

## Module Information

2022.01, Approved

### Summary Information

Module Code	4304CIT
Formal Module Title	Digital and Analogue Electronics
Owning School	Engineering
Career	Undergraduate
Credits	20
Academic level	FHEQ Level 4
Grading Schema	40

### Teaching Responsibility

LJMU Schools involved in Delivery
LJMU Partner Taught

### Partner Teaching Institution

Institution Name
Changshu Institute of Technology

### Learning Methods

Learning Method Type	Hours
Lecture	64
Practical	16

### Module Offering(s)

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

## Aims and Outcomes

Aims	The Students completing this course will understand basic analogue and digital electronics, including semiconductor properties, operational amplifiers, combinational and sequential logic and analogue-to-digital digital-to-analogue conversion techniques. Finally, students will gain experience in with the design of analogue amplifiers, power supplies and logic devices.
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**After completing the module the student should be able to:**

### Learning Outcomes

Code	Number	Description
MLO1	1	Explain the characteristics of basic analogue electronic circuit elements, and analogue electronic circuits and systems.
MLO2	2	Explain the arithmetic problems using a variety of digital number representations and understand the characteristics of combinatorial and sequential digital electronic circuits and systems.
MLO3	3	Develop and design basic analogue electronic circuits and systems.
MLO4	4	Develop and design combinatorial and sequential digital electronic circuits and systems.

## Module Content

Outline Syllabus	<p>1. SEMICONDUCTORS DEVICES.Solid State Physics. Mobility. Electrons and holes. The P-N junction. Diodes. Zener effect. Zener effect diode. Avalanche effect. Avalanche effect diode. Bipolar Transistors.PNP and NPN junctions. Base, collector and emitter. H parameters equivalent circuit. Common emitter amplifier. DC behaviour: the load slope and the Q point. AC behaviour. Emitter follower amplifier. Field effect transistors: JFET and MOSFET. Source, Drain and Gate.2. OPERATIONAL AMPLIFIERS: DC PERFORMANCE.The operational amplifier. Input resistance. Output resistance. Open loop gain. Bias currents. Offset currents. Offset voltage. Differential mode gain. Common mode gain. Common mode rejection ratio. Negative feedback. Open loop gain and closed loop gain. Inverter amplifier. Addition amplifier. Non-inverter amplifier. The voltage follower. Transimpedance amplifier (Current to voltage converter). Differential amplifier.3. OPERATIONAL AMPLIFIERS: AC AND TRANSIENT PERFORMANCE.Frequency response. Bode Plot. Stability. Differentiator amplifier. Integrator amplifier. 4. POWER SUPPLIESRectification. Half wave and completed wave. Filters. The 78XX and 79XX family.5. DIGITAL TECHNIQUES: PRINCIPLES.Numbering systems. Binary, octal and hexadecimal numbers. Boole algebra. Conversion and operations. AND gate. OR gate. Inverter. NAND gate. NOR gate. Exclusive OR gate. Morgan's laws. Logic families. TTL and CMOS.6. DIGITAL TECHNIQUES: COMBINATIONAL CIRCUITS.Truth tables. Karnough's diagram. Minterm addition. Maxiterm product. Synthesis of combinational circuits. Logic comparators. Codifiers. Decodifiers. Multiplexers.7. DIGITAL TECHNIQUES: SEQUENTIAL CIRCUITS.Monostable oscillator. Bistable oscillator. Astable oscillator. The MC555. The "Flip-Flop". Flip Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Level detector and slope detector. Counters. Shift registers.8. DIGITAL TO ANALOG CONVERTERS and ANALOG TO DIGITAL CONVERTERS.Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network. Pulse Width Modulation.Sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion. Quantification.Integrative Analog to Digital (A/D) conversion. The linear counting method. The successive approximation method.</p>
Module Overview	
Additional Information	<p>Indicative Content and Learning ActivitiesDigital ArithmeticAlternate number bases: binary, octal, hexadecimal. Base conversion. Binary arithmetic. Signed number representation. Logic circuits for addition and subtraction.Combinatorial LogicBasic Boolean operators (AND, OR, NOT) and corresponding circuit elements. Boolean algebra. De Morgan's Laws. Further Boolean operators (XOR, NAND, NOR). Minimisation of logic functions using Boolean algebra and using Karnaugh maps, including 3-variable and 4-variable cases.Diode devicesSemiconductor materials and properties. Forward/reverse bias pn junctions. Diode equation. Reverse breakdown and Zener diodes.Transistor devicesIntroduction to Bipolar Junction Transistors (BJT) and Field Effect Transistors (FET): MOSFET, JFET. FET.Sequential LogicSequential logic elements including S-R, D, and J-K latches and flip-flops. Basic applications of flip-flops, including registers and counters.Analogue &amp; DigitalIntroduction to the concepts of digital-to-analogue and analogue-to-digital conversion. This material also introduces the Arduino micro-controller and applies it to the task of A2D and D2A (PWM) conversion. The students perform an investigative laboratory on this topic.Reports are 2500 maximum word count.Examinations are 2 hour duration.</p>

## Assessments

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

## Module Contacts

### Module Leader

Contact Name	Applies to all offerings	Offerings
Wei Zhang	Yes	N/A

### Partner Module Team

Contact Name	Applies to all offerings	Offerings
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