

### Summary Information

Module Code	6504SDLBHG
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
Beaconhouse Group

### Learning Methods

Learning Method Type	Hours
Online	44

### Module Offering(s)

Display Name	Location	Start Month	Duration Number Duration Unit
JAN-PAR	PAR	January	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.
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**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-baremetal, 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
Technology	Embedded system	50	0	MLO1, MLO2
Exam	Examination	50	2	MLO3, MLO4

### Module Contacts

#### Module Leader

Contact Name	Applies to all offerings	Offerings

David Lamb	Yes	N/A
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**Partner Module Team**

Contact Name	Applies to all offerings	Offerings
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