

CRAFTSMEN TRAINING SCHEME (CTS)

ANNUAL INSTRUCTIONAL PLAN

ELECTRONICS MECHANIC (FIRST YEAR – 42 WEEKS)

Curriculum as per DGT / CSTARI Guidelines for Electronics Mechanic CTS Scheme

Trade Name	ELECTRONICS MECHANIC (Engineering Trade)
NSQF Level & Duration	NSQF Level-4 Two Years (First Year - 42 Weeks)
Academic Session	20____ - 20____
Institute Name & Address	
Instructor Name & Designation	
Group Instructor (GI) Name	
Principal / Supt. Name	

WEEKLY INSTRUCTIONAL PLAN (WEEK 1 TO WEEK 42)

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
WEEK 01	Safety & Workshop Induction: 1. Visit to various sections of the institute and identify location of various installations. 2. Identify safety signs for danger, warning, caution & personal safety message. 3. Use of personal protective equipment (PPE). 4. Practice elementary first aid. 5. Preventive measures for electrical accidents & steps to be taken in such accidents. 6. Use of Fire extinguishers.	Safety Guidelines & Housekeeping: 1. Familiarization with the working of Industrial Training Institute system. 2. Importance of safety and precautions to be taken in industry/shop floor. 3. Introduction to PPEs and First Aid. 4. Response to emergencies e.g. power failure, fire, and system failure. 5. Importance of housekeeping & 5S concept, Occupational Safety & Health guidelines.
WEEK 02	Hand Tools & Basic Fitting Operations: 1. Identify different hand tools. 2. Selection of proper tools for operation and precautions in operation. 3. Care & maintenance of trade tools. 4. Practice safety precautions while working in fitting jobs. 5. Workshop practice on filing and hacksawing. 6. Practice simple fitting and drilling.	Hand Tools, Sheet Metal & EMI/EMC: 1. Identification, specifications, uses and maintenance of commonly used hand tools. 2. Correct shape of files for filing different profiles. 3. Riveting of tags and lugs, cutting and bending of sheet metals, chassis and cabinets. 4. Introduction to Electro Magnetic Interference (EMI) and Electro Magnetic Compatibility (EMC).
WEEK 03	Basics of AC, Earthing & Electrical Cables: 1. Identify Phase, Neutral and Earth on power socket, use testers to monitor AC power. 2. Construct test lamp and use it to check mains healthiness. 3. Measure voltage between phase and ground and rectify earthing. 4. Identify and test different AC mains cables. 5. Prepare terminations, skin electrical wires/cables using stripper and cutter. 6. Measure wire gauge using SWG/AWG and outside micrometer.	Electrical Terms & Cable Classification: 1. Basic terms: electric charges, Potential difference, Voltage, Current, Resistance, AC vs DC. 2. Parameters: +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, Instantaneous value. 3. Single-phase and Three-phase supply, Line and Phase voltage/currents. 4. Insulators, conductors, semiconductors, SWG wire standards, cable current rating tables.
WEEK 04	Cable Crimping & Single Range Meters: 1. Refer table and find current carrying capacity of wires. 2. Crimp lugs to wire ends. 3. Measure AC and DC voltages using multimeter. 4. Identify type of meters by dial and scale marking/symbols. 5. Demonstrate various analog/Digital measuring Instruments. 6. Find minimum and maximum measurable range of meter. 7. Carry out mechanical zero setting of meter. 8. Check continuity of wires, meter probes and fuses. 9. Measure voltage and current using clamp meter.	Measuring Instruments (PMMC & MI): 1. Cable classification by gauge, core size, conductors, insulation, flexibility. 2. Introduction to electrical and electronic measuring instruments. 3. Basic principles and parts of simple meters (PMMC, Moving Iron). 4. Dial markings, symbols, meter range extension, multimeters and clamp meters.
WEEK 05	Cells & Secondary Batteries: 1. Identify +ve and -ve terminals of battery. 2. Identify rated output voltage and Ah capacity of given battery. 3. Measure voltages of given cells/battery using analog/digital multimeter. 4. Charge and discharge battery through load resistor. 5. Maintain secondary battery. 6. Measure specific gravity of electrolyte using hydrometer. 7. Test battery and verify whether ready for use or needs recharging.	Battery Chemistry & Maintenance: 1. Construction, types of primary and secondary cells/batteries. 2. Materials used, specifications of cells and batteries (Ah rating). 3. Charging processes, efficiency, battery life, electrolytes used. 4. Use of hydrometer, series/parallel grouping of batteries and applications.
WEEK 06	Digital Storage Oscilloscope (DSO): 1. Identify different front panel controls of DSO. 2. Measure Amplitude, Frequency and time period of typical electronic signals using DSO. 3. Connect USB to DSO, save waveform in USB, open in computer and print.	DSO Architecture & Controls: 1. Advantages, features, and block diagram of Digital Storage Oscilloscope (DSO). 2. Front panel controls, sampling rate, bandwidth, trigger controls. 3. Waveform capture, measurement cursors, USB data storage and retrieval.

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WEEK 07	AC/DC Parameters & Signal Generator Operation: 1. Use multimeter to measure functions: AC V, DC V, DC I, AC I, Resistance. 2. Identify different types of meters for AC & DC parameters. 3. Identify DSO front panel controls and observe function of each control. 4. Measure DC voltage, AC voltage, time period using DSO sine wave parameters. 5. Identify function generator controls and observe function of each control.	Meters & Signal Generators: 1. Classification, characteristics, sensitivity, and errors in meters. 2. Multimeter loading effect, care and maintenance of meters. 3. Function generator principles: sine, square, triangle waveform generation. 4. Use of LCR meters for impedance measurement.
WEEK 08	PCB Design, Layout & Gerber Generation: 1. Convert schematics into PCB layouts, apply design rules, generate Gerber files and G-code conversion. 2. Develop accurate circuit diagrams using PCB design software.	PCB Fundamentals & Layout CAD: 1. PCB types (single-sided, double-sided, multilayer), materials (FR4, phenolic). 2. Schematic capture, component footprint selection, design rule checks (DRC). 3. Track routing, trace width vs current capacity, Gerber files and G-code generation.
WEEK 09	PCB Printing & Fabrication Machine: 1. Setup and run PCB printing machine, material loading, alignment, and basic troubleshooting. 2. Inspect for defects and perform continuity and functionality tests on completed PCBs.	PCB Fabrication & Quality Control: 1. PCB printing machine operation, calibration, etching and drilling processes. 2. Inspection techniques, dry solder detection, short circuit and open circuit tests. 3. Safety measures, Electrostatic Discharge (ESD) precautions, and environmental disposal.
WEEK 10	Soldering, De-Soldering & Industrial Switches: 1. Practice soldering on electronic components, small transformers and lugs. 2. Practice soldering on IC bases and PCBs. 3. Practice de-soldering using pump and wick. 4. Join broken PCB tracks and test. 5. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches. 6. Make panel board using different types of switches for given applications.	Soldering Techniques & Switch Specifications: 1. Soldering irons/guns: wattage, temperature control, tip styles and maintenance. 2. Solder composition (lead/lead-free), flux grading, de-soldering braid and pump. 3. Temperature-controlled soldering stations and specifications. 4. Electronic switches: pole/throw configurations, ratings and applications.
WEEK 11	Resistors, Colour Code & Ohm's Law: 1. Identify different types of active and passive components. 2. Measure resistor values by colour code and verify measuring with multimeter. 3. Identify resistors by appearance and check physical defects. 4. Identify power rating of carbon resistors by size. 5. Practice parameter measurement in combinational circuits applying Ohm's Law.	Resistor Physics & DC Circuit Laws: 1. Active vs passive components classification. 2. Resistors: carbon composition, metal film, wire-wound, SMD resistors. 3. 4-band and 5-band colour coding, tolerance and power ratings. 4. Ohm's law, voltage drop, series-parallel equivalent resistance calculations.
WEEK 12	Kirchhoff's Laws & Series-Parallel Networks: 1. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Laws (KCL & KVL). 2. Verify laws of series and parallel circuits with voltage sources in different combinations. 3. Measure resistance, voltage, current through series and parallel connected networks using multimeter.	Network Theorems & Power Distribution: 1. Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL). 2. Voltage divider and current divider rules in resistive networks. 3. Power dissipation calculations in series and parallel circuits.
WEEK 13	Inductors & Magnetic Devices: 1. Identify different inductors and measure values using LCR meter. 2. Identify and test circuit breakers and other protective devices. 3. Dismantle and identify different parts of relay. 4. Connect timer relay in circuit and test for working. 5. Connect contactor in circuit and test for working.	Inductance & Electromagnetic Devices: 1. Principles of electromagnetic induction, self and mutual induction. 2. Inductors: types, cores (air, iron, ferrite), inductive reactance (XL), Q-factor. 3. Relays and contactors: construction, coil voltages, contact ratings (NO/NC). 4. Circuit breakers, fuses, and transient protection devices.
WEEK 14	Capacitors & RC Wave Shaping: 1. Identify different capacitors and measure capacitance using LCR meter. 2. Construct and test RC time constant circuit. 3. Construct RC differentiator circuit and convert triangular wave into square wave. 4. Use RC filters and make High Pass and Low Pass filters.	Capacitance & Passive Filters: 1. Capacitors: dielectric materials, capacitive reactance (XC), voltage ratings. 2. Series and parallel grouping of capacitors. 3. Time constant ($\tau = RC$) in charging and discharging cycles. 4. RC integrator, differentiator, High Pass and Low Pass passive filter circuits.

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WEEK 15	Resonance Circuits & AC Networks: 1. Construct and test series and parallel resonance circuits, plot frequency response curves, calculate resonant frequency and bandwidth using DSO and function generator.	Resonance & Quality Factor: 1. Resonance phenomena in RLC series and parallel circuits. 2. Resonant frequency formula (f_r), impedance at resonance, phase angle. 3. Bandwidth, half-power frequencies, Q-factor and selectivity.
WEEK 16	Semiconductor Diodes & V-I Characteristics: 1. Test given diode using multimeter and determine forward to reverse resistance ratio. 2. Measure voltage and current through diode in circuit and verify forward/reverse characteristics.	P-N Junction Semiconductor Physics: 1. Semiconductor materials (Si, Ge), intrinsic and extrinsic doping. 2. P-N junction formation, barrier potential, depletion layer. 3. Forward and reverse biasing, knee voltage, reverse breakdown, diode packaging styles.
WEEK 17	Mains Transformers & Testing: 1. Identify different types of transformers and test. 2. Identify primary and secondary windings and test polarity. 3. Measure primary/secondary voltages, calculate transformation ratio and test isolation.	Transformers in Power Supplies: 1. Working principle of transformer, mutual induction, transformation ratio. 2. Core types (laminated sheet, CRGO, toroidal, ferrite), winding construction. 3. Step-up, step-down, center-tapped, and isolation transformers; transformer losses.
WEEK 18	Rectifier Circuits (Half Wave & Full Wave): 1. Construct and test half-wave, full-wave center-tapped, and bridge rectifier circuits. 2. Measure ripple voltage, ripple frequency, and ripple factor for different loads and filter capacitors.	Rectification & Smoothing Filters: 1. Rectifier circuits: Half wave, Full wave center-tapped, Bridge configuration. 2. Rectifier efficiency, PIV rating, ripple factor, conduction angles. 3. Filter circuits: Shunt capacitor, series inductor, LC, and pi-filters.
WEEK 19	Zener Voltage Regulation: 1. Construct and test Zener diode based voltage regulator circuit. 2. Calculate percentage regulation of regulated power supply under varying line and load conditions.	Zener & Special Diodes: 1. Zener breakdown vs Avalanche breakdown mechanisms. 2. Zener diode specifications (VZ, IZ(min), PZ), series current-limiting resistor design. 3. Line regulation and load regulation percentage formulas, Varactor diode.
WEEK 20	Linear Fixed & Adjustable IC Regulators: 1. Construct and test +3V, +5V, +12V fixed voltage regulators using 78XX and 79XX series. 2. Identify fixed +ve and -ve regulator ICs and current ratings. 3. Observe output voltage of IC 723 metal/plastic packages. 4. Construct and test 1.2V - 30V variable regulated power supply using IC LM317T.	Three-Terminal Voltage Regulator ICs: 1. Three-terminal fixed positive (78XX) and negative (79XX) regulators, pinouts and drop-out voltage. 2. Adjustable regulator IC LM317T: circuit design, output equation, heat-sink selection. 3. Precision voltage regulator IC 723 (low and high voltage configuration, current limit).
WEEK 21	Bipolar Junction Transistors (BJT): 1. Identify different transistors with respect to package types (TO-92, TO-18, TO-220, TO-3), B-E-C pinout, power and switching ratings, heat sinks. 2. Test condition of transistor using ohmmeter/multimeter hFE socket. 3. Construct and test transistor-based switching circuit to control relay.	Transistor Theory & Switching: 1. BJT construction: NPN and PNP types, emitter, base, collector functions. 2. Transistor action, current relationships ($I_E = I_B + I_C$), alpha and beta parameters. 3. Transistor regions of operation: Cut-off, Active, Saturation. 4. Transistor as a switch: relay driver circuits, flyback freewheeling diodes.
WEEK 22	Transistor Biasing & Small Signal Amplifiers: 1. Construct and test fixed-bias, emitter-bias, and voltage-divider bias transistor amplifier circuits. 2. Construct and test common emitter (CE) amplifier with and without emitter bypass capacitor.	Biasing & Stabilization: 1. Operating point (Q-point), DC load line analysis. 2. Biasing methods: Base bias, collector feedback, voltage divider bias stability factor. 3. CE amplifier: input/output phase reversal (180 deg), voltage gain, bypass capacitor effect.
WEEK 23	CC Amplifier & Multistage RC Coupled Amplifiers: 1. Construct and test Common Collector / Emitter Follower amplifier. 2. Construct and test two-stage RC Coupled amplifier, measure gain and frequency response.	Amplifier Configurations & Coupling: 1. Transistor configurations (CB, CE, CC): input/output impedance, current/voltage gain. 2. Emitter follower (CC) circuit: high input impedance, impedance matching applications. 3. Multistage RC coupled amplifier, dB/dBm gain, frequency response, coupling capacitor roles.

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
WEEK 24	Sinusoidal Oscillators: 1. Demonstrate Colpitts oscillator, Hartley oscillator circuits and compare output frequency using DSO. 2. Construct and test RC phase shift oscillator circuit. 3. Construct and test crystal oscillator circuits.	Oscillator Principles & Criteria: 1. Barkhausen criteria for sustained oscillations, positive feedback vs negative feedback. 2. LC tank circuits: Hartley and Colpitts oscillator frequency calculations. 3. RC oscillators: RC phase shift and Wien bridge circuits. 4. Piezoelectric crystal oscillators, quartz crystal stability, applications.
WEEK 25	Multivibrators & Wave Shaping Circuits: 1. Demonstrate Astable, Monostable, Bistable multivibrator circuits using transistors. 2. Construct and test diode shunt clipper circuits. 3. Construct and test series and dual clipper circuits using diodes. 4. Construct and test clamper circuits using diodes. 5. Construct and test Zener diode as peak clipper.	Non-Sinusoidal Wave Shaping: 1. Transistor multivibrators: Astable (free-running), Monostable (one-shot), Bistable (flip-flop). 2. Diode clippers: positive, negative, biased, and combination dual clippers. 3. Diode clampers: positive and negative DC restorer circuits. 4. Zener diode voltage slicing circuits and transient suppression.
WEEK 26	JFET & UJT Relaxation Oscillator: 1. Identify power electronic components, specifications, and terminals. 2. Construct and test JFET amplifier. 3. Construct UJT-based free-running relaxation oscillator and vary its frequency.	Field Effect Transistors & UJT: 1. Junction Field Effect Transistor (JFET): N-channel and P-channel construction, drain characteristics. 2. Pinch-off voltage, transconductance, high input impedance advantages over BJT. 3. Uni-Junction Transistor (UJT): construction, intrinsic standoff ratio (η), negative resistance region, relaxation oscillator design.
WEEK 27	Thyristors (SCR, DIAC, TRIAC): 1. Construct test circuit of SCR using UJT triggering. 2. Construct simple lamp dimmer circuit using TRIAC and DIAC.	Thyristor Phase Control: 1. Silicon Controlled Rectifier (SCR): two-transistor analogy, gate triggering, latching and holding currents. 2. DIAC: bidirectional triggering diode, breakover voltage. 3. TRIAC: bidirectional thyristor, four-quadrant triggering, AC phase control in lamp dimmers and fan regulators.
WEEK 28	Power MOSFET & IGBT: 1. Identify Power MOSFETs by number and test using multimeter. 2. Construct MOSFET test circuit with small load driver. 3. Identify IGBTs by number and test using multimeter. 4. Construct IGBT test circuit with small load.	Advanced Power Semiconductor Switches: 1. Power MOSFET: enhancement and depletion modes, voltage-controlled characteristics, low $R_{DS(on)}$, high switching speed. 2. Insulated Gate Bipolar Transistor (IGBT): hybrid construction (MOS gate + bipolar output), high voltage/current capability. 3. Comparison: BJT vs MOSFET vs IGBT, gate driver circuits and snubber networks.
WEEK 29	Optoelectronic Devices & Optical Sensors: 1. Test LEDs with DC supply, measure voltage drop and current using multimeter. 2. Construct circuit to switch lamp load using photodiode. 3. Construct circuit to switch lamp load using phototransistor.	Optoelectronics Physics: 1. Visible LEDs, Infrared (IR) LEDs, spectral emission, forward voltage drops. 2. Photodiodes (reverse bias light detection) and phototransistors. 3. Opto-couplers / Opto-isolators (MOC series, 4N35, PC817): galvanic isolation, CTR rating. 4. Laser diodes: working principles and safety precautions.
WEEK 30	Logic Gates & Universal Gates: 1. Verify truth tables of all basic logic gate ICs (7404, 7408, 7432, 7486) connecting switches and LEDs. 2. Construct and verify truth tables of all gates using NAND (7400) and NOR (7402) universal gates. 3. Use digital IC tester to test various TTL and CMOS ICs.	Digital Number Systems & Boolean Logic: 1. Analog vs Digital signals, logic voltage levels (TTL 5V, CMOS). 2. Number systems: Binary, Decimal, Octal, Hexadecimal conversions. 3. BCD code, ASCII code, Gray code. 4. Basic gates (NOT, AND, OR, XOR, XNOR) and universal gates (NAND, NOR). 5. IC pinouts: 7400, 7402, 7404, 7408, 7432, 7486.
WEEK 31	Combinational Arithmetic Circuits: 1. Construct Half Adder circuit using logic gates and verify truth table. 2. Construct Full Adder using two Half Adders and verify truth table. 3. Construct Adder-cum-Subtractor circuit using 7483/XOR gates and verify results.	Binary Arithmetic & MSI Adders: 1. Binary addition and subtraction rules, 1's and 2's complement arithmetic. 2. Half Adder and Full Adder Boolean equations and logic diagrams. 3. 4-bit parallel binary adder IC 7483 and Magnitude Comparator IC 7485.

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
WEEK 32	Multiplexers, Encoders & Decoders: 1. Construct and test 2-to-4 Decoder circuit. 2. Construct and test 4-to-2 Priority Encoder circuit. 3. Construct and test 4-to-1 Multiplexer (MUX) circuit. 4. Construct and test 1-to-4 De-Multiplexer (DEMUX) circuit.	Data Routing & Code Conversion: 1. Decoders: 2-to-4, 3-to-8 (74138), BCD-to-7-segment decoder (7447). 2. Encoders: Priority encoders and decimal-to-BCD encoding. 3. Multiplexers (Data Selectors): 2:1, 4:1, 8:1 (74151) and De-multiplexers (74154).
WEEK 33	Flip-Flops & Latches: 1. Identify different Flip-Flop ICs by part numbers (7474, 7476, 7475). 2. Verify truth tables of Flip-Flop ICs (RS, D, T, JK, MS-JK) connecting input switches and output LEDs. 3. Construct and test 4-bit latch using IC 7475. 4. Construct and test R-S flip-flop using IC 7400 with and without clock pulses.	Sequential Logic Fundamentals: 1. Latches vs Flip-Flops, level triggering vs edge triggering. 2. S-R Flip-Flop, D Flip-Flop, T Flip-Flop, J-K Flip-Flop truth tables and race-around condition. 3. Master-Slave J-K Flip-Flop operation and timing diagrams. 4. Flip-flop applications: registers, counters, frequency dividers.
WEEK 34	Electronic Circuit Simulation Software: 1. Prepare simple digital and analog electronic circuits using circuit simulator software. 2. Simulate, test, and observe waveforms of prepared digital and analog circuits. 3. Convert prepared simulation circuit into PCB layout diagram. 4. Prepare power electronic and domestic electronic circuits using simulation tools.	EDA Software & Virtual Instrumentation: 1. Introduction to electronic circuit simulation tools (Proteus, Multisim, KiCAD, LTspice). 2. Component libraries, schematic capture, SPICE models, virtual instruments (oscilloscopes, meters). 3. Fault injection and virtual circuit debugging methods.
WEEK 35	Operational Amplifier (IC 741) Basics: 1. Construct and test Inverting, Non-inverting, and Summing Amplifier circuits using Op-Amp IC 741. 2. Construct and test zero-crossing detector and voltage comparator circuits using Op-Amp.	Op-Amp Fundamentals: 1. Operational Amplifier block diagram, differential amplifier stage, dual power supply (+/- 12V). 2. Ideal vs practical Op-Amp parameters: open-loop gain, input impedance, output impedance, CMRR, slew rate, offset null. 3. Inverting and Non-inverting closed-loop configurations, virtual ground concept, Summing amplifier.
WEEK 36	Advanced Op-Amp Circuits & D/A Converters: 1. Construct and test Op-Amp Differentiator and Integrator circuits. 2. Construct and test Instrumentation Amplifier circuit using Op-Amps. 3. Construct and test Binary Weighted and R-2R Ladder type Digital-to-Analog Converters (DAC).	Mathematical & Data Conversion Circuits: 1. Active Integrator and Differentiator frequency response, stability issues. 2. Instrumentation Amplifier: 3 Op-Amp topology, high CMRR, transducer signal conditioning. 3. Digital-to-Analog Converters (DAC): Binary-weighted resistor DAC vs R-2R ladder DAC network.
WEEK 37	Timer IC 555 (Astable & Monostable Modes): 1. Construct and test Astable multivibrator timer circuit using IC 555, measure output frequency and duty cycle on DSO. 2. Construct and test Monostable timer circuit using IC 555, calculate pulse width ($T = 1.1RC$).	Timer IC 555 Architecture: 1. Internal block diagram of IC 555: voltage divider, two comparators, RS flip-flop, discharge transistor, reset pin. 2. Astable mode: charging/discharging equations, frequency and duty cycle control. 3. Monostable mode: trigger requirements, output pulse width determination, applications.
WEEK 38	Timer IC 555 (VCO & PWM Applications): 1. Construct and test Voltage Controlled Oscillator (VCO / V-to-F converter) using IC 555. 2. Construct and test IC 555 timer as Pulse Width Modulator (PWM).	Modulation & Voltage-to-Frequency Conversion: 1. Pin 5 (Control Voltage) function in IC 555, threshold voltage modulation. 2. Principles of Voltage Controlled Oscillators (VCO). 3. Pulse Width Modulation (PWM) generation, motor speed control, DC-DC conversion.
WEEK 39-42	On the Job Training (OJT) / Group Project Work	On the Job Training (OJT) / Group Project Work

APPROVAL & SIGNATURES

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Sign of Instructor	Sign of Group Instructor (GI)	Sign of Superintendent / Principal