Electronics

Chapter 1: Work Organization and Management (10%)

Topics:

- Creativity in the design of circuits, PCB layout, and programming
- Critical thinking in circuit design, PCB, fault-finding, and programming
- Honesty and integrity
- Self-motivation
- Problem-solving
- Effective working under pressure
- Health and safety legislation
- Best practices in relation to skills
- Importance of continuing personal development
- Company cultures and procedures and potential national variations

The individual shall be able to:

- Work professionally in relation to the environment and others
- Collaborate with colleagues and teams locally and remotely
- Present ideas to teams and clients
- Ensure workplace safety for self and others
- Take preventive actions to minimize accidents and their impact
- Engage in continuing professional development proactively
- Maintain effective record-keeping for traceability and compliance
- Interpret and recognize international symbols, diagrams, and languages
- Source and purchase cost-effective components and test equipment
- Write reports and record data about testing techniques and specifications
- Communicate effectively with customers
- Train others on installations
- Keep up to date with technological changes
- Act professionally on clients' premises
- Initiate records for ongoing maintenance policies
- Establish maintenance contracts where appropriate

Chapter 2: Application of Electronics in Practice (15%)

Topics:

- Various electronics specialisms within specific industries
- Common industry standard symbols (ANDI - US, IEC - EU)
- Common distance measurement units (mils, mm)
- Client business environments
- Materials and tools in servicing, installation, and repair tasks
- Electronic circuit component specifications
- Analog and digital logic circuits, sensor circuits
- AC and DC technology
- Power, wire, and cables
- Connectors, displays
- Circuit design and analysis of electrical circuits, digital logic circuits
- Inductive and capacitive reactance
- Capacitor and inductor characteristics, selection, and suitability
- Passive and active filters
- Oscillators (RC, Crystal, PLL)
- Multistage circuits
- Basic amplifier circuits (AC, DC, power amplifiers)
- Basic Op Amp circuits
- Practical operational amplifier considerations
- Generators and pulse shapers
- Truth tables, timing diagrams, Karnaugh mapping, Boolean algebra
- Number systems: Binary and Hexadecimal
- Properties of basic logic gates
- Procedures for substituting basic NAND/NOR gates
- Methods for designing digital logic to perform specified operations
- Industry-standard waveform measurement characteristics
- Combinational and sequential logic circuits
- EMI shielding techniques
- Electrostatic Discharge (ESD) best practices

The individual shall be able to:

- Identify and analyze the appropriate principle for the task
- Apply cognitive skills as required
- Use computers for:
    - Circuit design, PCB layout, and simulation
    - Programming embedded devices
    - Test and measurement of components and circuits
    - Control of circuit boards and production machinery
- Interface MCUs with external devices
- Read and interpret engineering documents
- Install and upgrade components and systems

Chapter 3: Prototype Hardware Design (25%)

Topics:

- Electronic principles application
- Specialist PCB design software
- Design for purpose
- Converting a design into a working prototype

The individual shall be able to:

- Select and calculate fit-for-purpose component values
- Implement heatsinking principles
- Modify existing electronic circuit designs
- Use circuit simulation software for validation
- Interpret design briefs and specifications
- Draw schematic circuits using PCB layout software
- Utilize 3D PCB layout capabilities
- Generate PCB manufacturing data
- Assemble components onto PCBs
- Test prototypes and make necessary adjustments
- Rework and repair designs to industry standards

Chapter 4: Embedded Systems Programming (25%)

Topics:

- Embedded systems and microcontrollers
- Microcontroller development tools
- Integrated software development environments
- Device programming methods
- C-language programming for embedded systems
- Microcontroller interfacing principles
- Common MCU peripherals and power management
- Watchdog timers, interrupts, and resets

The individual shall be able to:

- Identify and fix syntax errors
- Write, compile, upload, test, and debug C code
- Use and write functions for specified tasks
- Modify, debug, and test pre-written code

- Develop interrupt handlers and polling techniques
- Implement power management strategies

Chapter 5: Fault Finding and Repair (15%)

Topics:

- Electronic principles and fault-finding techniques
- Testing, repair, and measurement processes
- Limitations and applications of test equipment
- Preventative maintenance and business impact of unreliable equipment
- Measurement techniques and troubleshooting for embedded systems
- Safe working practices for high voltage and ESD-sensitive devices

The individual shall be able to:

- Check and calibrate test equipment
- Select appropriate measurement tools
- Perform measurements on electronic components and systems
- Diagnose and isolate faults to component level
- Replace or repair defective circuit components
- Test and analyze results to ensure performance meets specifications
- Record and document repair details
- Develop and implement preventative maintenance schedules
- Use automated test equipment and digital documentation
- Implement temporary fixes for prototyping

Chapter 6: Assembly and Measurement (10%)

Topics:

- Industry standards
- Electronic principles
- Functions of components in circuit design
- Tools used in electronic assembly
- Safe working practices, including ESD safety
- Digital Storage Oscilloscope (DSO) measurements

The individual shall be able to:

- Identify and assemble electromechanical and sensor components
- Wire and form cable harnesses
- Work with surface-mount and through-hole components
- Follow correct assembly sequences and tolerances
- Solder components using lead-free solder
- Install, test, and calibrate electronic systems