Module Title: 4C4 Wireless Communications

Code: EE4C04

Level: Senior Sophister (Optional module)

Credits: 5

Lecturer(s): Assist. Prof. Nicola Marchetti (marchetn@tcd.ie)

Module Organisation

<table>
<thead>
<tr>
<th>Semester</th>
<th>Start Week</th>
<th>End Week</th>
<th>Associated Practical Hours</th>
<th>Lectures</th>
<th>Tutorials</th>
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<td>Per week</td>
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<td>12</td>
<td>4</td>
<td>33</td>
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Total Contact Hours: 48

Module Description
This module will expand on the third-year 3C5 Telecommunications module by applying communication principles to the analysis and design of wireless telecommunication networks. In this module, the performance evaluation of networks through analytical, simulation and experimental methods will be discussed. One will also study technologies and protocols for wireless and mobile networks, including wireless local area networks, cellular systems and ad hoc networks. Finally, some applications of complex system science to communication networks will be studied. The module explores fundamental concepts in wireless communications through the study of current and emerging wireless network technologies.

Learning Outcomes
On completion of this module the student will be able to:

1. Design simulation experiments, develop traffic models, develop network models, and evaluate the performance of queues, local area networks, internetworks, and protocols;
2. Analyse the use of digital modulation and wireless communication methods in personal, local and wide area wireless and mobile networks;
3. Assess the operation of medium access protocols in contemporary wireless standards for personal area networks, local area networks, and metropolitan area networks, and discuss co-existence between different types of systems;
4. Explain how complex systems science tools such as complexity metrics, cellular automata and network science can be applied to communication networks.
Module Syllabus
- Network performance evaluation
- Introduction to queuing theory
- Network traffic models: Poisson arrival process, self-similarity
- Wireless channel impairments and mitigation techniques, overview of wireless networks
- Wireless local area networks: IEEE 802.11/5G
- Wireless personal area networks: IEEE 802.15, Zigbee and Bluetooth
- Wide-area wireless and mobile networks: 2G/3G/4G/5G
- Cognitive radio and dynamic spectrum access
- Other wireless networks
- Application of complex systems science to communication networks: complexity metrics, cellular automata, network science

Associated Laboratory/Project Programme
Students are required to complete a project focusing on emerging topics in wireless communications and networks, such as 5G mobile broadband systems, machine-to-machine communication, or cognitive networks. Two software-based lab sessions will demonstrate some of the concepts covered in class.

Recommended Text(s)

Teaching Strategies
The module is taught using a combination of lectures and tutorials.

Assessment
Continuous assessment will be adopted. The final marks for the module will be calculated according to:
- A project (10%);
- Two in-class quizzes (20% each);
- End-of-year formal written two-hour examination (50%).