - |
| **LANGUAGE OF INSTRUCTION and EXAMINATIONS:** | Greek |
| **IS THE COURSE OFFERED TO ERASMUS STUDENTS** | YES |
| **COURSE WEBSITE (URL)** | www.telecomlab.gr/SHT/m423<br>http://courses.cn.ntua.gr/course/view.php?id=29 |

## (2) LEARNING OUTCOMES

**Learning outcomes**

*The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.*

*Consult Appendix A*

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and Appendix B*
- *Guidelines for writing Learning Outcomes*

This course aims to introduce postgraduate students to the concepts of Telecommunications and the principles of designing communications networks. After successful completion of the course, students will:

- Understand the structure and operation of modern communication networks and, above all, local networks such as Ethernet and the Internet.
- Implement and solves simple queuing models (M/M/1, M/M/m/N, M/G/1) to analyze the performance of queuing systems.
- apply the above models in particular to communication networks to determine their performance with measures such as: probability of blocking in telephone exchanges, probability of packet loss and transit delay in routers, average throughput and average information transfer time in local networks.
- Size the network elements (nodes, links) based on the intensity of the passing traffic and the desired performance (delay, probability of blocking/losses)

- Understand and applies the basic routing algorithms in networks (Link state – Dijkstra, Distance Vector – Bellman-Ford) and the basic Internet routing protocols (RIP, OSPF, BGP).
- Know basic telecommunication concepts and parameters
- Be able to analyze signals in the time and the frequency domain
- Know the stages of a telecommunications system and factors that influence its performance.
- Be able to comprehend and compare basic modulation methods
- Understand the structure and operation of communications networks in accordance with the OSI standard
- Have acquired the ability to study bibliography for modern telecommunication research topics and will be able to write and present a scientific paper "Survey Paper".

**General Competences**

*Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?*

| | |
|---|---|
| *Search for, analysis and synthesis of data and information, with the use of the necessary technology* | *Project planning and management* |
| *Adapting to new situations* | *Respect for difference and multiculturalism* |
| *Decision-making* | *Respect for the natural environment* |
| *Working independently* | *Showing social, professional and ethical responsibility and sensitivity to gender issues* |
| *Team work* | *Criticism and self-criticism* |
| *Working in an international environment* | *Production of free, creative and inductive thinking* |
| *Working in an interdisciplinary environment* | *……* |
| *Production of new research ideas* | *Others…* |
| | *…….* |

Search, analysis and synthesis of data and information, using the necessary technologies. Autonomous work. Production of new research ideas. Production of free, creative and inductive thinking

## (3) SYLLABUS

- Introduction to the architecture and protocols of communication networks
- Elements of Probability Theory - The basics of probability theory are gleaned, as a background for expectancy theory
- Elementary waiting theory - Simple waiting models are defined and analyzed: M/M/1, M/M/m, M/M/m/m, M/M/m/N, as well as M/G/1. The basic Erlang types (B, C) are derived and applied to examples of performance analysis and dimensioning of simple Internet switchboards and routers.
- Local Area Networks - A general introduction and taxonomy of local computer networks is given. Ethernet and token ring networks are presented and analyzed in more detail.
- The TCP/IP protocol stack - The main functional characteristics of the Internet protocol stack are presented, namely the Network (IP), Transport (TCP, UDP) and Application (HTTP, RTP) layers.
- Internet Topics - The basic functionality of the Internet Protocol (IP) is summarized and addressing topics, such as DHCP, NAT and classful and classless routing, are covered in particular. The main categories of routing algorithms (Link-state and Distance Vector) and their main "representatives" (Dijctra and Bellman-Ford) are examined. The most

common routing protocols on the Internet are also presented: RIP and OSPF, for intra-domain routing and BGP, for inter-domain routing. Finally, broadcast routing techniques are mentioned routing) and multicast routing•

- Telecommunication System Structure
- Signal Attenuation/Amplification
- Spectral signal analysis
- Information Theory
- Noise and channel degradation factors
- Basic digital modulation techniques
- Open systems interconnection
- New trends in the telecommunications (uwb, massive outside, lifi, cognitive radios, IoT, etc.)

## (4) TEACHING and LEARNING METHODS - EVALUATION

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|---|---|
| **DELIVERY**<br>*Face-to-face, Distance learning, etc.* | Face to face |
| **USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY**<br>*Use of ICT in teaching, laboratory education, communication with students* | Communication with students through email and lesson's web page |
| **TEACHING METHODS**<br>*The manner and methods of teaching are described in detail.*<br>*Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.*<br><br>*The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTS* | |
| **STUDENT PERFORMANCE EVALUATION**<br>*Description of the evaluation procedure*<br><br>*Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other*<br><br>*Specifically-defined evaluation criteria are given, and if and where they are accessible to students.* | Telecommunication concepts (60%)<br>• Problem solving (20%)<br>• Essay/Report (30%)<br>• Public presentation (25%)<br>• Written or/and oral exams (25%)<br>Principles of Communication Networks (40%)<br>Written final exam<br>• short answer questions (30%)<br>• problem solving (70%)<br><br>The course is successfully completed when the grade in the individual assessments is at least pass. |

| *Activity* | *Semester workload* |
|---|---|
| Lectures | 39 |
| Study of bibliography | 22 |
| Essay writing | 32 |
| Self-Study | 30 |
| Study | 25 |
| Written Exams | 26 |
| Interactive teaching | 20 |
| Practice | 6 |
| Written Exams | 39 |
| Course total | ***200*** |

## (5) ATTACHED BIBLIOGRAPHY


Modern Digital and Analog Communication (The Oxford Series in Electrical and Computer Engineering) 5th Edition by B.P. Lathi , Zhi Ding , 2018

Gu, Q. (2006). *RF System Design of Transceivers for Wireless Communications*. Dordrecht: Springer-Verlag New York Inc.

Morreale, P., & Terplan, K. (2010). *CRC handbook of modern telecommunications*. Boca Raton, FL: Taylor & Francis.

Συστήματα Επικοινωνίας, Έκδοση: 5η Έκδοση/2010, Συγγραφείς: Simon Haykin, Michael Moher, ISBN: 978-960-7182-68-5, Διαθέτης (Εκδότης): ΠΑΠΑΣΩΤΗΡΙΟΥ Α.Ε.

Jean Walrand, *Communication Networks*, 2nd edition, Mc Graw Hill1, 1998.

Kurose/Ross, Δικτύωση Υπολογιστών - Προσέγγιση από πάνω προς τα κάτω, 6η έκδοση, Γκιούρδας 2013 (Πρωτότυπη έκδοση: Computer Networking, Pearson 2013)

Slides - Lesson Notes

Peer-reviewed journals, articles, book chapters and open access content

**https://www.scopus.com/**

**https://www.sciencedirect.com/**

**https://link.springer.com/**

**https://www.tandfonline.com/**

**https://www.hindawi.com/journals/**

**https://www.researchgate.net/**