

Summary Information

Module Code	6004SEQR
Formal Module Title	Embedded Systems
Owning School	Computer Science and Mathematics
Career	Undergraduate
Credits	20
Academic level	FHEQ Level 6
Grading Schema	40

Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

Partner Teaching Institution

Institution Name
Oryx Universal College WLL

Learning Methods

Learning Method Type	Hours
Lecture	11
Workshop	33

Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
APR-PAR	PAR	April	12 Weeks
JAN-PAR	PAR	January	12 Weeks

SEP_NS-PAR	PAR	September (Non-standard start date)	12 Weeks
------------	-----	-------------------------------------	----------

Aims and Outcomes

Aims	To provide an overview of designing and engineering embedded systems, including high-level hardware architectures and software systems with references to architectures, communication and synchronisation. To investigate the development of a connected embedded system and appropriate support software services.
------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

After completing the module the student should be able to:

Learning Outcomes

Code	Number	Description
MLO1	1	Critically survey technologies and methods used in embedded systems design and development.
MLO2	2	Solve execution issues intrinsic to embedded architectures and develop software for embedded systems alongside other software systems.
MLO3	3	Appraise communications standards and techniques used in embedded systems.
MLO4	4	Critically evaluate operational issues in embedded and concurrent systems.

Module Content

Outline Syllabus	Embedded Systems: Basic Architectures / Issues-bare metal, superloops and real-time operating systems-interrupt-driven executionGPIO – Getting data in / out and electronic-software interfacing-basic related interfacing/electronics concepts-analogue-digital conversion and PWM-noise reduction/filteringMemory and storage: resource constrained systems-Programmer-centred memory management : stack, heap and global/statics-Smart pointers and automatic release / garbage collectionSerial over GPIO – SPI, I2C, flash/SD card storage-Bus systems and line arbitration / access-shared clock / asynchronous vs. synchronous systems-Hardware-support and bit-banged (software-defined) implementationsWiFi and Internet connectivity-common library and driver support-socket programming and stream parsing-RESTful server and smart client provisioning-Automatic update mechanisms Pattern-based embedded software design-Superloop and/vs Strategy / State / State Table / Scheduling-Façade / Proxy / Mediator / interfacingConcurrent vs. Serial execution-Liveness and Deadlock-Data Races and Atomicity
Module Overview	
Additional Information	This module broadens a Software Engineer's horizons to include system and software development for embedded systems, with consideration of the Internet of Things. Students are required to have considerable high-level programming knowledge by level 6; this will be expanded to consider working with lower-level architectural concerns and development software for "baremetal" systems.

Assessments

Assignment Category	Assessment Name	Weight	Exam/Test Length (hours)	Module Learning Outcome Mapping
Report	Embedded system	50	0	MLO1, MLO2
Centralised Exam	Examination	50	2	MLO3, MLO4

Module Contacts

Module Leader

Contact Name	Applies to all offerings	Offerings
David Lamb	Yes	N/A

Partner Module Team

Contact Name	Applies to all offerings	Offerings
--------------	--------------------------	-----------