COMM C3601: Digital Communications

Module Title:	Digital Communications
Language of Instruction:	English

Credits:	5

NFQ Level:	7

Module Delivered In	3 programme(s)

Teaching & Learning Strategies:	(a) Teaching will be conducted using lectures, tutorials and practicals. (b) The Institute's VLE will be used to evaluate the students understanding of the basic concepts during each section using online quizzes. (c) At the end of each section, self-test tutorial question sheets will be issued to the students. They will have one week to complete these questions. Any difficulties arising from the self-test question sheets will be addressed in class or laboratory sessions. (d) At various stages of the module students will be directed to online materials and resources and will also have to conduct independent research on specific topics for purpose of completing practical exercises and assignments. (e) The practical laboratory sessions will offer the students hands on laboratory experience using real measurement and test equipment, experimental apparatus and computational software environments. These applied experiments will serve to reinforce the theoretical knowledge and understanding of real world systems.

Module Aim:	The aim of this module is to provide the student with knowledge and understanding in relation to the analysis and design of modern digital communication systems. The module focuses on the digital conversion processes; digital modulation schemes; data transmission principles; fundamental information theory and error correcting codes; as well as multicarrier and spread spectrum communication systems.

Learning Outcomes	
On successful completion of this module the learner should be able to:	
LO1	Apply knowledge of sampling and analogue to digital conversion processes.
LO2	Explain and compare the various digital modulation schemes.
LO3	Demonstrate knowledge of digital data transmission principles.
LO4	Examine fundamental information theory concepts and analyse error correcting codes.
LO5	Evaluate multicarrier and spread spectrum communication systems as well as Bluetooth Low Energy (BLE).

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.*
No requirements listed

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Module Content & Assessment

Indicative Content
Sampling Analog to Digital Conversion (i) sampling theorem, (ii) pulse code modulation (PCM), (iii) PCM in Carrier Systems (iv) digital multiplexing (v) differential pulse code modulation (DPCM) and adaptive differential PCM (ADPCM), (vi) Vocoders and Video Compression.
Data Transmission Principles (i) digital communication systems (ii) line coding (iii) pulse shaping (iv) scrambling (v) digital receivers (vi) eye diagrams.
Information Theory (i) Measure of information, (ii) source encoding (iii) Binary Symmetric Channels (BSC) (iv) channel capacity (v) Shannon's equation (vi) frequency selective channel capacity (vii) Multiple-Input-Multiple-Output (MIMO) systems.
Error Correction Codes (i) Redundancy (ii) linear block codes (iii) cyclic codes (iv) effects of error correcting (v) convolutional codes (vi) trellis diagrams (vii) code combining and interleaving (viii) soft decoding and Soft-Output Viterbi Algorithm (SOVA) (ix) Turbo Codes (x) Low Density Parity Check (LDPC) Codes.
Multichannel and Multicarrier Communication Systems (i) Multichannel communications in AWGN (ii) single carrier Vs multicarrier modulation (iii) capacity of a non-ideal linear filter (iv) Orthogonal Frequency Division Multiplexing (OFDM) – modulation and demodulation (v) an FFT Implementation of an OFDM system (vi) spectral characteristics of multicarrier signals (vii) bit and power allocation and peak to average ratio in multicarrier modulation (viii) channel coding considerations for multicarrier modulation.
Spread Spectrum Communication Systems (i) Model of Spread Spectrum Communication System (ii) Direct Sequence Spread Spectrum (DSSS) (iii) frequency hopped spread spectrum signals (iv) Code Division Multiple Access (CDMA) (v) other types of spread spectrum (vi) synchronisation of spread spectrum systems.
Bluetooth Low Energy (BLE) (i) technical details of the radio interface (ii) hardware implementation (iii) security (iv) end applications.

Assessment Breakdown	%
Continuous Assessment	20.00%
Practical	20.00%
End of Module Formal Examination	60.00%

Continuous Assessment

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Examination	Class Assessment	1,2,3	10.00	Week 7
Written Report	CA Assignment/Research Exercise	4,5	10.00	n/a

No Project

Practical

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Practical/Skills Evaluation	Students will complete a set of practical assignments and computational exercises in the laboratory with reports as deliverables.	1,2,3,4,5	20.00	Week 14

End of Module Formal Examination

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	The written examination will evaluate the extent of the student's knowledge of the major learning outcomes.	1,2,3,4,5	60.00	End-of-Semester

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

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Module Workload

Workload: Full Time		
Workload Type	*Frequency*	*Average Weekly Learner Workload*
Lecture	Every Week	3.00
Practicals	Every Week	2.00
Independent Learning Time	Every Week	3.00
	Total Hours	8.00

Module Delivered In

Programme Code	Programme	Semester	Delivery
CW_EEBEE_B	Bachelor of Engineering (Honours) in Biomedical Electronics	5	Mandatory
CW_EESYS_B	Bachelor of Engineering (Honours) in Electronic Engineering	5	Mandatory
CW_EEBEE_D	Bachelor of Engineering in Biomedical Electronics	5	Mandatory