

SYLLABUS
FOR THE TRADE OF
Mechanic industrial electronics
UNDER
CRAFTSMEN TRAINING SCHEME
&
APPRENTICESHIP TRAINING SCHEME

Designed in 2001

Government of India
Ministry of Labour (D.G.E.&T.)
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN – Block, Sector – V, Salt Lake,
Kolkata-700091.

**LIST OF THE MEMBERS PARTICIPATED THE TRADE COMMITTEE MEETING
FOR THE TRADE OF “MECHANIC INDUSTRIAL ELECTRONICS” UNDER C.T.S.**

<u>Sl. No.</u>	<u>Name</u>	<u>Organisation</u>	
	<u>S/Sri</u>		
1.	S. R. Majumdar	Director, CSTARI, Kolkata	Chairman
2.	D. R. Chatterjee	General Manager, Rifle Factory, Ichapur	Member
3.	B. N. Mukherjee	Manager (Trg.),S.N.T.I. TISCO, Jamshedpur	Member
4.	S. C. Rudra	Dy. Director (Engg.) All India Radio, Kolkata	Member
5.	A. K. Ghosh	HOD, Electrical Asansol Polytechnic, W.B.	Member
6.	A. K. Saha	Addl. Director (Scientist-E) E.R.T.L. (E), Kolkata	Member
7.	T. K. Dey	In charge, Practical Trg. Kanchrapara Tech. School	Member
8.	P. K. Mukhopadhyay	Asst. Director of Indl. Trg., D.I.T., Govt. of W.B.	Member
9.	P. S. Ghosh	Sr. Officer (HRD) CESC, Kolkata	Member
10.	P. N. Sanyal	The George Telegraph Trg. Institute, Kolkata	Member
11.	B. K. Nandi	The George Telegraph Trg. Institute, Kolkata	Member
12.	S. K. Mondal	Sr. Lecturer, TTC, CLW Chittaranjan, W.B.	Member
13.	K. P. Chattopadhyay	Jt. Director, CSTARI, Kolkata	Member
14.	R. M. Sinha	Jt. Director, CSTARI, Kolkata	Member
15.	D. P. Ganguli	Jt. Director, CSTARI, Kolkata	Member
16.	B. Prasad	Jt. Director, ATI, Kolkata	Member
17.	T. Mukhopadhyay	Dy. Director, CSTARI, Kolkata	Member
18.	C. S. Murthy	Asst. Director, CIMI, Chennai	Member
19.	G. Giri	Asst. Director, CSTARI, Kolkata	Member
20.	T. Selvaraju	Asst. Director, RDAT, Kolkata	Member
21.	D. R. N. Bharati	Trg. Officer, CSTARI, Kolkata	Member

GENERAL INFORMATION

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| 1. Name of the trade | : Mechanic Industrial Electronics. |
| 2. N.C.O. Code No. | : 852.10
852.20 |
| 3. Entry Qualification | : Passed 10+2 with Physics, Chemistry & Mathematics. |
| 4. Duration of Craftsmen Training | : 2 Years. |
| 5. Duration of Apprenticeship Training | : 3 years (2 Years Basic Training & 1 Year Plant/Shop floor Training) |
| 6. Rebate | : 2 Years for Ex- ITI Trainees in the trade of Mechanic Industrial Electronics. |
| 7. Ratio of Apprentices to workers | : 1:7 |

NOTE

1. **The syllabus mentioned here is a guide for the Instructors to prepare their own schedule of training. The portion in respect of different weeks may be adjusted according to the Training schedule prepared by the Instructors concerned. While teaching Engineering Drawing, emphasis should be laid on free hand sketching, Drawing reading, Drawing of circuits and parts related to the trade according to the syllabus.**
2. **Workshop calculation & Science, similar as in “Mechanic (Electronics)” trade. Reading of Vernier Caliper & Micrometer also should be taught in Workshop Calculation & Science.**

SYLLABUS FOR THE TRADE OF “MECHANIC INDUSTRIAL ELECTRONICS” UNDER CTS

Duration: 2 Years

Week No.	PRACTICAL	THEORY	Engg. Drg
1	a) Visit to the various sections of the Institute . b) Introduction with the principal & other teaching staffs. c) Demonstration of various systems of the trade like Computer , Motor, CNC Machine etc.	a) Organisation of the Institute b) Introduction to the different Trades and Departments. c) Types of work, responsibility to be undertaken as trainees. d) Prospect and future of the trade. e) Incentives and future planning of profession. f) Elementary First Aid. g) Safety precautions to be observed related to the Trade.	Introduction to Engineering Drawing Instruments and their uses.
2.	Demonstration, Identification and uses of Trade HandTools. Handling of basic measuring Instruments and their connections. Familiarisation and use of CRO.	Introduction to Hand Tools used in the trade. Familiarisation with basic measuring instruments.	Geometrical Drawing.
3.	Soldering and De-soldering practice on copper wires.	Soldering techniques, Solder and Flux. Effects of Dry soldering. Different types of soldering and De-soldering equipments (should be updated as per the development of latest technology). Uses of copper, Zinc, Lead & tin.	Free hand sketching of hand tools.
4.	Soldering practice on Printed Circuit Boards.	Basic Atomic structure, Electron configuration,	

		Conductors, Insulators and semi conductors. Electricity and electrical terms, Concept of electrical energy. Sources of electrical energy like heat, pressure water, chemical, nuclear etc., Definition of Current, Voltage, Resistance and power.	
5.	Familiarise with rheostat, power supply, Ammeter, Voltmeter and ohm meter. Soldering practice on different types of connectors.	Electric circuits, open circuit, closed circuit and short circuit. Ohm's law. Calculation of current, Voltage, resistance and power.	
6.	Verification of Ohm's law. Measure power in simple electric circuits.	Resistance temperature co-efficient, PTC and NTC characteristics. Resistors- their value, wattage and tolerance. Colour coding of resistors.	Free hand sketching practice of inclined lines and polygons, rectangles, squares etc.
7.	Measurement of resistance by ohm meter and verification of colour code. Find the resistance temp. co-efficient of Tungsten filament lamp.	Constructional details of carbon resistors, wire wound resistors, carbon film resistors, metal film resistors, their properties and uses.	Free hand sketching practice on curved lines, arc, circle etc.
8.	Measure the total resistance, current and voltage drop in series circuit and parallel circuit. Verification of Kirchhoff's laws.	Series circuit, Parallel circuit their connection and characteristics. Series-parallel combination circuits. Kirchhoff's laws and its applications.	Picture, plane concept. Diverging and converging projections.
9.	Familiarise with various types of variable resistors. Construct and measure the voltages in voltage divider. Measure the resistance of Thermistors at different temperatures and plot the graph. Verify the non-linear characteristics of LDR and VDR.	Variable resistors, Carbon potentiometer, wire wound potentiometer, single turn, multi turn, ganged types, linear and logarithmic. Preset resistors. Non-linear resistors, Thermistor, LDR, VDR their characteristics and application.	Orthographic projection. Directional views by orthographic projection. First angle method of projection.

10.	Familiarise with various types of switches, construct circuits with SPST, SPDT, DPDT switches.	Magnetism-Magnetic properties, Earth magnetism, magnetic field, flux, flux density, reluctance, magnetizing force and hysteresis. Magnetic induction, Electro magnetism, Cork screw rule, right hand and left hand rules. Electromagnetic induction and Lenz's law.	
11.	Familiarise with relays and their contacts. Circuit breakers and their connections. Various types of contactors and their connections.	Electromagnetic switches, Relays their construction and working, construction and working principle of microphones and speakers. Circuit breakers and their working.	Third angle method of projection.
12.	Measure voltage and current in AC circuits.	Concept of DC & AC. AC fundamentals, induced emf, terms used in AC- frequency, time, period, peak value, average value, r.m.s. value, Sine Wave. Illustration with examples and problems.	Comparison of First angle and third angle projections. Practice on third angle projections. Practice on third angle projection.
13.	Demonstration on induced e.m.f. Measurement of inductance, Find the Q factor of the coil.	Inductance, Factors affecting the value of inductance, self inductance (L), Mutual inductance (M), Inductors in series and in parallel, L/R time constant. Q factor of the coil.	Third angle projection from pictorial views.
14.	Verify the laws of capacitance. Measure the values of capacitor by capacitance meter. Practice with the colour codes of capacitor. Verification of RC time constant.	Capacitance, construction and types of capacitor, unit of capacitance, factors affecting the value of capacitors, colour coding of capacitors, charge, energy stored in capacitors. Capacitors in DC circuit, RC time constant, variable capacitors.	Isometric projections.
15.	Find the total capacitance and charge in series and parallel circuits of capacitors.	Capacitors in series and parallel. Causes of failure of capacitor. Problems on series and	

		parallel circuit of capacitors.	
16.	Measure the voltage, current and power in series AC circuits and find inductive reactance , Capacitive reactance, impedance and power factor.	Series AC circuits, Reactance X_L & X_C , Impedance, power, power factor and its importance. Problems on series AC circuits.	
17.	Plot the graph between frequency and current in the series resonant circuit and parallel resonant circuit and find the bandwidth.	Representation of AC quantities by vectors. Resonance, series resonance circuit, Parallel AC circuits, parallel resonance circuits and their characteristics. Bandwidth . Problems on parallel AC circuit and resonance circuits.	Perspective drawing.
18.	Measure the voltage, current and power in star connected circuit and delta connected circuit.	Polyphase AC system and its advantages. 3 Phase AC system, Star connected system and Delta connected system.	
19.	-do-	Super-position theorem, Thevenin's theorem, Norton theorem. Conversion from Delta to Star and vice versa. Maximum Power transfer theorem including problems on above theorem.	Dimensioning technique & systems in dimensioning.
20.	To familiarise with the construction of Lead acid batteries . Measure the specific gravity of a charged and discharged cell. Charging of battery using battery charger. Routine maintenance, installation and removing of batteries from service.	General features of batteries, Primary cell, Internal resistance and polarisation. Dry cell, Lead acid cell, separator, Electrolyte, portable batteries.	
21.	Familiarise with the maintenance -free batteries used in UPS, Emergency lamps etc. Constant current charge, Constant voltage charge, Trickle charging.	Constructional features and rating of Ni-cd cell, Solar cell, Lithium cell, Mercury silver oxide cell. Series and parallel grouping of cells.	

22.	Identify and measure the resistance of Armature, field windings various types of generators. Find the open circuit and load characteristics of DC shunt generator.	DC Generator, principle of operation , construction, field magnets, armature windings, commutator and brushes. EMF equation. Open circuit characteristics and load characteristics of shunt generator.	Exercises on 3rd angle projection with dimensioning.
23.	Start the DC motors with starters and change the direction of rotation. Vary the speed of the shunt motor by varying the armature current and field current.	DC Motors their construction and working principle. Fleming's left hand rule, counter EMF, armature reaction and brush position. Types of motors and their applications. DC motor starters, DC motor speed control by field current control and armature current control, their merits and demerits.	
24.	Identify the primary and secondary windings of transformer. Find the turns ratio of transformer, Find the percentage of regulation of transformer.	Transformer, construction and principle of operation, turns ratio, equivalent resistance and reactance, losses in transformer. Open circuit test and short circuit test, regulation and efficiency of transformer.	Introduction to sections and sectional views.
25.	Star delta transformer and delta star transformer. Connect and vary the output of single phase auto transformer and three phase auto transformer.	Three phase transformers, auto transformer and its advantages, Instrument transformers- Potential transformer and current transformer. High frequency transformers, Pulse transformer, SMPS transformer. Problems involving turns ratio, efficiency, regulation.	
26.	Measure the output voltage, frequency, power and power factor in single phase alternator and find its regulation.	Alternator, construction and its windings, working principle, output emf and frequency regulation of alternator.	Different types of sections used in Engg. drawing. Conventions used in Engg. Drawing.
27 to	Identification of Induction motors (single phase), Squirrel cage type, split phase	Induction motor, principle of rotating magnetic field, synchronous speed, slip, rotor	Sectional view exercises.

29	type, capacitor type. Starting of induction motor, reversing. Dismantling and assembling. Stroboscopic method for measuring slip. Measurement of slip by means of synchronous motor. Repulsion motor and universal motor.	frequency and induced emf. Current, torque. Rotor slots of squirrel cage induction motor. Slip ring induction motor, slip torque characteristic curve, equivalent circuit of induction motor. Conventional speed control of Induction motor. Starting of squirrel cage induction motor. Problems involving slip, synchronous speed, rotor speed, poles etc.	
30.	Demonstration on synchronous motor.	Synchronous motor, principles and operation. Effect of increasing and decreasing field excitation. Effect of loading synchronous motor, excitation motor diagram. Synchronous condenser, use of synchronous motor for power factor improvement. Brush less and slot less motor.	Sectional view exercises.
31.	Demonstration of different types of Vacuum tubes.	Fundamentals of vacuum tube, Diode, Triode, Tetrode, pentode and CRT.	Sectional view exercises.
32.	Identification of diodes and testing by using multimeter. Plot the forward and reverse characteristics of silicon diode. Observe the effect of temperature on reverse current of diode.	Semi conductor, Covalent bond, Doping, Intrinsic and extrinsic semiconductor. PN junction diode, Forward and Reverse characteristics. The ideal diode, 2nd approximation, static and dynamic resistance. Specification of diodes (data sheets). Series and parallel connection of diodes and their effects.	Sectional view exercises.
33.	Construct and measure the input and output voltages of half wave rectifier. Observe the input and output wave form and find the	Rectifier, Half wave, full wave and bridge rectifiers. Peak inverse voltage, average DC output, ripple frequency and ripple factor.	Missing views and practice on above portion.

	average output DC of half wave rectifier circuit.	Applications of diodes. Three phase rectifier circuits. Problems involving peak value, average DC value, ripple factor, ripple voltage, efficiency, RMS voltage, Form factor etc.	
34.	Plot the forward and reverse characteristics of Zener diode, Varactor diode, photo diode, Schottky diode, and Light Emitting Diode.	Special diodes- Zener diode, Tunnel diode, Varactor diode, Photo conductive diodes, Light Emitting Diodes, IRLED and Schottky diode.	Dimensioning, sectioning and practice.
35.	Construct and plot the graph of frequency vs output voltage in Low pass, High pass and Band pass filters. Find the ripple factor of half wave and full wave circuits with filters.	Filters, Low pass filter, High pass filter, Band pass filter and Band stop filters. SAW filters. Power supply filters, Choke i/p, capacitor i/p and II filters. Ripple factor and percentage of ripple.	Dimensioning, sectioning and practice.
36.	Identification of leads of different packages of transistors. Testing transistor using multimeter. Learn to use the semiconductor data manual. Characteristics of transistors. Transistor as a switch.	Junction transistors, types and symbols, Amplifying action of a transistor. CB, CE, CC configurations and their comparison, Switching action of transistors. Thermal runaway of transistors.	Dimensioning, sectioning and practice.
37.	Identification of leads of FET, methods of testing FET using multimeter. Plot common source and common drain characteristics of FET.	Field effect transistors, principles of working, difference between bi-polar transistor and field effect transistors. Types of JFETs, their construction, characteristics and parameters.	Dimensioning, sectioning and practice.
38.	Application of JFET as amplifier, Application of JFET as constant source of current and constant resistance. Switching action of JFET.	MOSFETs, Enhancement mode and depletion mode, principles of working, characteristics of CMOS, VMOS, application of FETs and SIMFET. Power MOSFETs.	Theory of Isometric projection. Preparation of Isometric scale.
39.	Observe the effect on the leakage current	Transistor biasing, need for bias	Angles, arcs & circles in

	due to increase in temperature and hence collector current, Biasing of transistor.	stabilisation, requirements of a biasing circuit. Different types of biasing-Fixed bias, collector feed back bias.	Isometric construction.
40.	Check the effect on operating point (V_{ce}/I_c) in a fixed bias condition. To construct and measure voltages in a voltage divider bias.	Emitter feed back fixed bias circuit, voltage divider biasing circuit, Load line concept of biasing, static and dynamic resistance. Problems for a biased circuits with exercises (AC & DC)	Construction of sphere and irregular curves.
41.	Demonstration of typical amplifier system and its controls . Demonstration of industrial/domestic products such as voltage stabiliser (single phase & Three phase),uninterrupted power supply.	General characteristics of an amplifier, Concept of amplification, block representation of amplifier. Current gain, voltage gain and power gain. Amplifier output resistance, phase distortion, frequency distortion. Definition of dB, dBm & dBw.	Drawing of screws threads, fasteners, rivets and spring.
42.	Build a voltage divider biased single stage CE amplifier and observe phase relation between input and output, Find the gain and plot the frequency response curve.	Single stage voltage divider biased CE amplifier, Functions of coupling and by-pass capacitors. Input and output phase relation, graphical method of calculating gain.	Drawing of screw threads, fasteners, rivets and spring.
43.	Find the effect of coupling and by-pass capacitors. Assemble a CC amplifier; observe the phase relation and find the gain.	AC load line, equivalent circuit method, development of DC & AC equivalent circuit. Concept of h parameters. h parameter equivalent circuit of CE,CB,CC amplifiers.	Drawing of screw threads, fasteners, rivets and spring.
44.	Construct, measure the voltage gain and observe the wave form in a two stage RC coupled amplifiers and LC coupled amplifiers.	Coupling of amplifiers , RC coupling, LC coupling and Transformer coupled amplifiers, their construction and working; their frequency response, band width and applications.	Conventional electrical symbols.
45.	Find the maximum input signal of a amplifier. Construct and measure the gain	Direct coupled amplifier, its advantages and disadvantages, DC drift. Differential	Conventional electrical symbols.

	of DC amplifier. Measure the gain in Darlington coupled amplifier, Observe the output of Differential amplifier.	amplifier, Darlington pair and its advantages.	
46.	Construct and find the regulation in simple regulator, Series regulator and series parallel regulator. Construct a variable power supply with short circuit protection. Familiarise with three terminal voltage regulators.	Voltage regulator, Zener regulator, regulation, Series regulator Series parallel regulator, short circuit protection, Variable power supplies, ICs used as voltage regulators, three terminal voltage regulators.	Sketching of DC machines.
47.	Construct and measure the output in single ended power amplifier, push-pull power amplifier and complementary push-pull amplifier.	Power amplifier, Single ended power amplifier, Push-pull amplifier and complementary push-pull amplifier, their input and output impedance, working and applications.	Sketching of DC machines.
48.	Find the effects of positive feed back and negative feed back in amplifiers. Construct and find triggering voltage in Schmitt trigger circuit and observe the waveform.	Feed back, positive feed back and negative feed back; their effects and applications. Voltage feed back and current feed back; feed back systems. Schmitt trigger - its construction and working.	Sketching of DC machines.
49.	Construct, measure the output and observe the waveforms in Inverting amplifier. Non-Inverting amplifier, Summing amplifier.	Operational amplifier, its construction, input impedance, output impedance, open loop gain and closed loop gain, Inverting amplifier, Non-inverting amplifier and summing amplifier.	Sketching of DC machines.
50.	Differential amplifier, Voltage follower, Voltage to current converter and current to voltage converter.	Differential amplifier, CMRR, slew rate, offset, Voltage follower, Voltage to current converter, current to voltage converter and Instrumentation amplifier.	Sketching of DC machines.

51.	Assemble and measure the frequency in Hartley oscillator and Col-pit oscillator, observe the frequency with various values of inductors and capacitors.	Oscillators, basic oscillator, tank circuit, damped and undamped oscillation, Hansen criteria, Hartley oscillator, Col-pitts oscillator, Clapp oscillator,. their frequency of oscillation	Sketching of DC machines.
52.	Assemble and find the frequency of RC phase shift oscillators, Wein bridge oscillator, Crystal oscillator.	RC oscillators, their principle, RC phase shift oscillator, Wein bridge oscillator using OP-Amp. Peizo electric effect of crystals, crystal oscillator, their stability and applications.	Graphics symbol for transformer.
53.	Assemble and observe the outputs of Monostable, Bistable and astable multivibrators using transistors and IC 555.	Multivibrator Mono-stable multivibrator, its working, Bistable multivibrator and Astable multivibrator.	Drawing of sine wave.
54.	Assemble & observe the outputs of two input bistable multivibrator. Astable multivibrator as a VCO.	Bistable multivibrator with two inputs and two outputs. Voltage controller oscillators.	Wiring circuit of squirrel cage induction motor.
55.	Construct and measure the output of simple inverter, Familiarise with Emergency lamps, Fault findings in SMPS.	Inverter, Power inverter their working principle and circuit function. SMPS and UPS. Converters and their applications.	Diagram of single phase AC motor.
56.	Assemble and observe the outputs in clipper, clamper, biased clipper and clamper. Differentiator and integrator.	Wave forms, Sine wave, unit step, Pulse, ON-time . Off time, Duty cycle, delay time, rise time, false time, clipper, clamper, biased clipper, biased clamper, Differentiator, Integrator, OP-amp integrator and differentiator.	Drawing BIS symbols for different semi conductor devices such as Diode, Transistor, Zener diode. Thyristors, MOSFETs. UJT, LDR, VDR, LED etc.

57.	Verify the OP-AMP as Differentiator and Integrator.	Fixed amplitude sweep, constant current sweep, Miller time base generator, Boot-strap time base generator , Current time base generator, Blocking oscillators.	-do-
58.	Plot the characteristics of Photo transistor. Familiarise with various types of opto - couplers.	Photo transistor - its characteristics and application. Opto couplers, optical sensors and their application.	Circuit diagram of various types oscillators.
59.	Testing of SCR by multimeter. plot the Forward characteristics of SCR, Find the latching current and holding current of SCR, DC switching circuit. SCR OFF circuit.	Thyristor - SCR, its construction and characteristics, SCR in forward bias and reverse bias. Various firing methods, SCR gate firing circuits, DC switch , DC OFF circuit.	-do-
60.	AC switching circuit, SCR phase control circuit by RC firing. Characteristics of UJT, Find the stand-off ratio of UJT, Relaxation oscillators.	SCR in AC circuit, Natural commutation and forced commutation, Phase control action of SCR, RC firing circuit. UJT, its characteristics, stand-off ratio, UJT relaxation oscillator.	-do-
61.	Construct and observe the outputs of UJT firing circuit, Light dimmer, Pedestal and ramp circuit.	UJT firing circuit, Light dimmer, Pedestal and ramp circuit, Temp. controller, SCR with inductive load, dv/dt characteristics, SCR protection circuits.	-do-
62.	Characteristics of DIAC, DIAC as DC pulse generator, DC pulse generator. Characteristics of Triac, Fan regulator	Diac characteristics, DC and AC pulse generator, Triac-construction and characteristics, Triac power control circuit.	-do-
63.	DC motor speed control by SCR in flux control method and armature current control method.	DC motor speed control using SCR, Flux control method, Armature current control method, AC motor speed control systems.	Circuit diagrams of multivibrators.

64.	Assemble and verify the truth tables of OR, AND, NOT gates using discrete components. Verify the truth tables of NAND, NOR, EX-OR, EX-NOR gates.	Digital signals and analog signals, Basic logic functions and basic logic gates. Number system, Decimal, Binary, Octal and Hexa decimal system, their addition and subtraction. Combinational logic gates, NOR, NAND, EX-OR, EX-NOR gates their truth tables and timing diagrams. The excess - 3 code, Grey code, BCD code and ASCII code.	Circuit diagram of various types Oscillators. Circuit diagrams of Multivibrators.
65.	Verification of De-morgan's theorem, construct AND, OR, NOT, NAND, EX-OR gates using NOR gates.	Applications of logic gates. De-morgan's theorem, Universal logic gates, Concept of Karunnaugh map.	Drawing of various OP-AMP circuits.
66.	Construct AND, OR, NOT, NOR, EX-OR gates using NAND gates. Verify the functions of controlled inverter.	Half adder, Full adder, 2' compliment subtraction method, controlled inverter, 2's complement adder/subtractor, 4 bit adder/subtractor ALU.	-do-
67.	Handle & Use TTL & CMOS family integrated circuits (latest series of ICs may be used) Familiarisation with functional block and pin details of TTL and CMOS integrated circuits.	Digital ICs, Level of integration, Technologies and families of TTL, ECL and CMOS logic devices positive and negative logic, standard TTL, Totem pole output, propagation delay time and dissipation, TTL characteristics, Standard loading.	-do-
68.	Construct and observe the outputs of RS Flip-Flop, D Flip-Flop, JK Flip-Flop, T Flip-Flop, Master slave Flip-Flop with various combinations of inputs and clock signal.	Flip-Flop, RS Flip-Flop, clocked RS Flip-Flop, Flip-Flop with preset and clear inputs, D Flip-Flop, JK Flip-Flop, T Flip-Flop and Master slave Flip-Flop, timing diagrams.	-do-

69.	Construct and observe the functions of 4 bit series shift register, parallel shift register.	Registers, Series shift register, Bi-directional series shift register, Parallel shift register, Series in parallel out, Parallel in series out registers, series to parallel converter and parallel to series converter.	Drawing of Timer circuits.
70.	Construct and observe the outputs of ripple up counter, ripple down counter, decade counter, ring counter and Jhonson counter.	Counters, ripple- counter Up counter timing diagram frequency dividers, down counter, up-down counter, propagation delay, synchronous counters, decade counters, Ring Counter and Jhonson counter.	Block diagram of CRO.
71.	Familiarise with common anode, common cathode 7 segment LED displays, LCD displays and display drivers.	Display devices, LED display, 7 segment display format, Nixie tube, LCD display, Display drivers Dot matrix display format, Monitors, 4 digit BCD counter with display. Multiplexing and De-multiplexing.	-do-
72.	Construct and observe the output of Resistive network and Binary ladder D/A converter. Observe the output of comparator with different inputs. Familiarise with A/D converter.	Digital to analog converter, Resistive network and Binary ladder. Comparator, A/D converter, counter type conversion and continuous type conversion methods. Applications of D/A and A/D converters.	-do-
73.	Familiarise with the memory ICs, Parallel expansion of memory ICs, EPROM ICs, EPROM programmer, RAM ICs.	Memories- programmable switch, concept and types of primary memories, ROM, RAM, PROM, EPROM & EAROM. Concept of CACHE, SIMM, SD RAM, SG RAM, V RAM etc.	Block diagram of Function Generator.
74.	Familiarise with the computer and peripherals. Familiarise with functions of all keys. Familiarise with the Instruction set of 8085.	Computer, its block diagram, organisation of computer, Architecture of typical 18 bit Microprocessor viz. Intel 8085. Internal and External Data bus and Address bus, Internal	-do-

		registers, Accumulator, ALU, Flags, Program counter, Control unit, Micro instructions and Macro instructions.	
75.	Prepare and test programme in Assembly Language.	Memory Interfacing, I/O ports, Key board interfacing, Interrupts and Interrupt interfacing. Concept about monitor program, compilers & DMA.	Block diagram of Computer.
76.	Familiarise with the functions of DOS Commands. Develop programmes in Assembly Language.	Flow charts. Symbols used in flow charts. Develop programmes in Assembly language, Loop/Branch programs, Subroutines, Debugging of programmes.	Internal diagram of 8085 micro processor.
77.	Familiarise with HDD, FDD & CD ROM, Familiarise with BIOS setup.	Concept of Mother Board, FDD, HDD, CD ROM, RAM: Printer port, Mouse port, Monitor card, Multi Media.	-do-
78.	Installation of Printers, Scanners etc. Familiarise with the Programmes developed in high level language.	Develop programmes in High level languages.	Motor control circuits.
79.	Demonstration on closed loop control systems and servo mechanism. Observe the output of the thermocouple at various temperature and plot the graph.	Control system- open loop control systems and closed loop control system, merits of closed loop control system, block diagram, Laplace transform, reduction technique, signal flow diagram.	-do-
80.	Observe the output of various transducers like strain gauge, load cell, LVDT, Tacho generators. Flow sensors, Capacitance probe, DP cell etc.	Feed back systems- Transducers, various types of transducers used for the process variables temperature, flow, pressure, level, and speed- their types, functions and working principle.	-do-
81.	Construct and observe the output of P amplifier, Integrator and Differentiator.	Control amplifiers, their necessities, Proportional amplifier, Integrating	-do-

		Amplifier, Differentiating Amplifier.	
82 & 83	Familiarise with the Motorised control valve and solenoid relay, their functions. Construct a circuit for stepper motor control . Familiarise with the P, PI, PID controllers.	Actuators and final control elements - control valve, solenoid relays, stepper motor and servo motors- their construction, working principles and applications. Construction and working principles.	Closed loop control circuits for various types of pneumatic variables.
84.	Familiarise with the single phase and three phase servo controlled voltage stabilizers.	Constructional details and working of single phase and three phase voltage stabilizers.	-do-
85.	Familiarise with Programmable Logic controllers.	Analog control system, Digital control system, computerised control system, Hybrid control system. Interfacing with analog control systems, applications of D/A converter and A/D converter.	-do-
86 to 89	Uses of PLC to control Star/ Delta starter. Sequential logic controller.	Hard wire logic & programmable logic, comparison. Sequential logic controller for welding control system. CPU, Power supply and I/O card. CPU scanning of Inputs/ Outputs, Ladder Logic (rugs). Calculation of scan time. Details of Input and Output specification. Addressing of Z addressing of inputs/outputs, flags, timers and counters. Programme development terminal PDT. Unit for online and offline programming of PLC. Ladder diagram language, statement listing, checking status of contacts used in the ladder. Trouble shooting of PLC. Uses of PLC to control a relay to control a star/delta starter, Resistance welding control.	-do-

<p>90 to 95</p>	<p>Introduction to CNC Technology. Study of special constructional and operational features with reference to driving mechanism, machine tool design & lubrication system. Explain use of computer as a CNC., work station, communication hardware and software. Familiarization with co-ordinate system, use of CNC code and programming for simple test jobs, Manufacturing of simple jobs programmed on CNC trainer. Demonstrating the CNC machine features such as :- i) Flexibility, efficiency & repeatability. ii) Axis movement -- rapid, feed, jog manual data input modes, over travel limits. iii) Axis driving elements- Servomotor, gear box, ball screw, position feed back, open loop, close loop control, following error position loop. iv) Reference point, reference procedure. v) Execution of part programme without tool (DRY RUN), plotting /tracing of job profile on paper by executing part programme for two axis inter polaration for 5 to 6 different components. Study and practice of various CNC operating elements on CNC vertical machine centre. CNC operation-referencing (zeroing), part programming, execution of</p>	<p>Introduction to CNC machine, difference between NC, CNC & GPM importance of CNC machines over other man production process. Constructional details of CNC machine guide ways, ball screw, bed-ball screw mesh. Servo drive - feed back mechanism etc. Axis designation. Introduction to G & M codes. CNC tooling & fixtures. Manual port programming. Basic DOS commands, use of computer as CNC work station, communication between CNC computer. Purpose, types & construction, function and methods to use comparators. Latest inspection technique, ultrasonic flow detector, X-ray, Gama - ray and laser beam. Programming of CNC machines, Block numbers -G codes, M- codes, S - codes, T- codes, too off-set, zero off-set, axis movement as interpolation. Earthing, Importance of CNC earthing and shielding of wire etc.</p>	
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	part programmes. Use of M/S/T/G codes, and tool offset, cutter radius compensations facilities. Precautions to be followed while executing comments and part programmes. Practice on CNC machining centre, incorporating all available facilities.		
90 to 95	<p>Introduction to CNC machine maintenance card, history card & recording the data. Reading and analysing of CNC alarm message during machine operation. Preventive maintenance of machine such as checking of lubrication oil level etc. Inspection:- Handling of comparators for measurement and checking of finished product for its use and stability. Inspection of machine parts with ultrasonic flow detector, X-ray, Gama-ray & Laser beam.</p> <p>Study of:- <u>Spindle speed system</u> :</p> <p>i) True turning of spindle assembly with radial & axial load.</p> <p>ii) Types of spindle bearing-anti friction, hydrodynamics and hydrostatics</p> <p>iii) Pre-loading of spindle bearing.</p> <p>iv) Temperature rise test of spindle for proper pre loading, Lubrication of spindle. Lub oil, cooler.</p> <p>v) Study of gear box and automatic speed range for constant power and</p>	<p>Hydraulic & Pneumatic power source and circuits. Study of different hydraulic, pneumatic circuits of CNC. Turning, milling & grinding. Study of Hydraulic oil, air, coolant filtration system & hydraulic accessories. Study of :-</p> <ol style="list-style-type: none"> 1. Electrical and Electronic circuits for a CNC machine. 2. CNC system hardware. 3. Feed & spindle drive. 4. Programmable logic control. 5. Feed back devices. 6. Machine tools supply 7. Safety interlocks. 	

	<p>constant torque vi) Maintenance of same as mentioned above. vii) Spindle orientation, de-clamping of tool from spindle load. viii) Coolant through spindle and rotary joints. ix Coolant and chip disposal system.</p> <p>x) Study of tool handling, de-clamping devices, de-spring, air purging tool changing. Linear axis feed system</p> <p>i) Re-circulating ball screw</p> <p>ii) Basic element of ball screw.</p> <p>iii) Pre-loading of ball screw, tension & compression of nut assemblies, study of nut assembly.</p> <p>iv) Maintenance of ball screw-proper lubrication, proper pre-loading to eliminate back-lash, to reduce deflection & to optimise stiffness.</p> <p>v) Guide ways, friction, antifriction, hydrostatics & centralised lubrication system.</p> <p>vi) Coolant & lubrication system.</p> <p>vii) Rotary axis, automatic tool changer pallet-changer assemblies.</p> <p>viii) Curvic coupling- to ensure indexing accuracy, to ensure mechanically high load bearing capacity.</p> <p>ix) Changing and De-clamping-clamping by disc, springs and de-clamping by hydraulics or pneumatics.</p>		
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	<p>x) Drive to rotary table-using servo motor or hydro motor.</p> <p>xi) Mounting of rotary encoder and linear optical scale on the axis. xii) Worm and worm wheel to eliminate backlash. xiii) Turret on CNC lathes, automatic tool changer, spindle orientation.</p> <p>xiv) Hydraulic chuck, tail stock, quill. xv) Accuracy and performance of CNC machines problem and remedies.</p> <p>xvi) In-accuracies such as backlash, repeatability.</p> <p>xvii) Counter balancing system mechanism.</p>		
102 & 103	-- REVISION --		
104	-- TEST --		

LIST OF TOOLS & EQUIPMENT (MECH. INDUSTRIAL ELECTRONICS)
FOR A BATCH OF 16 TRAINEES & ONE INSTRUCTOR

TRAINEES KIT:

<u>Sl.No.</u>	<u>Specification</u>	<u>Quantity</u>
1.	Connecting screwdriver 100 mm	17 Nos.
2.	Neon tester 500 V.	17 Nos.
3.	Screw driver set (set of 5 bits)	17 Nos.
4.	Insulated combination pliers 150 mm	17 Nos.
5.	Insulated side cutting pliers 150 mm	17 Nos.
6.	Long nose pliers 150 mm	17 Nos.
7.	Soldering iron 25 W. 240 V.	17 Nos.
8.	Electrician knife D.B.	17 Nos.
9.	Digital multimeter portable	17 Nos.
10.	Soldering Iron 15 W/25 W/65 W	17 sets.
11.	De- soldering pumps	17 Nos.

LIST OF EQUIPMENTS REQUIRED

<u>Sl.No.</u>	<u>Specification</u>	<u>Quantity</u>
1.	First aid kit	1 no.
2.	Fire Extinguisher	1 No.
3.	Bench Vice	2 Nos.
4.	Steel Rule	2 Nos.
5.	Digital Multimeter	12 Nos.
6.	30-0-30 V, 2 Amps DC regulated power supply	10 Nos.
7.	0-300 V, 500 mA, DC regulated power supply	2 Nos.
8.	LCR Bridge (Digital)	1 No.
9.	Signal Generator, 100 KHz	2 Nos.
10.	Digital storage Oscilloscope, 100 MHz, with probe	2 Nos.
11.	Wattmeter	1 No.
12.	Megger,	1 No.
13.	Battery Charger	1 No.
14.	Digital IC Tester	2 Nos.
15.	Pulse Generator	2 Nos.
16.	Logic Probes	5 Nos.
17.	DOL Starter	1 No.
18.	DOL Starter with forward/reverse control	1 No.
19.	Automatic Sequencing control	1 No.
20.	Over load Relays	17 Nos.
21.	On delay Timers, off delay timers	1 No.
22.	Earth Leakage circuit breakers	1 No.
23.	Dimmerstat, 8 Amps	2 Nos.

24.	Counters	2 Nos.
25.	Temp. Controllers	2 Nos.
26.	Electronic control of DC Motor	2 Nos.
27.	Level detectors	1 No.
28.	Output Power meter	1 No.
29.	Distortion factor meter	1 No.
30.	EPROM programmer	1 No.
31.	Microprocessor trainer kit along with ADC/DAC with stepper motor controller and EPROM programmer	1 No.
32.	Proximity switches	2 Nos.
33.	Photo Tachometer	2 Nos.
34.	Burglar alarm	2 Nos.
35.	Smoke Detector	2 Nos.
36.	Emergency tube light	2 Sets.
37.	Single phase Preventer	2 Nos.
38.	Servo Motor	1 No.
39.	Servo controller	1 No.
40.	Spindle controller	1 No.
41.	Rotary encoder	1 No.
42.	Linear scale	1 No.
43.	Computerised numerical scale (CNC)	1 No.
44.	Programmable logic controller (PLC)	1 No.
45.	Personal computer with latest configuration with printer	2 Nos.
46.	High voltage testing kit	1 No.
47.	Surge Generator	1 No.
48.	Instrument tutor	1 No.
49.	Electronic Voltmeter	2 Nos.
50.	DC Generator	1 No.
51.	DC Motor	1 No.
52.	Single phase Alternator	1 No.
53.	S M P S	1 No.
54.	Induction Motor (Single phase)	1 No.
55.	Stroboscope	1 No.
56.	Synchronous Motor	1 No.
57.	Vacuum tube (various types)	8 Nos.
58.	Motorised control valve	1 No.
59.	Solenoid valve	2 Nos.
60.	Strain Gauge	2 Nos.
61.	Load cell	1 No.
62.	L V D T	1 No.
63.	Dual trace CRO	1 No.
64.	Analog Semi conductor trainer including power semi conductor Devices.	5 Nos.
65.	Linear amplifier Trainer	5 Nos.
66.	Digital Trainer	5 Nos.
67.	EE PROM Programmer-cum-copier with UV Eraser	1 Set.
68.	8085 Trainer Kit	1 Set.
69.	Digital trainer A/D, D/A converter, Mux , Demux-Display Devices etc.	
70.	Motor Trainer with Dummy loads	1 No.

71.	Three phase motor speed controller /Trainer	1 No.
72.	Soldering Station	1 No.
73.	De soldering Station	1 No.
74.	Hot air soldering station –cum-De-soldering Station for SMD Devices.	1 No.
75.	PLC Trainer	1 No.
76.	CNC Trainer	1 No.
77.	Work table/Bench	

LIST OF OTHER MATERIALS

<u>Sl.No.</u>	<u>Specification</u>	<u>Quantity</u>
1.	Maintenance Free Batteries	4 Nos.
2.	Re-chargeable Cells – Dry cells	4 Nos.
3.	Power Diodes	10 Nos.
4.	Heat sink, Heat sink compounds	24 Nos.
5.	LEDs	24 Nos.
6.	Switches	24 Nos.
7.	Relays (AC/DC), Contactors (AC/DC)	24 Nos.
8.	Push buttons switches	24 Nos.
9.	Lamps	24 Nos.
10.	ICs such as – 7400, 4001, 4011, 4017, 4007, 4033, 74159,74154 etc.	6 Nos. each
11.	OPAMP IC-741, Wave form Generator IC 8035	10 Nos. each
12.	IC DAC 0808, IC ACD 0801	6 Nos. each
13.	Transistors, JFET, SCRs, Diacs, Triacs, UJT etc.	6 Nos. each
14.	Various Diodes	6 Nos. each
15.	Various Transistors	6 Nos. each
16.	Microphone	2 Nos.
17.	Speaker 4", 8Ω	4 Nos.
18.	Various Capacitors	6 Nos. each
19.	Various Resistors	10 Nos. each
20.	Various Transformers	2 Nos. each
21.	Various SCR, DIAC, TRIAC	3 Nos. each
22.	Seven segment display (Both common Cathode & Anode)	5 Nos. each
23.	J & T type Thermocouple	2 Nos. each
24.	De-soldering Pump	2 Nos.

Syllabus for the trade of “Mechanic Industrial Electronics” under Apprenticeship Training Scheme (ATS)

Period of training for this trade is 3 years. The first two years training should be the same as the Practical Operations/Skills of the two years course of Mechanic Industrial Electronics under CTS. For the remaining period i.e. in 3rd year the shop training would include the operations/skills as per the syllabus for this trade.

Operations/ Skill to be learnt during 3rd year of Apprenticeship Training.

Week No. 105 – 106

Review of basic soldering and de-soldering practice, Dip Soldering, Wave Soldering, Study of various latest soldering and de-soldering technique.

Week No. 107

Industry specific Electronic devices.

Explanation, demonstration and application i.e. OJT, FET, MOS, CMOS, SCR, SMJD, ESD, Optical devices. Electronic Component packages.

Week No. 108 –109

Digital To Analog And Analog To Digital Conversion;

Theory: Basic D to A conversion using binary weighted registers Ladder R-2R network type D to A converter, Study of typical IC such as DAC 0808.

Voltage to frequency conversion: Describe the concept and operation of (1) Ramp ADC (2) Principle of dual slope integration. Its block diagram (3) Successive approximation ADC.

Practical :

- Study of IC 7107
 - Analog to Digital Converter (any one type)
 - Digital to Analog converter (any one type)
- To study: a) Weighted register D/A Converter &
b) R-2R Ladder network D/A converter.

Apprentices undergoing Apprenticeship / In-plant training should be given exposure to:

- a) Design, inspection, testing, quality control process in case of an electronic industry.
- b) Maintenance, testing, repair etc. in case of an engineering industry.

Equipment:

Dual power supply, 0-30 VDC variable supply, Digital multimeter, Oscilloscope with probe, Signal Generator; Pulse Generator, Breadboard, Assorted resistors, capacitors, IC DAC 0808, IC ADC 0801 or similar ones.

WEEK NO. 110 - 112 – 113 – 114 – 115

Devices Commonly Used In Industrial Controls

Theory

Timers : Sequential timers, Ultra long time delay circuits.

EQUIPMENT

Product listed above along with their drawings specification, application notes etc.

Apprentices under going in plant training should be given exposure to:

- i) Design, inspection, testing, quality control process in case of an electronic industry.
 - ii) Maintenance, testing, electronic repair cell etc. in case of an engineering industry.
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WEEK NO. 116 – 117 – 118 – 119

Other Commonly Used Industrial/Domestic Products

THEORY :

Burglar alarm, Smoke detector, Emergency tube light, Single phasing preventers, Pump controller, Electronic choke (ballast) Battery chargers, uninterrupted power supply, Emergency light, voltage stabilizers, Servo AC voltage stabilizers.

Wherever possible at least one working model of each, should be available for demonstration in the class, so that live demonstration can be given.

A circuit diagram should be discussed in the class, and when ever possible waveforms and voltages at various points should be monitored during discussion.

If numbers of such units are available then trainers should be asked to rectify the faults.

EQUIPMENT :

Product listed above along with their drawings, specification, application notes etc.

WEEK NO. 120 – 121 – 123

Transducers/Sensors Used In Industrial Controls

THEORY :

The rmocouples and thermistors, Strain gauge, LVDT pressure transducers , Flow recording transducers, Captive type, PUT type etc. Analog and digital timers, Basic principles, ranges, accuracy, limitations, applications etc. Study of some commonly used timer IC's eg. IC NE555, XR2240.

Counters :

- Application of counters, various versions available.
- Study of a typical circuit.

Proximity Switches :

AC and DC, INDUCTIVE and CAPACITIVE.

Advantages over conventional switches, various applications Basic principles, Block diagram, Specifications, Limitation etc.

Optoelectronic devices:

- Study of photo emissive devices.
- Study Photovoltaic and photoconductive (photo diodes and phototransistors) sensors.
- Study of devices such as LASCS, LASER.
- Optical couplers, Electronic relay circuits using these devices.
- Use of modulated light, Applications in industry.

Temperature Controllers:

ON/OFF type, P type, temperature recorders, Study of a typical circuit.

Photo tachometer:

Liquid level controllers, Hoist controllers, Stepper motor controller.

Optical film and pin diode detector

Wherever possible at least one working model of each should available for demonstration in the class, so that live demonstration can be given.

A circuit diagram should be discuss3ed in the class, and wherever possible waveforms and voltages at various points should monitored during discussions.

If number of such units are available then trainers should be asked to rectify the faults.

Level detectors

Study of level transducers, their construction, principle of working, limitations etc.

Application of a level transducers in industry: controller for displacement measurement using LVDT (INPROCESS GAUGING)

Practical:

Wherever possible at least one working model of each should be available for demonstration in the class, so that live demonstration can be given.

A circuit diagram should be discussed in the class, and wherever possible waveforms and voltages at various points should be monitored during discussion.

If numbers of such units are available then trainers should be asked to rectify the faults.

Equipments:

Product listed above along with their drawings, specifications, application notes etc.

Apprentices under going in plant training should be given exposure to:

- i) Design, inspection, testing, quality control process in case of an electronic industry.
- ii) Maintenance, testing, electronic repair cell etc. in case of an engineering industry.
- iii) Instrumentation Tutor.

WEEK NO 124 – 125 – 126 – 127 – 128 – 129

Industrial Process

Theory :

Resistance welding: -

Basic principle, Block diagram, Aggregates of typical resistance welding system. Various controls and circuits used. Sequence of timers, Weld heat control etc.

High frequency heating:

Induction heating and dielectric heating. Merits over other methods. Different frequencies involved, Skin effect. Application for surface hardening of metals. Drying , warming of dielectric material.

Ultrasonic :

Generators, transducers. Block diagram, various applications such as flaw detection in castings.

Sonar-Emulsification of liquids- Soldering of aluminium – Ultrasonic cleaners- Applications of electronics in medical field.

Practical:

Wherever possible at least one working model of each should be available for demonstration in the class, so that live demonstration can be given.

A circuit diagram should be discussed in the class, and wherever possible waveforms and voltages at various points should be monitored during discussion.

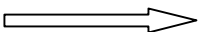
If numbers of such units are available then trainers should be asked to rectify the faults.

Equipments

Product listed above along with their drawings , specification, application notes etc.

Apprentices under going in plant training should be given exposure to:

- i) Design, inspection, testing, quality control process in case of an electronic industry.
- ii) Maintenance, testing, electronic repair cell etc. in case of an engineering industry.

WEEK No. 130  HALF YEARLY TEST

TYPICAL INDUSTRIAL ELECTRONIC SYSTEMS/CIRCUITS

Theory

Industrial rectifier circuits: 3-phase rectification, 3 phase controlled rectification, 3 phase half wave and full wave rectifier circuits, Rectifier performance.

DC MOTORS:

Principle of operation – Generation of unidirectional torque-Voltage equation – Necessity of starter.

Different types and their applications.

Working of loaded motor – Speed regulation techniques.

DC MOTOR CONTROL

The DC shunt motor, Armature control and Field control of motor speed,

Electronic control of DC motor: Control of small motor, speed regulator action, speed variation by SCR Control Trouble shooting of typical DC motor control circuit.

AC DRIVES

Familiarity to basic principles of AC drives, Adjustable frequency drive, rectifier + inverter, concept of pulse width modulation.

Eddy current drive: AC motor, eddy current clutch
Tacho-generator, Solid-state regulator etc.

SERVOMOTOR AND SERVOCONTROLLER

Servomotor and servo controllers

Difference between ordinary motor and servomotor, Its characteristics, Constructional details etc.

Basic blocks of servo controller and their functions.

FEEDBACK DEVICES

Importance of feedback devices such as Rotary encoder, Tachometer and Optical scale.

Principle of working, constructional details, Limitations etc.

Wherever possible at least one working model of each should be available for demonstration in the class, so that like demonstration can be given.

A circuit diagram should be discussed in the class, and wherever possible waveforms and voltages at various points should be mentioned during discussion.

If numbers of such units are available then trainers should be asked to rectify the faults.

Apprentices under going in plant training should be given exposure to:

- i) Design, inspection testing, quality control process in case of an electronic industry
- ii) Maintenance, testing, electronic repair cell etc. in case of an engineering industry.

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WEEK NO. 138 – 139 – 140 – 141

PROGRAMMABLE LOGIC CONTROLLER (PLC)

Theory

Historical background. Relays and contactor logic

Solid-state logic circuits – Programmable logic controller

Basic blocks: input/output interface, CPU, Memory, Power supply etc.

How PLC operators, Program development terminal programming of PLC. Ladder diagram language or statement listing.

Trouble shooting of PLC.

Equipment

- 1) Educational PLC such as PLC-4 Microtrol from Allen Bradley. 170 devices.

Teaching Aids

1. Educational video cassettes
2. Manuals from reputed manufacturers
3. Charts for block diagram of PLC
4. Pictures/posters displaying latest versions/models of PLC's from reputed manufacturer.

WEEK NO 142 – 143 – 144 – 145 – 147

COMPUTER FUNDAMENTALS:

Theory

HISTORICAL BACKGROUND. Applications of computer.

Basic block diagram of computer: In put devices, CPU Memory. Output devices.
(Already covered in earlier topics)

CPU/Processor of a computer: (already covered in earlier topics)

Memory: Primary and secondary, CACHE

Primary memory: RAM, ROM, PROM, and EPROM: (already covered in earlier topics)

Secondary memory: Magnetic tapes, Floppy disc. Hard disc.

Information in short about floppy disc drives and hard disc drives.

Input and output devices: play unit,

Alphanumeric keyboard, mouse, printers etc.

(Brief information on each I/O device)

SOFTWARE CONCEPTS

Compiler and interpreter.

Disk operating system (DOS): Introduction to Basic DOS commands such as dir, copy, del, rename, md, cd, rd, tree, format.

Computer virus.

Computer maintenance.

Introduction to applications packages (latest version)

Programming in c language and its applications.

Equipment

Personal computer with Printer.

Teaching Aid

- 1) Educational video cassettes
- 2) Tutorial software packages such as DOETUT, PC AEC etc.

WEEK NO. 148-149-150-151-152-153-154-155

CNC MACHINE

Theory

1. The purpose of CNC – Efficiency, Flexibility and repeatability of the M/C.
2. Axis movements
3. Position feedback
 - ☞ Need of position feedback, incremental, absolute
4. Digital feedback
 - ☞ Encoder, Linear scales.
5. Analogue feedback
 - ☞ Resolver, Inductosyn
6. Reference point
 - ☞ Necessity of ref. Point, refreshing procedure.
7. Programming
 - ☞ Block number, S codes, M codes, T codes Tool offset, Zero offset, Axis movement, Interpolation.

8. Earthing:

☞ CNC controller earthing its importance. Earthing methods, Shielding of wires etc.

9. Maintenance

Check for: - Any loose connections, soldered connections, Resistance between signal cables, Loosening of Linear scale slider, Encoder coupling, Temp. Rise for CNC Controller, Servo controller Servomotor.

Removal of dust collected on the CNC equipment.

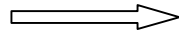
Message reading: - Its meaning, corrective action.

Equipment :- A trainer CNC machine from reputed manufacturer.

Teaching Aid :-

1. Pictures/posters of CNC machining centers with their accessories.
2. Videocassettes.
3. Manuals of CNC machine from reputed manufacturers.
4. Charts indicating block diagrams for a general CNC M/C.

WEEK NO. 156

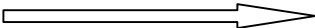


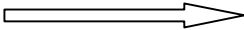
REVISION AND TEST

SYLLABUS FOR “MECHANIC INDUSTRIAL ELECTRONICS”

(THIRD YEAR)

SUBJECT : ENGINEERING DRAWING

Week No.	Portion
105 to 108	CIRCUIT DIAGRAMS (8 TO 10 SHEETS) Of commonly used circuits such as rectifiers, amplifiers, oscillators, Multivibrators, etc.
109 to 114	SCHMATIC DIAGRAMS (8 to 10 sheets) Such as that of preamplifier, transistor receiver, Star-Delta Starter, control Circuit for reversing of 3-phase induction motor. Etc.
115 to 119	FRONT PANEL DRAWINGS (3 to 5 sheets) Of commonly used instruments such as CRO, Signal generator, Pulse Generator, IC tester, etc.
120 to 123	CHASIS/CABINET DRAWINGS (3 to 5 sheets) Of some typical products of different sizes and shapes, say laboratory power Supply, Personal computer, Emergency light etc.
124 to 127	SECTIONAL VIEWS (6 to 8 sheets) Of some complicated assemblies showing constructional details such as moving Coil galvanometer, LVDT, Flow recording transducers, pressure transducer, Cathode ray tube, etc.
128 to 129	EXPLODED VIEWS (5 to 7 sheets) Such as mounting of a power transistor on a heat sink.
130	 REVISION & TEST

131 to 135	LAYOUT DRAWING (6 to 8 sheets)
	Of an inside of a typical control panel/cabinet for any industrial electronics Controller.
136 to 139	GRAPHS (8 to 10 sheets)
	Characteristics graph of semi conducting devices. Plotting a sine wave. Etc.
140 to 149	DESIGNING A PCB LAYOUT AND MAKING ARTWORKS (4 to 5)
	Of few simple circuits such as regulated power supply card. Amplifier card. Signal processing card. Etc.
150 to 155	READING ASSEMBLY DRAWINGS/BLUE PRINTS (6 to 10 sheets)
156	 REVISION & TEST

CHARTS/BOARDS/WIRING DIAGRAMS CATALOGUES/MANUALS

1. Artificial respiration charts
2. Various sizes of wires, insulating materials, resistors, capacitors, diodes, Transistors.
3. Formulae, equations
4. Colour codes for resistors/capacitors
5. Electrical instruments, relays, contactors, starters, transformers, symbols.
6. Handbooks, TTL Databooks
7. Manuals for CNC, PLC, Servomotor, Servocontroller
8. Any other relevant chart/catalogue/manual on topics covered in the syllabus.

LIST OF BOOKS

1. Digital computer electronics – Malvino
2. Digital Fundamentals – Floyd
3. Basic Electronics and linear circuits – Bhargava Kulshreshtha Gupta
4. OP Amps and linear integrated circuits – R. Gaikwad
5. Microprocessor architecture programming and applications - Gaonkar
6. Examples in Electrical calculations - Admiralty