<table>
<thead>
<tr>
<th><strong>Module Code</strong></th>
<th>CS7NS2</th>
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<tbody>
<tr>
<td><strong>Module Name</strong></td>
<td>Internet of Things</td>
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<tr>
<td><strong>ECTS weighting</strong></td>
<td>5</td>
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<tr>
<td><strong>Term</strong></td>
<td>MT</td>
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<tr>
<td><strong>Contact Hours</strong></td>
<td>2 lecture hours per week</td>
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<tr>
<td><strong>Module Personnel</strong></td>
<td>Assistant Professor Jonathan Dukes</td>
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| **Learning Outcomes** | On successful completion of this module a student will be able to:  
NS2LO1 Design, implement and debug application firmware for a low power hardware platform using standard and emerging frameworks, operating systems and tools, while demonstrating awareness of resource limitations, real-time constraints and performance.  
NS2LO2 Design, implement and evaluate appropriate wireless communication strategies, using existing technologies and standards, for an Internet-connected multi-sensor/actuator system with a limited energy budget.  
NS2LO3 Employ existing middleware solutions, architectural principles and platforms to construct a small-scale prototype Internet of Things application exhibiting multi-node sensing, actuation and device management.  
NS2LO4 Critically assess hardware, software and communication technologies and architectures relating to Internet of Things applications with respect to performance, applicability, compatibility, reliability and security.  
NS2LO5 Critically assess the value and appropriateness of existing and proposed Internet of Things applications, with an appreciation of the potential for “hype”. |
| **Module Learning Aims** | In this module, students will explore the prevailing vision for an Internet of Things in a practical, pragmatic manner. The foundation of the module will be the end-to-end implementation of a prototype Internet of Things application, from the development of firmware for a low-power, constrained platform, to the integration of multiple “things” in a practical application.  
Reflecting this end-to-end approach, the module will explore relevant hardware platforms and firmware development techniques, tools and frameworks to support the implementation of embedded “things”. Following on from this, the module will consider relevant wireless communication technologies, as well as strategies and standard protocols for connecting “things” to the Internet. Lastly, relevant platforms and middleware for discovering and managing things and combining their functionality in practical applications will be explored.  
Underlying themes will include the need to consider the constraints of low-power devices and communication technologies in particular, as well as issues such as scalability, reliability and security. Finally, while exploring the prevailing vision for an Internet of Things, students will be encouraged to recognise that predictions relating to new technologies often follow a “hype cycle”. Furthermore, the module will seek to emphasise that the “Internet of Things” is not a new technology but rather a vision built on the application of concepts and technologies in areas such as wireless sensor networks and embedded systems, among others. |
| **Module Content** | Specific topics addressed in this module include:  
- Introduction to the Internet of Things: definition, origins and scope |
| Assessment Details | Low-power, embedded architectures and platforms  
|                   | Programming for low energy consumption  
|                   | Embedded operating systems and SDKs (e.g. Contiki, MyNewt, mbed)  
|                   | Low-power, wireless communication technologies (e.g. Bluetooth Low Energy, LoRaWAN)  
|                   | Architectural models and protocols for Internet connectivity (e.g. 6Lo*)  
|                   | Application protocols and data representation (e.g. CoAP, MQTT, CBOR)  
|                   | Resource discovery  
|                   | Management and maintenance (e.g. LWM2M)  
|                   | Trust, security and privacy  

**Coursework 100%**

Coursework will be composed of a practical group project (70%) and two smaller, individual exercises (15% each).

The group project mark will be composed of a jointly assessed component (50% out of 70%) and an individually assessed component (20% out of 70%).