DIGITAL TECHNOLOGIES: KNOWLEDGE OF ELECTRONIC ENVIRONMENTS

Knowledge of electronic environments focuses on the concepts and operational function of components that underpin the understanding of how electronic environments (functional combinations of hardware and embedded software in the real world, ie, circuits, prototypes or products) are developed, assembled and tested.

Initially students learn about basic components and the concepts that describe the behaviour of a circuit. Students progress from this to more advanced understanding of circuit and embedded programming concepts and learn about an increasing range of components and their operation function in real circuits. At the highest level, students will be able to discuss complex electronic environments in terms of their subsystems and programming structures and apply some basic mathematical calculations within this discussion.

	LEVEL 6	LEVEL 7	LEVEL 8
LO	*Demonstrate understanding of basic concepts and components in electronic environments*	*Demonstrate understanding of advanced concepts and components in electronic environments*	*Demonstrate understanding of complex concepts and components in electronic environments*
TEACHER GUIDANCE	To support students to develop understandings about basic concepts and components in electronic environments at level 6, teachers could: • Provide the opportunity for students to learn about basic concepts through practical settings, for example, test conductors, insulators and semiconductor diode using a multimeter (ohms) or a light bulb and battery or learn why a circuit must be complete by identifying hidden breaks in a circuit using a multimeter. • Guide students to identify basic components and their symbols Support students to experiment with basic components in simple circuits to consolidate their understanding • Guide students to classify a provided selection of components in a tray as sensors, actuators or processors. • Provide opportunity for discussion about the components properties in terms of energy transfer, for example, an LDR converting light to electrical energy and an LED converting electrical energy to light • Support students to use symbols to create schematics for simple circuits, such as a simple microcontroller circuit with at least one input and a few simple outputs • Provide a range of practical experiences, for example: exploring the properties of series and parallel connections using LEDs in a circuit; using a multimeter in a simple LED-resistor circuit to introduce the concept of voltage as an energy level, and the concepts of current and resistance. • Provide opportunity for students to program a simple microcontroller to perform basic functions such as blinking LEDs controlled by a single switch. Students will be provided with the basic program structures for this. • Guide students to examine simple two-loop circuits, including those with a microcontroller to identify and describe voltage divider and transistor switch subsystems in these.	To support students to develop understandings about advanced concepts and components in electronic environments at level 7, teachers could: • Provide opportunity for students to learn about advanced concepts, including power and heat dissipation, analogue and digital signals, amplification, logical AND/OR and truth tables, parallel and series, how a single component type may have varied roles through hands-on practical work and research etc. • Provide opportunities for students to discuss and investigate practically, software programme development using advanced concepts, such as variables, binary notation (bits, bytes and words), logical structuring of software programmes (eg, flowcharting) and the use of subroutines and variables. • Provide opportunity for students to experiment with an extended range of components in circuits – such as a diode (pn and zener), capacitor (various types), npn transistor or FET – and an extended range of common sensors and actuators, such as Hall sensor, servo etc. • Guide students to explore the properties of integrated devices, for example, H-bridge, voltage regulators. • Guide students to research information (books,online etc) about the properties and operation of components and guide them to in selecting relevant material from these sources. • Support students to perform calculations, including power rating, parallel and series, based on parameters important in the behaviour of real circuits. • Provide the opportunity for students to explore an extended set of subsystems – including temperature sensors, LCDs, amplifier stages etc – and enable students to recognise these in advanced circuit schematics.	To support students to develop understandings about complex concepts and components in electronic environments at level 8, teachers could: • Provide opportunity for students to learn about complex hardware concepts, for example, IR and radio transmitting subsystems, amplifying stages, noise reduction circuits, UART, bus subsystems, through hands-on practical work and internet research, etc. • Provide opportunity for students to learn about complex software concepts, for example, variables, binary notation (bits, bytes and words), protocols (I2C, RS232), macros, flags, interrupts, counters, XOR, bitwise AND/OR, pwm, through hands-on practical work and internet research, etc. • Provide opportunity for students to learn about complex components – such as FETs, npn and pnp transistors, voltage regulators, SCRs, gates, H-bridges, op-amps, data latches, keypads, LCD and other displays, pressure and proximity sensors, servo and stepper motors etc – and describe these in terms of their operational function in different contexts. • Provide opportunity for students to identify, describe and explain some complex subsystems in circuits, such as transistor combinations (eg, push-pull), transistor configurations (eg, common emitter), extended gate arrangements, power supply circuits, FET circuits. • Provide opportunity for students to learn about software programme development through the logical structuring of software embedded programmes (eg, flowcharting/state machines) and the use of subroutines and variables. • Support students to choose an embedded platform based upon its features, for example, a selection between various PICAXE, Microchip or AVR microcontrollers, or Arduino, Raspberry Pi/otr Tablet platform etc. • Guide students to research information (books, online etc) about the properties and operation of components and ensure they are able to determine relevant material and critique and/or synthesise this in ways that support their understanding. • Support opportunities for students to perform complex calculations – such as gain, RMS and power values – based on parameters important in the behaviour of real circuits.
INDICATORS	Students can: • analyse basic concepts of electronics to explain the behaviour of electronic systems • discuss the operational function of electronic components in a practical context.	Students can: • use advanced concepts of electronics to discuss the implications of multiple variables on the performance of electronic environments • discuss the advantages and disadvantages of different electronic components to achieve desired advanced operational functions.	Students can: • discuss complex software concepts • discuss complex hardware concepts.
AS	**AS91077 Digital Technologies 1.47** *Demonstrate understanding of basic concepts used in the design and construction of electronic environments*	**AS91374 Digital Technologies 2.47** *Demonstrate understanding of advanced concepts used in the construction of electronic environments*	**AS91638 Digital Technologies 3.47** *Demonstrate understanding of complex concepts used in the design and construction of electronic environments*
	Level 1 Digital Technologies standards & assessment resources	Level 2 Digital Technologies standards & assessment resources	Level 3 Technology achievement standards & assessment resources DRAFT