

# ES96T-15 Advanced Wireless Systems and Networks

**22/23**

**Department**

School of Engineering

**Level**

Taught Postgraduate Level

**Module leader**

Subhash Lakshminarayana

**Credit value**

15

**Module duration**

10 weeks

**Assessment**

40% coursework, 60% exam

**Study location**

University of Warwick main campus, Coventry

---

## Description

### Introductory description

ES96T-15 Advanced Wireless Systems and Networks

[Module web page](#)

### Module aims

To understand the performance of different wireless networks in modern cities, in the context of: functionality, architecture, resource allocation and mutual interaction. The systems considered include legacy 1G/2G/3G systems, as well as current 4G/5G/IoT systems.

### Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- 1 Introduction to Wireless Networks and its History
- 2 Revision of Single Link Communications, including Link Adaption
- 3 Multiple Access Techniques

- 4 Legacy 1G-2G Systems
- 5 3G Cellular Network
- 6 4G Cellular Network
- 7 Radio Resource Management
- 8 Heterogeneous Networks
- 9 Stochastic Geometry
- 10 Traffic Models
- 11 Large-Scale Network Simulation
- 12 Wi-Fi Networks
- 13 Energy and Cost Metrics
- 14 5G and Future Trends

## **Learning outcomes**

By the end of the module, students should be able to:

- Explain how channels adapt to real world conditions to achieve Shannon capacity subject to a certain quality of service demand.
- Analyse the achievable multiple user capacity of different multiple access schemes.
- Design efficient networks in terms of energy and/or cost.
- Acquire in depth knowledge and evaluate the architecture of legacy 1G/2G/3G, as well as current 4G/5G/IoT cellular and Wi-Fi networks.
- Analyse different cell planning patterns for different cellular network generations and traffic service demands.
- Design networks and analyse their performance through modelling their mutual interference interactions using simulation software and random graph theory for different network deployments.

## **Indicative reading list**

1. Heterogeneous Cellular Networks, R. Hu and Y. Qian, Wiley, 2013
2. 4G LTE Networks: LTE for UMTS: OFDMA and SC-FDMA Based Radio Access, H. Holma and A. Toskala, Wiley, 2009
3. Heterogeneous Cellular Networks: Theory, Simulation, and Deployment, X. Chu and D. Lopez-Perez, and Y. Yang and F. Gunnarsson, Cambridge University Press, 2013
4. Mathematical Modeling: Stochastic Geometry for Wireless Networks, M. Haenggi, Cambridge University Press, 2013
5. Radio Resource Management for Mobile Traffic Offloading in Heterogeneous Cellular Networks, Y. Wu and L. Qian, Springer, 2017

## **Subject specific skills**

Understanding of the evolution of cellular communication systems. Latest trends in 5G/6G cellular networks and IoT networks.

## **Transferable skills**

Knowledge of how wireless communication systems work today and how the latest research trends in this field.

---

## Study

### Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Other activity	1 hour (1%)
Private study	119 hours (79%)
Total	150 hours

### Private study description

Guided Independent Learning

### Other activity description

1x1 hour Revision Class

## Costs

No further costs have been identified for this module.

---

## Assessment

You must pass all assessment components to pass the module.

### Assessment group D4

	Weighting	Study time
Assignment	40%	
Essay and simulation assignment (8 pages)		
Online Examination	60%	
QMP Examination		
~Platforms - AEP,QMP		

---

## Weighting

## Study time

- Online examination: No Answerbook required

## Feedback on assessment

Marked assignments with comments.

[Past exam papers for ES96T](#)

---

## Availability

### Pre-requisites

To take this module, you must have passed:

- All of
  - [ES335-15 Communications Systems](#)
  - [ES3C5-15 Signal Processing](#)

## Courses

This module is Core for:

- Year 1 of TESA-H641 Postgraduate Taught Communications and Information Engineering

This module is Optional for:

- Year 4 of UESA-H116 MEng Engineering with Exchange Year
- Year 5 of UESA-H115 MEng Engineering with Intercalated Year
- Year 1 of TCSA-G5PA Postgraduate Taught Data Analytics
- Year 5 of UESA-H607 Undergraduate Electrical and Electronic Engineering with Intercalated Year

This module is Option list A for:

- Year 4 of UESA-H63X MEng Electronic Engineering
- Year 5 of UESA-H63Y MEng Electronic Engineering with Intercalated Year
- Year 4 of UESA-H114 MEng Engineering
- Year 4 of UCSA-G408 Undergraduate Computer Systems Engineering
- Year 5 of UCSA-G409 Undergraduate Computer Systems Engineering (with Intercalated Year)
- Year 4 of UESA-H606 Undergraduate Electrical and Electronic Engineering MEng