Title:	Digital Systems Fundamentals APPROVED
Long Title:	Digital Systems Fundamentals

Module Code:	ELTR6005	**Duration:**	1 Semester

Credits:	5
NFQ Level:	Fundamental
Field of Study:	Electronic Engineering
Valid From:	Semester 1 - 2020/21 (September 2020)
Module Delivered in	2 programme(s)
Module Coordinator:	MARTIN HILL
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Module Description:	This module introduces the learner to the basic building blocks of modern digital electronics. Assuming no prior knowledge, it begins with the basic logic gates from which all digital and computer systems are built, dealing with simple binary numbers processed by these systems, and goes on to develop and refine more advanced circuits as the module progresses.

Learning Outcomes	
On successful completion of this module the learner will be able to:	
LO1	Convert between binary, BCD, decimal, and hexadecimal number systems and perform simple operations on numbers in these formats.
LO2	Draw logic symbols, truth tables, and Boolean expressions for all basic logic gates, use these to construct logic circuits and identify suitable SSI chips to implement these circuits.
LO3	Perform all elements of a design cycle, including using algebraic and mapping techniques, for simple combinational logic circuits from a given specification to an efficient implementation with universal NAND/NOR logic.
LO4	Work alone and in groups to construct simple logic circuits on breadboard. Measure and analyse the performance of these circuits using modern simulation software, and standard laboratory test equipment. Verify correct operation using truth tables, timing diagrams.
LO5	Write short laboratory reports, in accordance with accepted engineering professional standards.
LO6	Conduct themselves in accordance with professional engineering standards while collecting and reporting on experimental data and in their dealings with others.

Pre-requisite learning

Module Recommendations
This is prior learning (or a practical skill) that is strongly recommended before enrolment in this module. You may enrol in this module if you have not acquired the recommended learning but you will have considerable difficulty in passing (i.e. achieving the learning outcomes of) the module. While the prior learning is expressed as named MTU module(s) it also allows for learning (in another module or modules) which is equivalent to the learning specified in the named module(s).

13975	ELTR6005	Digital Systems Fundamentals

Incompatible Modules
These are modules which have learning outcomes that are too similar to the learning outcomes of this module. You may not earn additional credit for the same learning and therefore you may not enrol in this module if you have successfully completed any modules in the incompatible list.

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. You may not enrol on this module if you have not acquired the learning specified in this section.*
No requirements listed

Module Content & Assessment

Indicative Content
Digital Concepts Digital and analogue quantities. Logic levels. Typical voltages encountered. Digital waveforms: clock and pulse. Practicalities of IC chips.
Number Systems Pure binary counting system, binary to decimal conversion, decimal to binary conversion, addition of binary numbers, signed binary numbers: sign-magnitude, 1's complement, 2's complement, subtraction using 8-bit 2's complement addition, hexadecimal number system, binary coded decimal (BCD) system.
Basic Logic Gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR gates: distinctive-shape symbols, truth tables. Boolean expressions for associated logic functions. Timing diagrams for pulsed operation. Pinout diagrams of SSI chips.
Simple Logic Circuits Precedence of logic functions. Draw logic circuits given Boolean equations. Derive Boolean equations from logic circuits. Determine output levels for input combinations. Construct truth tables for complete logic circuits. Draw timing diagrams for complete logic circuits.
Minimisation State and prove (by truth table or algebraically) the laws and rules of Boolean algebra. Minimisation of simple expressions using Boolean algebra. Use of De Morgans Laws. Standard SOP formulation. Use of mapping techniques to minimise multi-variable expressions.
Universal NAND/NOR Logic Implementation of any logic gate using all-NAND/all-NOR circuits. Conversion of complete logic circuits to all-NAND/all-NOR formats to minimise chip-count. Elimination of redundant inverter-pairs. Selection of ICs for above circuits.
Design cycle for simple circuits Circuit specification. Block diagram. Truth table. Boolean expression. Minimisation. AND-OR-NOT implementation. Optimisation using universal NAND/NOR logic. The use and interpretation of bubble logic in circuit diagrams
Written Report Correct use of Passive voice, Spelling & Grammer, Units, Figures & Diagrams, Tables.
Personal and Professional Conduct Use of Peer review, ethical conduct considerations, plagiarism and due recognition of sources, Health and Safety considerations of practical work.

Assessment Breakdown	%
Course Work	50.00%
End of Module Formal Examination	50.00%

Course Work

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Performance Evaluation	A week-by-week assessment of practical competency through laboratory-based assignments with reports.	4,5,6	20.0	Every Week
Short Answer Questions	A written assessment comprising a number of short quiz-type questions.	1,2,3	15.0	Week 6
Written Report	Short (max 1000 words) written reports on topics as they arise in class and appropriately timed to allow for feedback.	1,2,3,5,6	15.0	Sem End

End of Module Formal Examination

Assessment Type	*Assessment Description*	*Outcome addressed*	*% of total*	*Assessment Date*
Formal Exam	End-of-Semester Final Examination	1,2,3	50.0	End-of-Semester

Reassessment Requirement

Repeat examination
Reassessment of this module will consist of a repeat examination. It is possible that there will also be a requirement to be reassessed in a coursework element.

The institute reserves the right to alter the nature and timings of assessment

Module Workload

Workload: Full Time				
Workload Type	*Workload Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Lectures on theory	2.0	Every Week	2.00
Lab	A laboratory-based session covering practical construction, testing, troubleshooting and analysis of relevant logic circuits	2.0	Every Week	2.00
Independent & Directed Learning (Non-contact)	Review of lecture notes and recommended material and preparation of reports for selected laboratory sessions, and in class topics	3.0	Every Week	3.00
			Total Hours	7.00
			Total Weekly Learner Workload	7.00
			Total Weekly Contact Hours	4.00

Workload: Part Time				
Workload Type	*Workload Description*	*Hours*	*Frequency*	*Average Weekly Learner Workload*
Lecture	Lectures on theory	1.5	Every Week	1.50
Lab	A laboratory-based session covering practical construction, testing, troubleshooting and analysis of relevant logic circuits	1.5	Every Week	1.50
Independent & Directed Learning (Non-contact)	Review of lecture notes and recommended material and preparation of reports for selected laboratory sessions, and in class topics	4.0	Every Week	4.00
			Total Hours	7.00
			Total Weekly Learner Workload	7.00
			Total Weekly Contact Hours	3.00

Module Resources

Recommended Book Resources

- **Thomas L. Floyd, 2015, *Digital Fundamentals*, 11th Ed., Chapters 1 to 6, Pearson [ISBN: 9780132737968]**

Supplementary Book Resources

- **Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss 2017, *Digital Systems: Principles and Applications*, 12th Ed., Chapters 1 - 4, Pearson [ISBN: 9780134220130]**

This module does not have any article/paper resources

Other Resources

- **website: *Data sheets***
  http://www.datasheetcatalog.com

Module Delivered in

Programme Code	Programme	Semester	Delivery
CR_EELXE_7	Bachelor of Engineering in Electronic Engineering	1	Mandatory
CR_EELXE_6	Higher Certificate in Engineering in Electronic Engineering	1	Mandatory