Module Title:	Industrial Networks for Robotics
Language of Instruction:	English

Credits:	5

NFQ Level:	8

Module Delivered In	1 programme(s)

Teaching & Learning Strategies:	To validate the skills required to installation, configuration, and operationalise a medium-size routed and switched network

Module Aim:	A combination of lectures, class discussions, tutorials, practical's and demonstrations will be used. Particular emphasis will be placed on active learning including problem/project-based learning.

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Dissect, the Ethernet frame, construct network frames, packets and segments and observe their operation in detail on the wire.
LO2	Apply IPv6 addressing plans to networks using OSPFv3 and MP-BGP routing protocols and compare and classify IPv6 transition mechanisms.
LO3	Classify and discriminate on the role of mobile generation technologies as communications platforms to IIoT and Robotic devices.
LO4	Catogorise and contrast the particular protocols used for communication within Industrial Networks.
LO5	Identify how Software Defined Networks provides a programmable interface to simplify network automation tasks.

Pre-requisite learning	
Module Recommendations *This is prior learning (or a practical skill) that is recommended before enrolment in this module.*	
No recommendations listed	
Incompatible Modules *These are modules which have learning outcomes that are too similar to the learning outcomes of this module.*	
No incompatible modules listed	
Co-requisite Modules	
No Co-requisite modules listed	
Requirements *This is prior learning (or a practical skill) that is mandatory before enrolment in this module is allowed.*	
A level 7 Computer Networks module	

Module Content & Assessment

Indicative Content

1. Ethernet Deepdive
Ethernet Introduction, Medium Access, Ethernet Physical Layer, Data Link Layer, MAC & LLC Sublayers, Ethernet frame analysis.

2. Networks deep dive
Build Ethernet frames, Build IP packets, TCP/UDP Segments, Build Application payload data, Send packets, Extract packets, Analyse packets, Simple python scripts using scapy.

3. Internet Protocol version 6 (IPv6)
The structure of an IPv6 frame and address types, IPv6 prefix terminology, Configuration of IPv6 on a computer, Configuration of IPv6 in a Cisco Ethernet switch, Configuration of basic IPv6 in a Cisco Router, Basic IPv6 network testing procedures, IPv6 Address planning, IPv6 Multicast address, Applications for IPv6, IPv6 ND and SLAAC, IPv6 Address Resolution and redirection, Configuration static routes on IPv6 on Cisco devices, IPv6 best practice – inter-router links, IPv6 routing, OSPFv3, MP-BGP, Tunnelling transition mechanisms; 6in4 Tunnelling, Tunnel Broker, IPv6 Rapid Deployment (6rd)' Dual Stack Lite (DSlite), Lightweight 4o6 tunnel (lw4o6)' Transition mechanisms; NAT64, XLAT / 464LAT.

5. Mobile Technologies
Mobile communications evolution, Long Term Evolution (LTE), New Radio (NR), massive MIMO, Beamforming, mmWave, Next Generation RAN (NG-RAN), Non Orthogonal Multiple Access (NOMA), Successive Interference Cancellation (SIC), Superposition Coding (SC), Terahertz (THz) waves for 6G. Tactile networks.

6. Industrial Protocols
Categorise communications technologies used in Industrial Control Systems (e.g. Distributed Network Protocol 3 (DNP3), BACnet, Modbus, Modbus TCP, Profibus, DeviceNet, CANbus, Zigbee, Profinet).

7. SDN and network programmability
Data, Control, and Management Planes, SDN Controllers, North-Bound Interface (NBI), South-Bound Interface (SBI), OpenFlow, Mininet, RESTful APIs. Remote access python examples.

Assessment Breakdown	%
Continuous Assessment	25.00%
Practical	15.00%
End of Module Formal Examination	60.00%

Continuous Assessment

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Case Studies	n/a	1,3,4,5	25.00	n/a

No Project

Practical

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Practical/Skills Evaluation	n/a	1,2,5	15.00	n/a

End of Module Formal Examination

Assessment Type	Assessment Description	Outcome addressed	% of total	Assessment Date
Formal Exam	n/a	1,3,4,5	60.00	End-of-Semester

SETU Carlow Campus reserves the right to alter the nature and timings of assessment

Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lab/Lecture	Every Week	3.00
Independent Learning	Every Week	5.00
Practicals	Every Week	2.00
	Total Hours	10.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_EEROB_B	Bachelor of Engineering (Honours) in Robotics and Automated Systems	7	Mandatory