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| **A GENERAL INFORMATION**  *Please complete a module specification for each module included in this application for validation of provision* | |
| **1** | **Module Title** |
|  | Embedded Systems Development |
| **2** | **Module Code**  *(enter code or NEW)* |
|  | SITS 600085  AIS 08026 |
| 3 | **Module Level** |
|  | 6 |
| 4 | **Portfolio/Programme**  *(the host portfolio/programme for this module)* |
|  | Computer Science |
| 5 | **Credit Value** |
|  | 20 |
| 6 | **Module Leader**  *(name and email)* |
|  | Dr Yongqiang Cheng  Y.Cheng@hull.ac.uk |
| 7 | **Total Number of Learning Hours**  *(normally 10 hours per credit)* |
|  | 200 |
| 8 | **Pre-Requisite**  *(where applicable)* |
|  | 08149 Electronics and Interfacing |
| 9 | **Co-Requisite**  *(where applicable)* |
|  | N/A |
| 10 | **Post-Requisite**  *(where applicable)* |
|  | N/A |

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| 11 | **Number Attending Module**  *(anticipated)* |
|  | 15 |
| 12 | **Trimester**  *(please tick as many as appropriate)* |
|  | |  |  | | --- | --- | | Trimester 1 – T1 | X | | Trimester 2 – T2 |  | | Trimester 3 – T3 |  | |
| 13 | **Module Delivery Mode**  *(please tick as many as appropriate)* |
|  | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Face to Face | X | Online | X | Collaborative |  | | Blended | X | Distance Taught |  | Placement |  | |  | | | | Year/Semester Abroad |  | |
| 14 | **Mandatory Constraints**  *(e.g. Disclosure and Barring Service Check)* |
|  | N/A |
| 15 | **Other portfolios/programmes this module is validated to**  *(Please include Portfolio name/Programme Name)* |
|  | N/A |
| **B MODULE DESIGN** | |
| 16 | **Module Aims** *(200 words max)*  *As a guide you should include 3 – 4 module aims. Please see* [*A Guide to Writing Programme and Module Level Learning Outcomes at the University of Hull*](https://share.hull.ac.uk/Change/Curriculum2016/SitePages/AcaHandbookP1.aspx?RootFolder=%2FChange%2FCurriculum2016%2FC2016_Displine_Meetings%20June%2FGuide%20to%20writing%20Aims%20and%20Learning%20Outcomes&FolderCTID=0x012000ED2E58E06CB2F34283B9976F10B16E8F&View=%7bEE4B755C-269E-4110-BC1F-E3BA3F521E12%7d) *for further information* |
|  | The module gives students the experience of developing software on an embedded device. It also gives a good grounding on the means by which a peripheral device can be connected to a processor.  The aims of the module are to:   * Develop the students’ understanding and development of techniques used in developing software for resource constrained platforms. * Equip students with the knowledge and understanding that allows them to choose techniques most appropriate to solving embedded computing and hardware interfacing issues. * Provide the students with opportunities to acquire practical skills in creating and deploying software for embedded devices. |

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| 17 | **Module Learning Outcomes**  *As a guide you should include 3 – 4 module learning outcomes. Please see* [*A Guide to Writing Programme and Module Level Learning Outcomes at the University of Hull*](https://share.hull.ac.uk/Change/Curriculum2016/SitePages/AcaHandbookP1.aspx?RootFolder=%2FChange%2FCurriculum2016%2FC2016_Displine_Meetings%20June%2FGuide%20to%20writing%20Aims%20and%20Learning%20Outcomes&FolderCTID=0x012000ED2E58E06CB2F34283B9976F10B16E8F&View=%7bEE4B755C-269E-4110-BC1F-E3BA3F521E12%7d) *for further information.* |
|  | *On successful completion of this module, students will be able to:*   |  |  | | --- | --- | |  | **Learning Outcome description** | | **LO1** | Critically appraise future trends in embedded hardware platforms and software development. | | **LO2** | Construct and deploy software applications for constrained resource processors, using low level assembler and generating appropriately timed and sequenced signals for successful communication with external peripheral devices. | | **LO3** | Use available resources (datasheets and specifications) to design and create software which serves as driver for given hardware device and expose hardware behaviours via an appropriately designed Application Programmer Interface (API). | | **LO4** | Work within a team to create a fully functional embedded appliance that makes use of a number of different peripheral interfaces to deliver a consumer-ready product. | |
| 18 | **Module Indicative Content**  *Please provide up to 200 words which outline the key themes and topics to be included in this module* |
|  | This module explores in detail the fundamental mechanisms of program execution on a processor and how different processor architectures affect the way that software is made to execute on a device. Students create systems using low-level assembler before moving on to the creation of embedded solutions using a high-level programming language. During the practical work, the students create software that generates the requisite signals to interface to individual peripheral devices and build a driver architecture onto the fundamental behaviours that they implement.  The final practical deliverable is a complex device, which is created by a team of students. Each student must present and document the interface for one or more peripheral components, with the whole team contributing to the overall application code.  To this end, each student will create low-level driver code that will interface directly to hardware, before designing and implementing drivers that expose the device behaviours to an application. The students will then go on to a group development project where the device and their individual drivers are integrated into a single product. |
| 19 | **Module Learning and Teaching Methods and rationale for selection**  *Please provide up to 200 words which outline the teaching and learning methods and your rationale for their selection* |
|  | The taught content is delivered at the very start of the course in a concentrated examination of the fundamentals elements of an embedded processor. The rest of the content is delivered as a series of exercises which start with experimental coding at a very low level, before moving on to the use of a high level language in an embedded context. The students then use the techniques explored in the exercises to develop their own software interfaces to hardware, at first individually and then as part of a group working together to create an embedded device to a given specification. |
| 20 | **Breakdown of Teaching and Learning hours**  *Please refer to* [*QAA Explaining Contact Hours guidance*](https://share.hull.ac.uk/Change/Curriculum2016/SitePages/AcaHandbookP1.aspx) *for further information.* |
|  | |  |  | | --- | --- | | **Student time associated with the module** | **%** | | Guided independent study | 70 | | Placement/Study abroad |  | | Scheduled learning and teaching activities | 30 | | Total | 100 | |
| 21 | **Ethical issues, Risk and inclusivity**  *Universities research and develop modules which deal with issues that may be sensitive or involve ethical considerations. As with research, the duty of care extends to all involved in learning and teaching. Please highlight any relevant issues that relate to content, teaching methods and assessment and state how they are to be addressed (include evidence of support from relevant ethics committees and relevant risk assessments as appropriate).* |
|  | The consideration of ethical issues, risk and the inclusivity of the curriculum of this module fully comply with the standard approaches of the Department of Computer Science, which are described in the Programme Specification document. |
| **C MODULE ASSESSMENT** | |
| 22 | **Rationale for the assessment methods chosen**  *Maximum 200 words* |
|  | The use of an exam allows for a wide range of topics to be covered, but is also used as the basis of a number of scenario based questions which allow the students to show their design skills. The written questions in the exam allow the students to show their design skills in a specific scenario. The design and build project reinforces the taught content in a practical way and also allows the students to have experience of working directly with hardware and creating an integrated system as part of a team. |
| 23 | **Formative Assessments for this module** |
|  | |  |  | | --- | --- | |  | **Assessment type and title (where relevant)** | | **FA1** | Design report reviews. | |

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| 24 | **Summative Assessment for this module** | |
|  | |  |  |  |  | | --- | --- | --- | --- | |  | **Assessment type and title (where relevant)** | **%** | **LOs addressed** | | **SA1** | Exam with design question | 50 | 1-3 | | **SA2** | Group coursework: device development | 50 | 2-4 | | |
| 25 | **Module Re-assessment Method**  *(if different)* | |
|  | Written examination and design report with demonstration.  Partial reassessment applies with students being reassessed in the element they have failed. | |
| 26 | **Explanation for the Re-Assessment methods chosen**  *Maximum 200 words* | |
|  | The original assessments included a small group exercise. This reassessment will be an individual exercise that includes elements of the planning and exploration of issues around teamwork, but not relying on multiple team members - there being no guarantee of multiple students requiring reassessment. | |
| 27 | **Summative Re-assessment for this module** | |
|  | |  |  |  |  | | --- | --- | --- | --- | |  | **Assessment type and title (where relevant)** | **%** | **LOs addressed** | | **SA1** | Exam with design question | 50 | 1-3 | | **SA2** | Individual design report with demonstration: device development | 50 | 2-4 | | |
| **D MODULE RESOURCES** | | |
| 28 | **Indicative Reading List**  *(please refer to the University guidelines for Reading Lists)* | |
|  | **Essential** | Please see  <https://hull.rl.talis.com/index.html> |
| **Recommended** |  |
| **Background** |  |
| 29 | **Other Resources Required**  *(Please list any further resources that may be required for the successful delivery of this module).* | |
|  | PIC QL 200 development boards are used for the coursework in this module. | |