

*Course syllabus*

# Moderna trådlösa system - 5G och dess efterföljare

## Modern Wireless Systems - 5G and Beyond

**EITP30, 7,5 credits, A (Second Cycle)**

**Valid for:** 2023/24

**Faculty:** Faculty of Engineering, LTH

**Decided by:** PLED C/D

**Date of Decision:** 2023-04-18

### General Information

**Main field:** Communication Systems.

**Elective for:** C4-ks, D4, E4-ks, MSOC2, MWIR2

**Language of instruction:** The course will be given in English

### Aim

This course considers the latest technology development in wireless communications, including 5G and LTE systems. These systems are high performing and represent "state-of-the-art" in many aspects. A central part of this course is to give detailed knowledge of the communication methods that are used in down-link and in up-link, respectively, that make these high performance increases possible. This course also includes trends for future system solutions. The aim of this course is to give good knowledge concerning principles, concepts, functioning, performance and limitations for such systems for mobile communications.

### Learning outcomes

*Knowledge and understanding*

For a passing grade the student must

- be able to show a significantly deeper knowledge concerning modern systems for mobile communications
- be able to critically analyse and describe modern systems for mobile communications from an overall perspective

### *Competences and skills*

For a passing grade the student must

- be able to identify, formulate, and handle complex problems within the area of multi-user communication
- be able to suggest technical solutions based on 5G/LTE concepts that satisfy given performance requirements
- be able to independently work in a creative way with advanced projects, and also orally and in writing clearly present, motivate and discuss obtained conclusions

### *Judgement and approach*

For a passing grade the student must

- be able to show ability to make judgements with respect to relevant scientific, social, and ethical aspects

## Contents

The course will contain the following topics:

1. Evolution of wireless communication from 1G up to 5G
2. 5G Standardization and spectrum allocation
3. Introduction to OFDM: single-carrier communication VS multi-carrier communication
4. The role of FFT in OFDM signals generation: advantages and disadvantages
5. Multipath propagation effects onto OFDM signals: the importance of cyclic prefix insertion
6. Channel estimation in OFDM systems
7. Introduction to LTE
8. LTE Signals' structure
9. LTE Channel-dependent scheduling
10. LTE Radio-interface architecture
11. LTE Transport-channel processing
12. LTE Physical-layer control signaling
13. LTE Initial access overview
14. LTE Random access channel overview
15. A smooth transition to 5G/NR from LTE (5G/NR Introduction)
16. 5G/NR Signals' structure
17. 5G/NR Radio-interface architecture
18. 5G/NR Transport-channel processing
19. 5G/NR Multi-antenna transmission and beam management
20. 5G/NR Physical-layer control signaling
21. 5G/NR Initial access overview
22. Successful examples of future applications in 5G/NR
23. Vision and thoughts towards 6G
24. Professionals from leading companies talk about the development of wireless technologies

## Examination details

**Grading scale:** TH - (U,3,4,5) - (Fail, Three, Four, Five)

**Assessment:** Written examination (5hours), laboratory work report, and oral presentation of the laboratory work. Approved laboratory work is a requirement to be allowed to enter the written examination.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

**Parts**

**Code:** 0122. **Name:** Written Exam.

**Credits:** 5,5. **Grading scale:** TH. **Assessment:** Approved exam. **Contents:** Written exam

**Code:** 0222. **Name:** Computer Laboratory Sessions.

**Credits:** 2. **Grading scale:** UG. **Assessment:** Computer lab. **Contents:** Students should complete some tasks during the computer based laboratory classes.

**Admission**

**Assumed prior knowledge:** ETT051/EITG05 Digital Communications. EITN75

Wireless System Design Principles

**The number of participants is limited to:** No

**Reading list**

- Erik Dahlman, Stefan Parkvall, and Johan Sköld: 5G NR: The Next Generation Wireless Access Technology. Academic Press, 2018, ISBN: 9780128143230.
- E. Dahlman, S. Parkvall, and J. Sköld: 4G: LTE-Advanced Pro and the Road to 5G. Academic Press, 2016, ISBN: 9780128045756.

**Contact and other information**

**Course coordinator:** Aleksei Fedorov, [aleksei.fedorov@eit.lth.se](mailto:aleksei.fedorov@eit.lth.se)

**Course homepage:** <http://www.eit.lth.se/course/eitp30>

**Further information:** With less than 16 participants, the course may be given with reduced teaching and more self studies.