

# **INDUSTRIAL TRAINING INSTITUTE (ITI)**

## **ANNUAL INSTRUCTIONAL PLAN**

**TRADE: ELECTRONICS MECHANIC (SECOND YEAR)**

**DURATION: 42 WEEKS (CTS 3.0 / NSQF-4)**

|                                    |                                 |
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| <b>Name of Institute:</b>          |                                 |
| <b>Trade Name &amp; Year:</b>      | Electronics Mechanic — 2nd Year |
| <b>Academic Session:</b>           |                                 |
| <b>Instructor Name:</b>            |                                 |
| <b>Group Instructor (GI) Name:</b> |                                 |
| <b>Superintendent / Principal:</b> |                                 |

## INSTRUCTIONAL PLAN — WEEK 01

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                                                                           | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                                |
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| <b>WEEK 01</b> | <p>Electronic Cables &amp; Connectors:</p> <ol style="list-style-type: none"><li>1. Identify various types of cables: RF coaxial, screened cable, ribbon cable, RCA connector cable, digital optical audio/video cable, RJ45, RJ11, Ethernet cable.</li><li>2. Prepare terminations, make UTP and STP cable connectors and test.</li><li>3. Identify suitable connectors, solder/crimp/terminate and test cable sets.</li></ol> | <p>Cable Types &amp; Pin Assignments:</p> <ol style="list-style-type: none"><li>1. Cable signal diagram conventions.</li><li>2. Classification of electronic cables w.r.t. insulation, gauge, current capacity, flexibility.</li><li>3. Different types of connectors &amp; terminations: Male/Female DB connectors, Ethernet cross-over cable pinouts, UTP, STP, Coaxial.</li></ol> |

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INSTRUCTIONAL PLAN — WEEK 02

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                          | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                            |
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| WEEK 02  | Audio/Video Connectors & Internal PC Cabling:<br>4. Check continuity as per marking on connectors for preparing cable sets.<br>5. Identify and select connectors and cables inside PC CPU cabinet (SATA, power cables).<br>6. Prepare cross-over cable and connect computer to network switch. | AV Interfacing & Networking Connectors:<br>4. Servo connectors, FTP, RCA, BNC, HDMI.<br>5. Audio/video connectors: XLR, RCA (phono), 6.3 mm, 3.5 mm/2.5 mm phono, Bantam, Speakon, DIN, mini-DIN, RF connectors.<br>6. USB standards, FireWire, SATA, VGA, DVI, MIDI, RJ45, RJ11 specifications. |

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INSTRUCTIONAL PLAN — WEEK 03

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                  | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                  |
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| WEEK 03  | Computer Hardware & Peripheral Setup:<br>7. Demonstrate parts of system unit and motherboard components (CPU, chipset, RAM slots, PCIe).<br>8. Identify computer peripherals and connect to system.<br>9. Boot system from different boot options (USB, SSD, Network). | Computer Hardware Architecture:<br>7. Basic blocks of a computer, desktop motherboard architecture, CPU, chipset, bus architecture.<br>8. Primary and secondary storage devices: RAM, ROM, HDD, SSD, optical drives.<br>9. I/O devices, printers (Dot Matrix, Inkjet, Laser), computer ports (USB, HDMI, DisplayPort). |

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INSTRUCTIONAL PLAN — WEEK 04

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                   | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                      |
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| WEEK 04  | <p>OS Installation &amp; System Configuration:</p> <p>10. Install OS in a desktop computer (partitioning, file systems).</p> <p>11. Install printer driver software and test printouts.</p> <p>12. Install antivirus software, scan system, explore scan options.</p> <p>13. Install application software packages.</p> | <p>Operating Systems &amp; IT Utilities:</p> <p>10. Operating system principles: Windows OS architecture, boot process, device managers.</p> <p>11. File management, control panel settings, user accounts, system configuration utilities.</p> <p>12. Antivirus configuration, threat detection, malware prevention, software installation protocols.</p> |

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INSTRUCTIONAL PLAN — WEEK 05

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                              | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                            |
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| WEEK 05  | Computer Networking & Wireless Setup:<br>14. Configure wireless Wi-Fi network and access point.<br>15. Connect two network systems, configure static/dynamic IP addresses, verify connectivity using ping commands.<br>16. Share resources (printers, folders) over local network. | Networking Fundamentals:<br>13. Network topologies (Star, Bus, Ring, Mesh), network media, OSI model basics.<br>14. Network hardware: Hub, Switch, Router, NIC cards, gateways, firewalls.<br>15. IP addressing (IPv4/IPv6), subnet masks, Wi-Fi security standards (WPA2/WPA3). |

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## INSTRUCTIONAL PLAN — WEEK 06

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                     | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                      |
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| <b>WEEK 06</b> | <p>SMD Components Identification &amp; Handling:</p> <p>17. Identification of 2, 3, 4 terminal SMD components (resistors, capacitors, diodes, transistors).</p> <p>18. Identify different types of SMD packages (SOIC, SOT, QFP, BGA).</p> <p>19. Prepare Bill of Materials (BOM) for SMD assemblies.</p> | <p>Surface Mount Technology (SMT):</p> <p>16. Introduction to Surface Mount Technology (SMT) vs Through-Hole Technology (THT).</p> <p>17. SMD component coding systems (3-digit, 4-digit, EIA-96, color coding).</p> <p>18. SMD package classifications, advantages of miniaturization, power ratings.</p> |

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INSTRUCTIONAL PLAN — WEEK 07

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                              | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                         |
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| WEEK 07  | <p>SMD Soldering, De-Soldering &amp; Inspection:</p> <p>20. De-solder SMD components from PCB using hot air rework station and tweezers.</p> <p>21. Solder SMD components onto PCB using solder paste and temperature-controlled iron.</p> <p>22. Identification of loose/dry solder, broken tracks on PCB, cold continuity tests on printed wired assemblies.</p> | <p>SMD Rework &amp; Soldering Standards:</p> <p>19. Hot air rework stations, nozzle selection, air flow and temperature profiling.</p> <p>20. Solder paste, flux chemistry, reflow soldering and wave soldering concepts.</p> <p>21. PCB track repair, jumper wiring techniques, inspection under stereo zoom microscope.</p> |

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## INSTRUCTIONAL PLAN — WEEK 08

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                          | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                           |
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| <b>WEEK 08</b> | Low Potential Motors & Stepper Motor Control:<br>23. Test various low potential DC motors.<br>24. Test stepper motor windings, identify unipolar and bipolar stepper motor leads.<br>25. Demonstrate working process of stepper motors in various equipment, control speed and rotation using pulse generator. | Stepper Motor Principles:<br>22. Construction and working principle of Stepper motors (Permanent Magnet, Variable Reluctance, Hybrid).<br>23. Unipolar vs bipolar windings, step angle calculation, full-step, half-step, micro-stepping.<br>24. Stepper motor driver ICs (ULN2003, L298N, A4988) and speed control techniques. |

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INSTRUCTIONAL PLAN — WEEK 09

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                               | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                               |
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| WEEK 09  | BLDC Motors & Industrial Drivers:<br>26. Test Brushless DC (BLDC) motor windings, Hall effect sensors.<br>27. Demonstrate working process of BLDC motor with Electronic Speed Controller (ESC) in automotive and robotic equipment. | Brushless DC (BLDC) Motor Theory:<br>25. Construction, working principle, and internal layout of BLDC motors.<br>26. Commutation in BLDC motors: Hall sensor feedback vs sensorless back-EMF detection.<br>27. Electronic Speed Controllers (ESC), PWM drive switching, high-efficiency advantages. |

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## INSTRUCTIONAL PLAN — WEEK 10

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                                                  | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                           |
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| <b>WEEK 10</b> | <p>Electrical Control Circuits &amp; Starters:</p> <p>28. Measure coil winding resistance and insulation resistance of induction motor.</p> <p>29. Prepare setup and control induction motor using Direct-On-Line (DOL) starter.</p> <p>30. Construct direction control circuit to reverse rotation of induction motor.</p> <p>31. Connect thermal overload relay and test for proper functioning.</p> | <p>Motor Starters &amp; Control Gear:</p> <p>28. Principles of AC induction motor control.</p> <p>29. Direct-On-Line (DOL) starter circuitry, contactor holding circuits, push buttons (NO/NC).</p> <p>30. Reversing contactor circuits with mechanical/electrical interlocking.</p> <p>31. Thermal overload relays, bimetallic trip mechanisms, single-phasing protection.</p> |

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## INSTRUCTIONAL PLAN — WEEK 11

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                         | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                 |
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| <b>WEEK 11</b> | Radio Wave Modulation (AM & FM):<br>32. Modulate and demodulate signals using AM trainer kit, observe waveforms on DSO, calculate modulation index.<br>33. Modulate and demodulate signals using FM trainer kit, observe frequency deviation. | Communication Fundamentals:<br>32. Radio wave propagation: Ground wave, sky wave, space wave, fading phenomena.<br>33. Need for modulation, Amplitude Modulation (AM) principles, modulation index, sidebands.<br>34. Frequency Modulation (FM) and Phase Modulation (PM) principles, deviation ratio, Carson's rule. |

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## INSTRUCTIONAL PLAN — WEEK 12

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                               | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                         |
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| <b>WEEK 12</b> | Antennas, AM/FM Transmitters & Receivers:<br>34. Test IC-based AM receiver stages, alignment and sensitivity checks.<br>35. Test IC-based AM transmitter and measure transmitter output power.<br>36. Test IC-based FM transmitter and verify broadcast range.<br>37. Dismantle FM receiver, identify RF, IF, detector, and audio amplifier stages. | Transmitters, Receivers & Antennas:<br>35. Antenna fundamentals: radiation pattern, gain, bandwidth, dipole, Yagi-Uda antenna.<br>36. Block diagram and working of superheterodyne AM and FM receivers, intermediate frequency (IF).<br>37. FM generation (varactor, reactance) and detection (ratio detector, PLL detector). |

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## INSTRUCTIONAL PLAN — WEEK 13

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                          | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                           |
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| <b>WEEK 13</b> | <p>Pulse Modulation &amp; Multiplexing:</p> <p>38. Modulate and demodulate signals using Pulse Amplitude Modulation (PAM).</p> <p>39. Modulate and demodulate signals using Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM).</p> <p>40. Demonstrate time division multiplexing (TDM) and de-multiplexing.</p> | <p>Digital Pulse Modulation Systems:</p> <p>38. Sampling theorem, Nyquist rate, flat-top sampling, sample-and-hold circuits.</p> <p>39. PAM, PWM, PPM generation and detection techniques.</p> <p>40. Pulse Code Modulation (PCM): quantization, encoding, digital multiplexing principles.</p> |

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## INSTRUCTIONAL PLAN — WEEK 14

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                    | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                          |
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| <b>WEEK 14</b> | <p>Microcontroller ATmega328 Architecture:</p> <p>41. Identify various ICs and their functions on microcontroller trainer kit.</p> <p>42. Identify pins, ports, power rails, and oscillator connections on Arduino Uno (ATmega328) board.</p> <p>43. Measure crystal oscillator frequency using DSO.</p> | <p>Microcontroller Hardware &amp; Architecture:</p> <p>41. Microprocessor vs Microcontroller comparison.</p> <p>42. Architecture of ATmega328: Harvard architecture, ALU, flash ROM, SRAM, EEPROM.</p> <p>43. Pinout description, GPIO ports (Port B, C, D), system clock, reset circuitry.</p> <p>44. Bootloader concept and in-system programming (ISP).</p> |

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## INSTRUCTIONAL PLAN — WEEK 15

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                             | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                    |
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| <b>WEEK 15</b> | <p>Arduino IDE &amp; Digital I/O Programming:</p> <p>44. Install Arduino IDE on computer, configure COM ports, install board packages and libraries.</p> <p>45. Write, compile, upload program to blink onboard/external LED with software delay.</p> <p>46. Configure GPIO port pins as inputs and outputs, interface push buttons and LEDs.</p> | <p>Embedded Programming Basics:</p> <p>45. Arduino IDE tool structure, toolbar, compilation, debugging, hex file generation.</p> <p>46. Embedded C syntax: data types, setup() and loop() structures, pinMode(), digitalWrite(), digitalRead().</p> <p>47. Interfacing digital inputs, switch bounce phenomena, software debouncing.</p> |

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## INSTRUCTIONAL PLAN — WEEK 16

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                         | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                            |
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| <b>WEEK 16</b> | <p>Timers, Counters &amp; Interrupts:</p> <p>47. Perform initialization, load and turn ON LED with precision delay using internal hardware timers.</p> <p>48. Program and use timer as an external event counter.</p> <p>49. Demonstrate simple embedded C programs, monitor execution on serial monitor.</p> | <p>Timers &amp; 8051 Comparison:</p> <p>48. Internal hardware timers/counters of ATmega328, prescalers, CTC mode, PWM registers.</p> <p>49. Interrupts: internal and external interrupts, interrupt service routines (ISR).</p> <p>50. Overview of 8051 family, SFRs, memory banks, comparative study with PIC architecture.</p> |

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## INSTRUCTIONAL PLAN — WEEK 17

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                             | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                     |
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| <b>WEEK 17</b> | <p>Display Interfacing (LED, 7-Segment, LCD, DPM):</p> <p>50. Identify LED display modules, decoder/driver ICs, display word on 2-line alphanumeric LCD.</p> <p>51. Interface seven-segment display and display numeric digits.</p> <p>52. Measure voltage/current flowing through resistor/sensor and display on DPM module.</p> | <p>Display Devices &amp; Driver ICs:</p> <p>51. Seven-segment displays (common anode/cathode), BCD-to-7-segment decoders (7447/7448).</p> <p>52. Alphanumeric LCD modules (16x2), HD44780 controller, command/data registers, 4-bit/8-bit mode.</p> <p>53. Digital Panel Meters (DPM): IC 7106 (LCD) and IC 7107 (LED) architecture and applications.</p> |

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## INSTRUCTIONAL PLAN — WEEK 18

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                                                                                              | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                                                                  |
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| <b>WEEK 18</b> | <p>Industrial Temperature Sensors &amp; RTDs:</p> <p>53. Identify industrial sensors: RTD (PT100), Thermocouple, Thermistor (NTC/PTC), Temperature ICs (LM35).</p> <p>54. Measure flame/water temperature using Thermocouple, record data with reference chart.</p> <p>55. Measure temperature using RTD PT100 and signal conditioning circuit.</p> <p>56. Interface LM35 sensor with ATmega328 and display temperature on LCD/Serial monitor.</p> | <p>Thermal Transducers:</p> <p>54. Transducer classification: active vs passive transducers, transfer characteristics.</p> <p>55. Thermocouple: Seebeck effect, Peltier effect, cold-junction compensation, temperature ranges.</p> <p>56. Resistance Temperature Detectors (RTD): Callendar-Van Dusen equation, 2-wire, 3-wire, 4-wire setups.</p> <p>57. Thermistors and IC temperature sensors (LM35, DS18B20).</p> |

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## INSTRUCTIONAL PLAN — WEEK 19

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                                  | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                      |
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| <b>WEEK 19</b> | <p>Mechanical &amp; Proximity Transducers (LVDT, Strain Gauge):</p> <p>57. Measure AC/DC voltage output of Linear Variable Differential Transformer (LVDT) across core displacements.</p> <p>58. Test Load Cell and Strain Gauge using instrumentation amplifier.</p> <p>59. Detect metal and non-metal objects using Inductive, Capacitive, and Photoelectric proximity switches.</p> | <p>Displacement &amp; Force Transducers:</p> <p>58. LVDT: construction, differential secondary windings, null voltage, phase sensitivity, linearity.</p> <p>59. Strain gauge: piezoresistive effect, gauge factor, Wheatstone bridge configurations.</p> <p>60. Proximity sensors: eddy-current inductive, capacitive dielectric, photoelectric reflection principles.</p> |

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## INSTRUCTIONAL PLAN — WEEK 20

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                               | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                         |
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| <b>WEEK 20</b> | Environmental Sensors for Home & Building Automation:<br>60. Interface DHT11/DHT22 humidity and temperature sensor with ATmega328.<br>61. Interface MQ-2/MQ-6 gas and smoke sensors with microcontroller and sound alarm buzzer.<br>62. Interface LDR light sensor and switch ON/OFF relay module based on ambient light intensity. | Environmental Sensing:<br>61. Humidity sensors: capacitive and resistive hygrometers.<br>62. Gas and smoke sensors: metal oxide semiconductor (MQ series) operating mechanism, preheating.<br>63. Photo-resistors (LDR), phototransistors, optocoupler-driven relay modules for AC switching. |

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INSTRUCTIONAL PLAN — WEEK 21

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                             | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                         |
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| WEEK 21  | <p>Motion &amp; Spatial Sensors:</p> <p>63. Interface Passive Infrared (PIR) motion sensor with ATmega328 to detect human movement.</p> <p>64. Interface HC-SR04 ultrasonic distance sensor, calculate distance using pulse transit time.</p> <p>65. Interface MPU6050 3-axis Accelerometer and Gyroscope module via I2C bus.</p> | <p>Motion &amp; Ultrasonic Sensing:</p> <p>64. PIR sensor: pyroelectric crystals, Fresnel lens, dual-element differential detection.</p> <p>65. Ultrasonic sensors: acoustic echo ranging, trigger/echo timing calculations.</p> <p>66. MEMS technology: accelerometer, gyroscope principles, I2C communication protocol.</p> |

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INSTRUCTIONAL PLAN — WEEK 22

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                    | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                        |
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| WEEK 22  | <p>Agricultural &amp; Flow Sensors:</p> <p>66. Interface soil moisture sensor and rain drop sensor with microcontroller.</p> <p>67. Interface Hall-effect water flow rate sensor and calculate liquid flow rate.</p> <p>68. Interface potentiometer to analog ADC input (A0) and map 10-bit digital values (0-1023).</p> | <p>Agricultural &amp; Fluid Instrumentation:</p> <p>67. Soil moisture sensing: resistive vs capacitive soil probes, soil salinity effects.</p> <p>68. Turbine/Hall-effect flow meters, pulse frequency to volume conversion.</p> <p>69. Analog-to-Digital Conversion (ADC): successive approximation ADC, reference voltage, resolution.</p> |

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## INSTRUCTIONAL PLAN — WEEK 23

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                   | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                                                     |
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| <b>WEEK 23</b> | <p>IoT Architecture &amp; Smart City Applications:</p> <p>69. Connect ATmega328 Arduino Uno to PC, upload telemetry code over serial link.</p> <p>70. Interface wireless modules (Wi-Fi ESP8266/ESP32, Bluetooth HC-05) to microcontroller.</p> <p>71. Demonstrate smart street lighting and automated water management simulation.</p> | <p>Internet of Things (IoT) Principles:</p> <p>70. Definition and architecture of IoT, embedded systems vs IoT, edge devices.</p> <p>71. IoT building blocks: sensors, connectivity, data processing, cloud platforms.</p> <p>72. Wireless protocols: RFID, Wi-Fi, Bluetooth, Zigbee, LoRaWAN.</p> <p>73. Introduction to Industry 4.0/5.0, Industrial IoT (IIoT), IoT cyber security best practices.</p> |

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## INSTRUCTIONAL PLAN — WEEK 24

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                 | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                |
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| <b>WEEK 24</b> | <p>Industrial Robotics:</p> <p>72. Identify constructional features, coordinate systems, and links of industrial robot manipulator.</p> <p>73. Connect robot system for automated welding/CNC machine tending simulation.</p> <p>74. Program teach-pendant movements, execute pick-and-place operation, verify safety interlocks.</p> | <p>Robotics Technology:</p> <p>74. Evolution of robots, robotic classifications: Cartesian, Cylindrical, SCARA, Articulated, Delta.</p> <p>75. Robot anatomy: links, joints, end-effectors, degrees of freedom (DoF).</p> <p>76. Actuators in robotics (servo, stepper, pneumatic), sensors in robotics, robot safety standards.</p> |

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INSTRUCTIONAL PLAN — WEEK 25

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                              | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                             |
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| WEEK 25  | Microcontroller Project Assembly (Selection & Fabrication):<br>75. Plan, design, and assemble selected microcontroller project (e.g. Solar charger, Water level controller, Metal detector).<br>76. Fabricate circuit on general purpose PCB, solder components, test DC voltages. | Project Engineering & Circuit Design:<br>77. Project planning, component selection, datasheet analysis, power budget calculations.<br>78. Schematic capture, PCB prototyping guidelines, circuit protection against back-EMF.<br>79. Embedded firmware modular design, flowcharts, interrupt-driven architecture. |

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INSTRUCTIONAL PLAN — WEEK 26

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                          | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                  |
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| WEEK 26  | <p>Microcontroller Project Testing &amp; Debugging:</p> <p>77. Program microcontroller for selected project, calibrate sensor thresholds.</p> <p>78. Debug hardware-software integration faults, verify operational parameters under load.</p> | <p>Embedded Debugging Techniques:</p> <p>80. In-circuit debugging, serial terminal monitoring, logic analyzer usage.</p> <p>81. Thermal management in project enclosures, noise decoupling capacitor placement.</p> <p>82. Enclosure assembly, wiring harness standardization, documentation of project test logs.</p> |

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INSTRUCTIONAL PLAN — WEEK 27

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                         | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                  |
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| WEEK 27  | Digital IC Project Assembly:<br>79. Assemble digital logic project using TTL/CMOS ICs (e.g. Digital Event Counter, Frequency Multiplier, Dancing LEDs).<br>80. Test clock generation using IC 555, verify decade counter (7490) and 7-segment display driver. | Digital System Integration:<br>83. Digital system design principles using MSI logic chips.<br>84. Clock generation, propagation delays, fan-in and fan-out limits in digital circuits.<br>85. Decoupling techniques on digital power rails, switch bounce elimination. |

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INSTRUCTIONAL PLAN — WEEK 28

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                            | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                           |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WEEK 28  | <p>Fiber Optic Communication Links:</p> <p>81. Identify resources on fiber optic trainer kit (optical transmitter, receiver, fiber cable).</p> <p>82. Transmit and receive analog and digital signals over optical fiber cable.</p> <p>83. Demonstrate FM, PWM, and PPM modulation and demodulation over optical voice link.</p> | <p>Fiber Optic Principles:</p> <p>86. Optical fiber fundamentals: Total Internal Reflection (TIR), acceptance angle, numerical aperture.</p> <p>87. Cable construction: core, cladding, buffer jacket; Step-index vs Graded-index fibers, Single-mode vs Multi-mode.</p> <p>88. Light sources (LED, Laser diode) and light detectors (PIN photodiode, APD).</p> |

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## INSTRUCTIONAL PLAN — WEEK 29

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                             | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                              |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 29</b> | <p>Fiber Splicing, Cleaving &amp; OTDR Testing:</p> <p>84. Prepare optical fiber ends using precision fiber cleaver and stripper.</p> <p>85. Perform optical fiber mechanical splicing and fusion splicing.</p> <p>86. Test fiber link attenuation and detect fault locations using Optical Time Domain Reflectometer (OTDR).</p> | <p>Optical Cable Splicing &amp; Losses:</p> <p>89. Optical fiber losses: attenuation, scattering (Rayleigh), absorption, macro-bending, micro-bending.</p> <p>90. Fiber splicing techniques: fusion splicing vs mechanical splicing, splice protectors.</p> <p>91. Working principle of OTDR, optical power meters, optical safety and eye hazard precautions.</p> |

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## INSTRUCTIONAL PLAN — WEEK 30

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                     | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                       |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 30</b> | <p>Voltage Stabilizers (Manual, Auto &amp; Servo):</p> <p>87. Identify components and trace circuit of automatic voltage stabilizer.</p> <p>88. Dismantle stabilizer, test step-up/step-down autotransformer taps, test relay switching stages.</p> <p>89. Calibrate high-voltage and low-voltage cut-off circuits, time delay relay.</p> | <p>Voltage Stabilization Principles:</p> <p>92. Need for voltage regulation, mains voltage fluctuations and effects on appliances.</p> <p>93. Automatic relay-type voltage stabilizers: tap-changing autotransformer, comparator circuits.</p> <p>94. Servo voltage stabilizers: motorized variac, feedback error amplifier, high precision regulation.</p> |

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INSTRUCTIONAL PLAN — WEEK 31

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                          | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                       |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WEEK 31  | Switch Mode Power Supplies (SMPS) Architecture:<br>90. Identify input/output sockets, connectors, and color-coded wire voltages in computer ATX SMPS.<br>91. Open SMPS, identify EMI filter, input rectifier, high-voltage filter, switching power transistors, high-frequency transformer, PWM controller IC. | SMPS Topologies & Regulation:<br>95. Linear power supply vs Switch Mode Power Supply (SMPS) efficiency comparison.<br>96. SMPS topologies: Buck, Boost, Buck-Boost, Flyback, and Forward converters.<br>97. High-frequency pulse-width modulation (PWM) control ICs (TL494, UC3842), feedback optocouplers. |

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## INSTRUCTIONAL PLAN — WEEK 32

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                        | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                        |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 32</b> | <p>SMPS Servicing &amp; DC-DC Converters:</p> <p>92. Measure voltages at major test points in PC SMPS (+12V, +5V, +3.3V, -12V, +5VSB, Power Good).</p> <p>93. Troubleshoot faults in SMPS unit, replace blown MOSFETs, shorted Schottky diodes, swollen capacitors.</p> <p>94. Construct switching step-down regulator using LM2576 and step-up regulator using MC34063.</p> | <p>SMPS Fault Rectification:</p> <p>98. Common SMPS failure modes: input fuse blown, shorted bridge rectifier, switching transistor breakdown.</p> <p>99. Output short circuit protection, over-voltage protection (OVP), Power Good signal generation.</p> <p>100. Step-down (Buck) and step-up (Boost) switching ICs operation and inductor selection.</p> |

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## INSTRUCTIONAL PLAN — WEEK 33

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                      | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                               |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 33</b> | <p>Inverters: Construction &amp; Circuit Tracing:</p> <p>95. Identify major components of power inverter: H-bridge MOSFETs, driver transformer, control PCB.</p> <p>96. Install and connect battery stack to power inverter.</p> <p>97. Test inverter in mains mode (battery charging) and backup mode (inverter operation), verify changeover action.</p> | <p>Inverter Systems &amp; Topologies:</p> <p>101. Operating principle of inverters, DC to AC conversion, power ratings (VA/Watt).</p> <p>102. Inverter waveforms: Square wave, modified sine wave, pure sine wave (SPWM).</p> <p>103. MOSFET H-bridge configuration, driver transformer, relay/solid-state changeover circuits.</p> |

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INSTRUCTIONAL PLAN — WEEK 34

| Week No. | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                             | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                          |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WEEK 34  | <p>Inverter Troubleshooting &amp; Battery Charging:</p> <p>98. Troubleshoot inverter faults: no output, overload tripping, charging failure, low backup time.</p> <p>99. Test and replace power MOSFETs, driver transistors, charging relay.</p> <p>100. Verify low battery cut-off, overload trip, and trickle charging circuits under load.</p> | <p>Inverter Protections &amp; Battery Chargers:</p> <p>104. Inverter protection systems: overload sensing, battery reverse polarity, over-temperature cutoff.</p> <p>105. Battery charging methods: Constant Current (CC), Constant Voltage (CV), float charging.</p> <p>106. Systematic fault diagnosis flowcharts for domestic and commercial inverters.</p> |

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## INSTRUCTIONAL PLAN — WEEK 35

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                          | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                        |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 35</b> | Uninterruptible Power Supply (UPS):<br>101. Connect battery stack and load to UPS, test on battery mode.<br>102. Open top cover of UPS, identify isolation transformer, inverter board, static switch.<br>103. Measure backup time and changeover time on DSO under full load. | UPS Technologies & Power Quality:<br>107. Definition and need for Uninterruptible Power Supplies (UPS).<br>108. Inverter vs UPS comparison (transfer time differences).<br>109. UPS classifications: Offline (Standby) UPS, Line-Interactive UPS, Online (Double Conversion) UPS.<br>110. Power factor, crest factor, harmonic distortion, static transfer switch operation. |

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## INSTRUCTIONAL PLAN — WEEK 36

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                                 | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                                                                                           |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 36</b> | <p>Solar Photovoltaic (PV) Panels &amp; Charge Controllers:</p> <p>104. Connect solar panels in series and parallel, measure open circuit voltage (Voc) and short circuit current (Isc).</p> <p>105. Connect solar charge controller (PWM/MPPT) with solar panel, battery, and DC load.</p> <p>106. Install roof-mount solar panel, wire panel to solar inverter, power AC loads.</p> | <p>Solar PV Systems &amp; MPPT:</p> <p>111. Photovoltaic effect: silicon P-N junction solar cell, cell to module to array hierarchy.</p> <p>112. Solar panel parameters: Voc, Isc, Vmp, Imp, fill factor, irradiance effects.</p> <p>113. Solar charge controllers: Pulse Width Modulation (PWM) vs Maximum Power Point Tracking (MPPT).</p> <p>114. Solar on-grid, off-grid, and hybrid solar inverter configurations, earthing protocols.</p> |

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## INSTRUCTIONAL PLAN — WEEK 37

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                             | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                                   |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 37</b> | <p>Cell Phone Hardware &amp; Repair:</p> <p>107. Dismantle different types of smartphones using precision mobile repair toolkit.</p> <p>108. Identify smartphone sections: RF section, Power Management IC (PMIC), Baseband CPU, display connector.</p> <p>109. Replace modular parts: microphone, earpiece, ringer speaker, charging port (Type-C), battery.</p> | <p>Mobile Communication &amp; Smartphone Architecture:</p> <p>115. Cellular communication principles: cell sites, frequency reuse, handover, GSM vs CDMA vs 4G/5G.</p> <p>116. Smartphone block diagram: RF transceiver, power distribution, battery management, audio codecs.</p> <p>117. IMEI number architecture, SIM card interfacing, safety precautions with Li-Po batteries.</p> |

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## INSTRUCTIONAL PLAN — WEEK 38

| Week No.       | Professional Skills (Trade Practical)                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Professional Knowledge (Trade Theory)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WEEK 38</b> | <p>Smartphone Software &amp; LCD/LED/Smart TV Servicing:</p> <p>110. Interface smartphone to PC, backup data, flash firmware using flashing software tools.</p> <p>111. Identify controls and sections of LED/Smart TV: Power board, Main board, T-Con board, Backlight driver.</p> <p>112. Dismantle TV remote control, test IR LED using phone camera/detector, clean keypad matrix.</p> <p>113. Troubleshoot TV faults: no power, sound OK but no picture (backlight fault), HDMI input failure.</p> | <p>Smartphone Software &amp; Smart TV Technology:</p> <p>118. Smartphone software troubleshooting: boot-loop recovery, firmware flashing, OS updating.</p> <p>119. Display technologies: LCD vs LED vs OLED vs QLED, IPS panels, refresh rates.</p> <p>120. TV architecture: SMPS board, Motherboard (SoC), Timing Controller (T-Con), LVDS signaling.</p> <p>121. LED backlighting topology (edge-lit, direct-lit), constant current LED drivers.</p> <p>122. TV remote control operation: IR protocol (NEC/RC5 code), IR receiver sensors.</p> |

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INSTRUCTIONAL PLAN — WEEK 39

| Week No. | Professional Skills (Trade Practical)           | Professional Knowledge (Trade Theory) |
|----------|-------------------------------------------------|---------------------------------------|
| WEEK 39  | On the Job Training (OJT) / Group Project Work: |                                       |

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INSTRUCTIONAL PLAN — WEEK 40

| Week No. | Professional Skills (Trade Practical)           | Professional Knowledge (Trade Theory) |
|----------|-------------------------------------------------|---------------------------------------|
| WEEK 40  | On the Job Training (OJT) / Group Project Work: |                                       |

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**INSTRUCTIONAL PLAN — WEEK 41**

| Week No. | Professional Skills (Trade Practical)           | Professional Knowledge (Trade Theory) |
|----------|-------------------------------------------------|---------------------------------------|
| WEEK 41  | On the Job Training (OJT) / Group Project Work: |                                       |

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INSTRUCTIONAL PLAN — WEEK 42

| Week No. | Professional Skills (Trade Practical)           | Professional Knowledge (Trade Theory) |
|----------|-------------------------------------------------|---------------------------------------|
| WEEK 42  | On the Job Training (OJT) / Group Project Work: |                                       |

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