

Syllabus for the trade
of
Mechanic Industrial Electronics

UNDER
CRAFTSMAN TRAINING SCHEME (CTS)

Designed in 2013

By
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CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
Directorate General of Employment & Training
Ministry of Labour & Employment (DGET)
EN – 81, SECTOR – V, SALT LAKE CITY,
Kolkata – 700 091.

List of Members of Trade Committee Meeting for the Trade of Mechanic Industrial Electronics held at ATI – EPI, Ramanthapur, Hyderabad-500 013.

Shri S.J. Amalan, Director, CSTARI, Kolkata

Sl. No.	Name & Designation Shri/Smt.	Representing Organisation	Remarks
1.	A.K. Mishra, Director	ATI-EPI, Ramanthapur, Hyderabad	Chairman
2.	J. Sudharani, Asst. Professor- Medical Bio-Chemistry	G.V.P. College of Engineering for Women, Madhuravada, Visakhapatnam, Andhra Pradesh.	Member
3.	S. Sambaiah, Director	M/s Medisonics, Flat No. 102, Aries Plaza, Chandana Brother's Building, Mehedipatnam, Hyderabad-28.	Member
4.	Sandhya Salwan, Director	ATI-EPI, Dehradun.	Member
5.	D.K. Ojha, Dy. Director	ATI-EPI, Dehradun.	Member
6.	C. Chandrasekhar, Jt. Director	ATI-EPI, Ramanthapur, Hyderabad	Member
7.	M.S. Ekambaram, Dy. Director	ATI-EPI, Ramanthapur, Hyderabad	Member
8.	C.S. Murthy, Dy. Director	ATI-EPI, Ramanthapur, Hyderabad	Member
9.	T. Ragulan, Dy. Director	ATI-EPI, Ramanthapur, Hyderabad	Member
10.	V. Subrahmanyam, Asst. Director	ATI-EPI, Ramanthapur, Hyderabad	Member

List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6th to 10th May'2013 at CSTARI, Kolkata.

Sl. No.	Name & Designation	Organisation	Remarks
1.	R.N. Bandyopadhyaya, Director	CSTARI, Kolkata-91	Chairman
2.	K. L. Kuli, Joint Director of Training	CSTARI, Kolkata-91	Member
3.	K. Srinivasa Rao, Joint Director of Training	CSTARI, Kolkata-91	Member
4.	L.K. Mukherjee, Deputy Director of Training	CSTARI, Kolkata-91	Member
5.	Ashoke Rarhi, Deputy Director of Training	ATI-EPI, Dehradun	Member
6.	N. Nath, Assistant Director of Training	CSTARI, Kolkata-91	Member
7.	S. Srinivasu, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
8.	Sharanappa, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
9.	Ramakrishne Gowda, Assistant Director of Training	FTI, Bangalore	Member
10.	Goutam Das Modak, Assistant Director of Trg./Principal	RVTI, Kolkata-91	Member
11.	Venketesh. Ch. , Principal	Govt. ITI, Dollygunj, Andaman & Nicobar Island	Member
12.	A.K. Ghate, Training Officer	ATI, Mumbai	Member
13.	V.B. Zumbre, Training Officer	ATI, Mumbai	Member
14.	P.M. Radhakrishna pillai, Training Officer	CTI, Chennai-32	Member
15.	A.Jayaraman, Training officer	CTI Chennai-32,	Member
16.	S. Bandyopadhyay, Training Officer	ATI, Kanpur	Member
17.	Suriya Kumari .K , Training Officer	RVTI, Kolkata-91	Member
18.	R.K. Bhattacharyya, Training Officer	RVTI, Trivandrum	Member
19.	Vijay Kumar, Training Officer	ATI, Ludhiana	Member
20.	Anil Kumar, Training Officer	ATI, Ludhiana	Member
21.	Sunil M.K. Training Officer	ATI, Kolkata	Member
22.	Devender, Training Officer	ATI, Kolkata	Member
23.	R. N. Manna, Training Officer	CSTARI, Kolkata-91	Member
24.	Mrs. S. Das, Training Officer	CSTARI, Kolkata-91	Member
25.	Jyoti Balwani, Training Officer	RVTI, Kolkata-91	Member
26.	Pragna H. Ravat, Training Officer	RVTI, Kolkata-91	Member
27.	Sarbojit Neogi, Vocational Instructor	RVTI, Kolkata-91	Member
28.	Nilotpal Saha, Vocational Instructor	I.T.I., Berhampore, Murshidabad, (W.B.)	Member
29.	Vijay Kumar, Data Entry Operator	RVTI, Kolkata-91	Member

GENERAL INFORMATION

1. **Name of the Trade** : **Mechanic Industrial Electronics**

2. **NCO Code No.** :

3. **Duration** : **2 Years (4 Semesters having duration of six months each)**

4. **Entry Qualification :** : **Passed 10th class examination under 10+2 system of education with Science and Mathematics or its equivalent.**

5. **Unit Size (No of student)** : **20**

6. **Space Norm :** : **80 Sq mtrs**

7. **Power Norms :** : **3 Kw**

8. **Trainer's Qualification :**
 - a) B.E./B.Tech in Electronics/Electronics & Telecommunication /Industrial Electronics with 2 yrs. experience in the relevant field
OR
 - b) Diploma in Electronics/Electronics & telecommunication/Industrial Electronics from recognized board of technical education with three years experience in the relevant field.
OR
 - c) NTC/NAC in the trade with three years experience in the relevant field

9. **Desirable qualification :** Preference will be given to a candidate with CIC (Crafts Instructor Certificate).

NOTE: At least one Instructor must have Degree/ Diploma in the relevant trade.

Syllabus for the Trade of Mechanic Industrial Electronics
Duration : Six Months

First Semester

Semester Code: MIE: SEM I

Week No	Trade practical	Trade theory	Engg. Drawing	Vocational Science & calculation
1	Practice fixing of screws of different sizes on wooden board. Practice of Cutting on wooden blocks using Tenon saw/6 inch hand saw Drill holes on wooden boards using Electric/Hand Drill Machine. Smoothen the blunt surfaces using suitable files Repeat the above tasks on Metal and Plastic sheets. Practice the electrical safety norms Practice the Mock treatment of electrical shock	Introduction to NCVT and its certification mechanism Semester system and its flexibility for the Trainee and to the Institute. EM Trade and its applicability in industries. Expectations of the Industry from trainees after the completion of the Trade. The skills to be acquired to become part of industry. Intro to Safety and measures to be taken to maintain the standards of safety of personnel working and the equipment. Different First aid mechanisms to rescue the effected by electric shocks or any physical injuries.	What is Engineering drawing, Importance, free hand sketching of straight lines, rectangles, square, circles, polygons, etc.	Quadratic equation, Simultaneous linear equation in two variables. Fundamentals and derived units, Supplementary units, of electrical parameters. Standards-definition, types-primary and secondary standards, working standards, Standards of length, mass, time, current, voltage.
2	Introduction to NCVT and its certification mechanism Semester system and its flexibility for the Trainee and to the Institute. EM Trade and its applicability in industries. Expectations of the Industry from trainees after the completion of the Trade. The skills to be acquired to become part of industry. Intro to Safety and measures to	Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, P-P, instantaneous value. Single phase and Three phase power , terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties Different type of electrical cables and	do	do

	<p>be taken to maintain the standards of safety of personnel working and the equipment. Different First aid mechanisms to rescue the effected by electric shocks or any physical injuries.</p>	<p>their specifications. Different types of Cables used in the electronic industries. Ohm's law and its variables.</p>		
	<p>Identify the Live, Neutral and Earth on power socket. Construct a test lamp and light a lamp Use a Tester to monitor AC power. Measure the unwanted voltage between the neutral and Ground and take measures to reduce it. Connect two lamps in parallel to the AC Source and observe illumination. Connect two lamps in series to the AC Source and observe illumination Identify different wires and cables. Practice removal of insulation without destroying the strands on wires and cables of different ratings Measure the gauge using SWG Make cable joints using soldering gun Desolder to separate the soldered joints Read and interpret the settings, sockets on an Analog and Digital Multi meters.</p>	do	do	do
3	Measure and Test the voltage of the given primary/secondary	Battery /Cells: construction, types of primary and secondary cells,	Free hand sketching of tools, reading of simple drawings and	do Electricity: Negative & positive

	<p>cell(s). Charge and discharge the cell while measuring the respective Voltage and currents. Measure the voltage and current at different terminals of a resistive circuit Identify an electromagnet and a permanent magnet. Prepare a solenoid valve Prepare an electromagnet for a bell Dismantle and identify different parts of a relay identify coil voltage and contact current capacity. Assemble and test the relay (any four different relays). Repeat the above three tasks for an electrical connector. Operate a Three phase Induction Motor with three pole EM Contactor having 1 NO + 1 NC auxiliary contacts</p>	<p>materials used, specification of cells and batteries. Charging process, efficiency, shelf life, Selection of cells / Batteries etc. Use of Hydrometer. Types of electrolytes used in cells and batteries. Types and Properties of magnets and their materials, preparation of artificial magnets, significance of Electromagnetism, types of cores. Electromagnetic Relays, types, construction, specifications.</p>	<p>concepts of dimensions and dotted lines, chain lines etc. Magnifying glass. Atomic Structure, Different components.</p>	<p>polarities, structure of Atoms, Electrons & protons, coulomb, unit of charge, volt, unit of potential difference, and charge in motion is current.</p>
4	<p>Identify different transformers Measure the primary and secondary winding resistances for transformers of different capacities (upto 500 VA) Identify different sizes, shapes of cores used in low capacity transformers. Measure the primary and secondary voltage of different transformers. Identify primary and secondary terminals of the centre tapped</p>	<p>Working principle of a Transformer, Transformer construction , Types of cores used Specifications of a transformer. Step-up , Step down and isolation transformers with applications. Different type of losses in Transformers. Phase angle, phase relations, active and reactive power, power factor and its importance in the industry. Three phase Transformers and their applications.</p>	do	do

	<p>transformer and test it. Measure input and output voltages of a given isolation transformer Identify different terminals on the given single phase and three phase fractional HP AC Induction Motor. Connect the power and test run Identify unmarked terminals of a three phase induction motor, connect to the DOL starter and run. Connect a DOL starter to the given single phase motor and control it Connect a DOL starter to the given three phase motor and operate it</p>	<p>Electrical motors: AC Motor (single phase induction motor) construction, sub assemblies, type of winding used, interpretation of name plate specifications, conventional speed control methods. Types of AC motors and their applications. Starting of split phase motor and three phase AC motors.</p>		
5	<p>Identify and Test Permanent Magnet DC motor Identify and Test Brushless DC motor Identify and Test stepper motor Identify and familiarize with various types of fuses with their bases. Trip a MCB by simulating fault conditions and Reset the MCB. Measure the current drawn by the motor and speed using a TACHO. Connect a DOL starter and run the given AC motor Identify the terminal connections of the ceiling Fan(permanent capacitor motor).</p>	<p>DC Motor construction, sub assemblies, commutators, carbon brushes, interpretation of name plate specifications, conventional speed control methods and applications. Types of DC motors and their applications. Overload Relay, Fuse ratings, types of Fuses, Fuse bases, single/three phase MCBs, single phase ELCBs. (Download the pictures of the above mentioned component of different manufacturers from Internet and show them to Trainees) Types of Contactors, contactor coils and working voltages, contactor</p>	do	do

	<p>Connect, set proper direction of rotation and Run. Remove the ceiling Fan motor and test it Remove the Fan capacitor and test it</p>	<p>contact currents, protection to contactors and high current applications.</p>		
6	<p>Identify Resistors of different types(include NTC,PTC,W/W, Log, Linear, preset, VDR,LDR) values and power ratings. Use colour code to identify the Resistors and values. Measure with multimeter the Resistance, current and voltage through series and parallel connected resistor networks Identify different inductors, test and measure the values. Apply AC and DC to RL circuit and observe the response. Identify, Test and measure capacitance of various capacitors. Monitor RC ckt behavior by applying different voltages and frequencies Measure Time constant for different values of R and C. Measure the V, I of a RLC series and parallel ckts at resonant frequencies. Find the resonant frequency of the given RLC ckt. Measurement of inductance, capacitance and resistance with L.C.R. Bridge</p>	<p>KVL & KCL with applications. : Resistor -definition, types of resistors, their construction & specific use, color-coding, power rating, Equivalent Resistance of series parallel ckts. Distribution of V & I in series parallel ckts. Principles of induction, inductive reactance, Types of inductors , construction, specifications and applications(energy storage concept). Self and Mutual induction. Behaviour of inductor at low and high frequencies. series and parallel combination, Q factor, Electromagnets ,Solenoids & relays construction & its application Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behavior with AC and DC. Concept of Time constant of a RC ckt. Concept of Resonance and its application in RC,RL & RLC series and parallel ckts.</p>	<p>Reading of simple drawing, free hand sketching of simple solids with dimensions, free hand sketch of solids viewed perpendicularly to their surface and axes. Electronic Component symbols, Series circuit, Representation of IR voltage drops.</p>	<p>do Ohms law: Current, voltage, resistance, and related problems, multiple and submultiples units, electric power, power dissipation in resistance, power formulas. Series circuits: Total resistance, same current in series circuits, IR voltage drops, Sum of IR drops equal to the applied voltage, Polarity of IR voltage drops, Total power in series circuits, related exercise. Arithmetic and geometric progression, sum of n-terms, simple calculations.</p>

7	<p>Identify Si and Ge diodes Record any ten Diode component numbers (both Si & Ge) from Data book with their specifications. (I_f, PIV and forward voltage drop) Identify any five different packaging styles of Diodes with respective heat sinks Response of a Diode for different AC and DC voltages Test the PIV and Forward current of the given diode Construct and test Diode as a half wave, full-wave and Bridge rectifier. Connect a capacitor to the rectifier ckt and filter the output Observe on CRO the ripple from rectifiers by varying load and filter capacitance Identify and Test Zener diode, Varactor diode, tunnel diode. Construct and test zener based voltage regulator circuit and test.</p>	<p>Semiconductor component number coding for different electronic components such as Diodes, Zeners, Transistors, FETs, MOSFETs, IGBTs. PN Junction, Forward and Reverse biasing of diodes, Interpretation of diode specifications Forward current and Reverse voltage, packing styles of diodes. Diode Bridge Modules. Rectifier configurations, their efficiencies, Filter components and their role in reducing ripple. Working principles of Zener diode/specifications/applications Varactor diode /Tunnel diode/ specifications with applications.</p>	do	do
8	<p>Identify PNP and NPN Transistors Record any ten Transistors numbers (both NPN & PNP) from Data book with their specifications. (β, V_{BE}, V_{CB}, V_{CE}, I_C, I_B, Junction Temperature, junction capacitance, Frequency of operation, Power Rating) Identify any five different packaging styles of Transistors with respective heat sinks</p>	<p>Construction, Working of a PNP and NPN Transistors. Purpose of E, B & C Terminals. Flow of currents into and out of terminals of PNP/ NPN Transistors and their relations. Significance of β of a Transistor. Need for Biasing of Transistor junctions Interpretation of main parameters of a Transistor. V_{BE}, V_{CB}, V_{CE}, I_C, I_B, Junction Temperature, junction capacitance, Frequency of operation,</p>	<p>do Free hand sketches of nuts with dimensions from samples. Circuit s and wiring diagrams. Parallel circuits, Branch currents, representation.</p>	<p>Parallel circuits: Applied voltage is the same across parallel branches, Each branch current, Total current equal to the sum of the branch currents. Resistance in parallel circuits, Total power in parallel circuits, effect of open branch, short</p>

	<p>Measure E-B, C-B & C-E terminal resistances and infer. Wire a circuit using a switch to turn on a Relay via Transistor (use Relays of different coil voltages and Transistors of different β)</p> <p>Construct a Transistorized amplifier and amplify a small signal. Vary the gain by changing the circuit components Calculate input impedance and output impedance of the constructed amplifier.</p>	<p>Discuss a Transistor application as a switch.</p> <p>Discuss a Transistor application as an amplifier. Define input impedance and output impedances</p>		<p>circuit across parallel branches, related exercise.</p>
9	<p>Identify any five FET Transistors and record main parameters from the Data book</p> <p>Test the given FET (at least 5 no's) and record the impedances.</p> <p>Construct and test a FET Amplifier</p> <p>Identify SCRs of different ratings by their number.</p> <p>Test different SCRs (at least 5 no's) for healthiness using a Multimeter.</p> <p>Construct SCR test circuit with a small load and test.</p> <p>Identify different heat sinks used with various SCRs.</p> <p>Identify and test a DIAC(at least 3 no's) by its number.</p> <p>Use an RC circuit to fire and change the firing angle of SCR.</p> <p>Construct a circuit using DIAC</p>	<p>Construction of FET, differentiate it with BJT. Purpose of Gate, Drain and source terminals and voltage/current relations between them. Amplification factor of FET. Impedances between various terminals. Interpret the main parameters of the FET. Suitability of FET amplifiers in measuring device applications.</p> <p>Working of power electronic components such as SCR, TRIAC,DIAC,UJT ,MOSFET and IGBT.</p>	<p>Explanation of simple orthographic projection 3rd angle.</p> <p>Types of resistors, colour coding, tolerance representation,</p>	<p>Temperature, pressure. Newton's law of motion, applications, momentum. Simple problems</p>

	<p>as trigger device to fire SCR</p> <p>Identify and Test a UJT by its number</p> <p>Construct UJT based free running oscillator and change its frequency.</p> <p>Identify and test a DIAC(at least 3 no's) by its number</p> <p>Construct a circuit using DIAC as trigger device to fire TRIAC for phase control application.</p> <p>Identify and test a power MOSFET (at least 3 no's) by its number</p> <p>Identify different heat sinks used with various power MOSFET devices.</p> <p>Construct MOSFET test circuit with a small load and test</p> <p>Identify and test a IGBT (at least 2 no's) by its number</p> <p>Construct IGBT test circuit with a small load and test</p>			
10	<p>Dismantle an Analog multimeter and identify components /sections and trace path for measurement of V, I & R.</p> <p>Measure the indicator coil voltage corresponding to different measurements.</p> <p>Assemble and test the meter</p> <p>Dismantle Digital Multimeter and Identify components /ICs/sections and Trace circuit path for measurement of V, I</p>	<p>Working principle of PMMC type ammeter. Conversion of ammeter into voltmeter.</p> <p>Working principles and study of Block diagrams / Schematic diagrams of Analog multimeter, Digital Multimeter, Digital LCR meter.</p>	do	<p>Series-Parallel circuits: Finding Total resistance for series-parallel resistances, Whetstones' bridge.</p> <p>Resistor types, their colour codes and tolerance, series and parallel combination of resistors, power</p>

	(AC & DC) & R. Measure the Signal voltage to the display IC corresponding to different measurements. Assemble and test the DMM.			rating of resistors. Static and dynamic friction. Gravitational forces. Force-definition, units, and fractional, forces. Problems on force and frictional forces.
11	Identify different electrical cables of various gauges and of different insulation strength. Remove the insulation of different cables and prepare for joining Make Solder joints of different cables Make Lug joints of different Electrical cables Identify at least 12 different type of cables (including FRC) used in electronic industries. Identify at least 12 different type of cable connectors used in electronic industries Solder/crimp/terminate atleast 10 connectors to the respective cables and test for continuity as per the marking on the connectors.	Classification of cables according to gauge, core size, insulation strength, flexibility etc	Explanation of simple orthographic projection 3 rd angle. Moving coil meter, Moving Iron meters, voltmeter, Ammeter, Ohm meter.	
12	Practice with cable ties, ferrools, routing of cables etc. Identify and familiarize with spst, spdt, dpdt, tumbler, toggle, piano type electrical switches Identify and familiarize with electronic pushbutton (NO, NC),	Different electrical cables and their specifications	do	do

	with and without indicator lamps, with auxiliary contacts of different sizes			
13	Select a soldering gun and practice soldering of different electronic active and passive components/digital ICs on varieties of PCBs. Join the broken PCB track and test. Desolder the soldered component and clean the surface of the track.	Different type of soldering guns, relate temperature with wattages, types of tips. Solder materials and their grading. Use of wax and other materials. Selection of a soldering gun for specific requirement. Soldering and Desoldering stations and their specifications.	Explanation of simple orthographic projection 3 rd angle. Different types of series parallel circuits, representation of nodes, etc.	
14	Measure logical high and low for TTL and CMOS ICs. Identify by the number and Monitor the clock frequency of different crystal ICs on CRO and measure it. Identify different Logic Gates (AND, OR,NAND,NOR, X-OR, X-NOR,NOT ICs) by the number printed on them and draw I/O pin-out numbers. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. Use NAND Gates to realize an OR operation Use NAND Gates to realize a NOR operation Use NOR Gates to realize an AND operation Use NOR Gates to realize a NAND operation	Difference between analog and digital signals, logic levels of TTL and CMOS Introduction to Digital Electronics, Number systems and codes Digital code: binary, octal , Excess 3 code, grey code, BCD code, ASCII code and code conversions Logic Gates and their truth tables, propagation delay, power dissipation and noise immunity Logic families like TTL/CMOS and sub families and their comparison. Availability of logic gates in multiple numbers in a package with examples. Combinational logic circuits such as AND-OR Logic, AND-OR invert Logics Universal property of NAND and NOR gates. Study different IC Packages	do	Voltage dividers, & current dividers: Series voltage dividers, current divider with two parallel resistances. Direct-current meters: Moving coil meter, design of voltmeter, ammeter, loading effect of voltmeters, related problems. Complex numbers. Simple problems Work, power and energy- definition, units, and simple problems and on shop floor practices. Conservation of momentum and energy

15	<p>Wire and illuminate LEDs of different sizes and observe the current drawn. Expose LDR different lights and Record the variation in resistance. Expose Photovoltaic cell to different lights and Record the variation in Voltage produced. Wire a photo Diode based circuit and switch a lamp load. Wire a photo Transistor based circuit and switch a lamp load. Identify an IRED coupled to photo Transistor (Optocouler) and operate a Relay by connecting a switch to input.</p>	<p>IR LEDS, Photo diode for photo transistor, its characteristics and application, optical sensor, opto-couplers, circuits with opto isolation, characteristics of LASER diodes</p>	<p>Familiarization and sketching the details of components</p>	
16	<p>Construct and test voltage divider bias Construct and Test a common emitter Amplifier Construct and Test common base amplifier Construct and Test common collector amplifier Construct and Test Darlington amplifier</p>	<p>Transistor biasing circuits and stabilization techniques. Voltage amplifiers- voltage gain, loading effect. configuration of common emitter, common base, common collector transistor, their definition characteristics and application</p>	do	<p>Kirchoff's laws: Kirchoff's voltage & current law, Branch currents, node voltages, Mesh currents, related problems. Trigonometry – identity & solve</p>
17	<p>Construct and test Class A amplifier. Construct and test Class B amplifier Construct and test Class AB push pull amplifier Construct and test a single stage CE amplifier with and without emitter bypass capacitor.</p>	<p>Classification of amplifiers according to frequency, mode of operation, methods of coupling. CE ,CB,CC amplifier circuit and their characteristics Alpha ,beta, voltage gain, Concept of dB dBm</p>	<p>Use of drawing instruments, 'T' square, drawing board, construction of simple figures & solids with dimensions, use of different types of scales in inch & millimeters, lettering numbers & alphabets. Symbols, Cells, batteries, series,</p>	do

			parallel, representation, Magnets, Electromagnets, symbols,	
18	<p>Construct an emitter follower, RC coupled amplifier Construct and test push pull power amplifier Construct and test oscillator using a HF transistor.</p> <p>Construct and test RC Phase shift oscillator</p>	<p>Distinguish between voltage and power amplifier Types and effect of negative feedback in amplifiers Working of emitter follower circuit and its advantages different packages styles of transistors, in-circuit testing of transistor introduction to positive feedback and requisites of an oscillator</p>	do	<p>Network theorems: Thevenin's, Norton's theorems, conversion of voltage and current sources.</p> <p>Moment of inertia of simple shapes like disc, cylinder & sphere.</p>
19	<p>Construct and test astable multi vibrator circuit</p> <p>Identify and test Transistors of different packaging styles</p> <p>Identify and pick a suitable heat sink for Transistors of different packaging styles</p> <p>Test various analog electronic components using linear IC Tester.</p>	<p>Types of multivibrators and study of circuit diagrams Transistor power ratings & packaging styles, use of different heat sinks. Study of a Linear IC Tester</p>	do	do
20	<p>Construct and Test Half Adder circuit and verify the truth table. Construct and Test Full adder and verify the truth table. Construct the Adder cum Subtractor and verify the result Construct and Test a 2 to 4 Decoder and test</p>	<p>Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders. IC 7482 as 2-bit and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations</p>	<p>Drawing of various electrical circuits with B.I.S. symbols of circuits, series & parallel circuits, power transformer instrument transformer etc.</p> <p>AC wave form, frequency, wavelength representation,</p>	<p>Alternating voltage and current: AC fundamentals, RMS, Average values, Frequency, time period, wavelength, related problems,</p>

	Construct and Test a 4 to 2 Encoder and test Construct and Test a 4 to 1 Multiplexer and test Construct and Test a 1 to 4 De-Multiplexer and test	Basic Binary Decoder and four bit binary decoders. ICs 74LS138 and 74154 pin details and functionality. BCD to Decimal decoder. Decimal to BCD Encoder, IC 74147 details and functionality. Need for multiplexing of data and IC 74151 AS Data selector/Multiplexer. 1 to 4 line De multiplexing. IC 74154 as a De multiplexer.	Inductors, series parallel, transformers, types, cores, types, lamination types, representation,	
21	Construct and test four bit latch using 7475. Identify different Flip-Flop (ICs) by the number printed on them. Verify the truth tables of Flip-Flop ICs (D,T,RS,JK) by connecting switches and LEDs Identify & Wire a Master-Slave Flip-Flop and Test the truth table. Familiarization with front panel controls and display system of Digital IC Tester Testing of : TTL , CMOS ,Memory Peripheral ICs	S-R Latch, Gated S-R Latch, D-Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop Clocked Flip Flop, Master-Slave flip flops and Timing diagrams Basic flip flop applications like data storage , data transfer and frequency division. Specifications and block diagram , Operation of a Analog IC Tester and its Circuit description (in brief	Capacitance: Charge stored in capacitors, Farad unit and conversions, Capacitor colour coding, Series and parallel capacitances, Capacitive reactance, Impedance,	Areas of rectangle, circles, regular polygons, calculation of areas, volumes & weight of simple solids, cubes, hexagonal prism. Shop problems
22	Construct and test a four bit asynchronous binary counter using 7493. Connect 7493 as a modulus-12 counter. Construct and test a four bit Synchronous binary counter using 74163. Construct and test synchronous Decade counter. Construct and test an up/down	Basics of Counters. Two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams. 3- bit Synchronous counters and synchronous decade counters. BCD display, BCD to decimal decoder. BCD to 7 segment display circuits	Simple problems on stress in bars. Concept of share modulus, bulk modulus & poisson's ratio	Batteries: Cells & Batteries, Series and parallel cells, related exercise, Logarithm definition, properties, simple problems. Magnetism & Magnetic units: The

	<p>synchronous decade counter using 74190 and monitor the output on LEDs. Display the count value on seven segment display using decoder/driver ICs.</p>			<p>magnetic field, flux, flux density, Ampere-turns, Angular momentum & torque simple problems</p>
23-24	<p>Construct the shift register using RS/D/JK flip flop and verify the result Construct and test four bit SIPO register Construct and test four bit PIPO register Construct and test two digit Seven segment LED / Decoder-Driver circuits. Construct and test of Dotmatrix / LCD Displays. Construction and testing of Binary weighted and R-2R Ladder type Digital-to-Analog Converters. Familiarization with various types of Memory ICs Identification of Flash Memories of various capacities. Test various digital ICs using digital IC Tester.</p>	<p>Shift Register functions, Serial to parallel and vice versa, Parallel to parallel and serial to serial, Bidirectional shift registers, Timing diagram ,important applications.pin details and functionality of universal shift register IC 74194 Memory concepts, types of memories RAM/ROM/EPROM/FLASH PROM etc. and their applications. Study of a Digital IC Tester : Specifications & Block diagram , Operation and circuit description of a Digital IC Tester</p>	<p>Inductance: Inductance, mutual inductance, transformer, Inductances in series and parallel, Impedance, related problems. Concepts of elasticity & elastic limits, stress & strength, hooke's law, young modulus of elasticity, applications in plant</p>	<p>Free hand sketching of plan & elevation of simple objects hexagonal bar, sq. bar, circular bar tapered bar hollow bar etc. Capacitor structure, symbol, types, colour code, Variable capacitors,</p>
25	Project Work / Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of Mechanic Industrial Electronics
Duration : Six Months

Second Semester

Semester Code: MIE: SEM II

<i>Week no</i>	<i>Trade practical</i>	<i>Trade Theory</i>	<i>Engg Drawing</i>	<i>Vocational Science & calculation</i>
1	Construct RC circuit and measure the Time constant by measuring voltages. Construct and test a simple high pass RC circuit and observe the integrated output for applied input. Construct RC differentiator circuit and convert Triangular wave into square wave. Construct simple diode based shunt clipping circuits to clip below and above reference voltages.	Time constants of RC & RL circuits. Diode shunt and series clipper circuits and clamping/limiting circuits and their applications. RC based Differentiator and Integrator circuits	Explanation of simple orthographic projection 3 rd angle.	Voltage dividers, & current dividers: Series voltage dividers, current divider with two parallel resistances. Complex numbers. Simple problems
2	Construction and testing of various Op-Amp circuits like Inverting, Non-inverting and Summing Amplifiers, Differentiator and Integrator Integrator	Introduction to Differential amplifier: construction & working block diagram of Op-Amp, importance, characteristics, common-mode gain, advantages and applications. schematic diagram of 741, symbol, Non- inverting voltage amplifier, inverting voltage amplifier, , linear and non-linear applications of 741,Comparator using op-amp ,other popular op-amps	<i>do</i>	<i>do</i>

3	Instrumentation Amplifier. Construct the comparator using OP-AMP Construct and test mono stable timer circuit using IC 555 Construct and test Astable timer circuit using IC 555 Construct and test VCO (V to F Converter) using IC 555 Construct and test 555 timer as pulse width modulator.	Block diagram of 555, functional description wrt different configurations of 555 such as monostable, astable and vco operations for various application	Moving coil meter, Moving Iron meters, voltmeter, Ammeter, Ohm meter	Direct-current meters: Moving coil meter, design of voltmeter, ammeter, loading effect of voltmeters, related problems.
4	Measure using CRO – DC Voltage, AC voltage, Period & Frequency & and observe different wave forms Troubleshooting CRO Vertical Preamplifier & all other sections (a) to (c).	Study of CRO : Specifications and block diagram , Familiarization with front panel and controls of a CRO. Study of CRO circuits (a) Vertical preamp (b) Vertical Intermediate amplifier (c) Vertical Final amplifier	Explanation of simple orthographic projection 3 rd angle.	do
5	Troubleshooting CRO Vertical Preamplifier & all other sections (d) to (f). Familiarize and doing measurement using Digital storage oscilloscope Interfacing DSO with a PC (IEEE)	(d) Time base circuits, (e) Horizontal Final amplifier (f) Low voltage & EHT power supply circuits. Study of H V circuits Digital storage and IEEE interface of a oscilloscope. Trouble shooting procedure of a CRO.	do	Work, power and energy- definition, units, and simple problems and on shop floor practices. Conservation of momentum and energy
6	Identify and test DIODE/SCR Power bridge Identify and test MOSFET Power bridge -Identify and test IGBT. Power bridge Connect the heat sinks to the above power bridges	Power MOSFET, IGBT - their types, characteristics, switching speed, power ratings and protection	do	do

7	<p>Construct and test a lamp dimmer /fan regulator circuit</p> <p>Construct a flashing lamp circuit using a thyristor</p> <p>Construct a UJT based Time delay circuit to turn on a lamp load with delay of 5 seconds</p> <p>Control the speed of a universal motor using a TRIAC based circuit.</p>	- do -	Different types of series parallel circuits, representation of nodes, etc.	<p>Kirchoff's laws: Kirchoff's voltage & current law, Branch currents, node voltages, Mesh currents, related problems.</p> <p>Trigonometry – identity & solve</p>
8	<p>Identify different fixed +ve and –ve voltage regulator ICs of different current ratings (78/79 series) alongwith i/o, reference pins.</p> <p>Wire a fixed voltage regulator as a variable one by floating the reference.</p> <p>Identify proper heatsinks for different IC based voltage regulators.</p> <p>Vary the input voltage and observe the fixed output for the above mentioned series</p> <p>Construct a dual power supply using above regulator ICs with current limiting and short circuit features.</p>	Regulated Power supply using 78XX series, 79XX series, Op-amp regulator, 723 regulator , (Transistorized & IC based) voltage regulation, error correction and amplification etc.	Familiarization and sketching the details of components	Network theorems: Thevenin's, Norton's theorems, conversion of voltage and current sources.
9	<p>Identify different front panel controls and connectors of the given power supply.</p> <p>Test the given power supply and limit the output for a</p>	<p>Specifications & block diagram of Linear power supplies.</p> <p>Front panel controls and features of various power supplies.</p> <p>Different types of power switches and</p>	do	do

	<p>specific voltage and current. Open the power supply and identify major sections and power components with heat sinks. Test the semiconductor power switches of a power supply. Operate a programmable power supply and test its features</p>	<p>heat sinks used in power supplies. .</p>		
10	<p>Dismantle the given stabilizer and find major sections/ ICs/ components. Measure voltages at vital points. Identify various input and output sockets/connectors of the given SMPS. Apply input and measure outputs using a multimeter. Test capacity of the given SMPS. Identify major sections/ ICs/ components of SMPS. Measure / Monitor major test points of SMPS. Identify and replace the faulty components. Use SMPS used in TVs and PCs for practice</p>	<p>Manual & automatic and servo voltage stabilizers-concept and block diagram, o/p voltage adjustment, voltage cutoff systems, study of different types of relays used in stabilizers, study of electronic circuit commonly used, buck and boost concept Block Diagram of Switch mode power supplies and their working principles. Principles of Inversion and Inverter circuits using different techniques. Pulse width modulation and their applications.</p>	do	<p>Moment of inertia of simple shapes like disc, cylinder & sphere.</p>
11	<p>Construct and test step up type chopper circuit Construct and test step down</p>	<p>Various types of chopper circuits step-up, step down, inverting types. Introduction to DC-DC Converters</p>	<p>Use of drawing instruments, 'T' square, drawing board, construction of simple figures & solids with dimensions, use</p>	do

	<p>type chopper circuit Construct and test inverter type chopper circuit Construct and test IC Based DC-DC converter for different voltages</p>	<p>ICs used for converting DC- DC , block diagrams and their pin outs. Applications of DC-DC converters</p>	<p>of different types of scales in inch & millimeters, lettering numbers & alphabets.</p>	
12	<p>Identify various input and output sockets/connectors /indicators on the given UPS. Make individual connections between batteries of battery stack and test for healthiness of batteries on stack. Connect battery stack to the UPS. Make load test to measure backup time</p>	<p>Electrical wiring for Single phase and Three phase systems, Earthing and earth resistance measurement, calculation of load power and power factor of a power source. Review on Batteries – various types, their selection, grouping of cells and batteries, charging of batteries, Various Battery charging circuits used in Inverters and UPS , Maintenance of Batteries Inverter – their principle & operation, power rating, change over period. Installation of Inverters, Protection circuits used in inverters– battery level, over load, over charging etc. Various faults and its rectification</p>	<p>Symbols, Cells, batteries, series, parallel, representation, Magnets, Electromagnets, symbols,</p>	<p>Batteries: Cells & Batteries, Series and parallel cells, related exercise, Logarithm definition, properties, simple problems.</p>
13	<p>Identify isolator transformer, inverting transformer and control transformers. Adjust charging current according to number of batteries Identify various circuit boards and monitor voltages at vital test points. Identify the charging section and set the charging current</p>	<p>Types of UPS. Block diagram and working principle of different types UPS. Specifications of a typical UPS. Most frequently occurring faults and their remedies. Concept of UPS, OFF LINE and ONLINE . Difference between Inverters and UPS. Selection of UPS – calculation of load power, Line interactive UPS ON- Line UPS, their circuit description and working- controlling circuits, Micro</p>	<p><i>do</i></p>	<p><i>do</i></p>

	<p>according to backup. Identify the semiconductor power modules and measure voltages. Perform a load test to UPS</p>	<p>controller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits</p>		
14	<p>Identify and draw different active, passive components using symbols Draw schematic diagrams for basic analog circuits Draw schematic diagrams for basic Digital circuits Draw schematic diagrams for Microprocessor and Microcontroller based circuits</p>	<p>Identify different active, passive components using symbols Draw schematic diagrams for basic analog circuits Draw schematic diagrams for basic Digital circuits Draw schematic diagrams for Microprocessor and Microcontroller based circuits.</p>	<i>do</i>	<i>do</i>
15	<p>Identify foot prints for different analog /digital electronic (lead and SMD) components Prepare layouts for simple analog/digital circuits Generation of output prints for fabrication (topside / bottom side / solder mask)</p>	<p>Identify foot prints for different analog /digital electronic (lead and SMD) components Prepare layouts for simple analog/digital circuits Generation of output prints for fabrication (topside / bottom side / solder mask)</p>	<p>Drawing of various electrical circuits with B.I.S. symbols of circuits, series& parallel circuits, power transformer instrument transformer etc.</p>	<p>Magnetism & Magnetic units: The magnetic field, flux, flux density, Ampere-turns, Angular momentum & torque simple problems</p>
16	<p>Identification of 2/3/4 terminal SMD components Soldering / desoldering of above components Identification of PGA packages Soldering / Desoldering of above PGA components Cold/Continuity check of</p>	<p>Identification of 2/3/4 terminal SMD components Soldering / desoldering of above components Identification of PGA packages Soldering / Desoldering of above PGA components Cold/Continuity check of PCBs Identification of lose /dry solders,</p>	<i>do</i>	<i>do</i>

	PCBs Identification of loose /dry solders, broken tracks on printed wiring assemblies.	broken tracks on printed wiring assemblies		
17	Familiarize with the Microprocessor kit, identify different ICs on the kit. Observe the voltage/waveforms on different ICs and IC pins of the processor Monitor the clock frequency. Write down the address range of different memory ICs and peripheral ICs on the kit Enter data to different memory locations in RAM Enter simple programs and execute using assembly language	Intro to 8085 Microprocessor, Architecture, pin details and Bus System of the processor Function of different ICs such as decoders, buffers, latches etc used with 8085 processor	AC wave form, frequency, wavelength representation,	Alternating voltage and current: AC fundamentals, RMS, Average values, Frequency, time period, wavelength, related problems,
18	Use assembler to assemble the programs and load them for execution by the processor Program to Blink an LED using port pins of 8255. Program to Control a relay using the port pins of 8255. Program to read the data from memory to sequentially ON the LEDs	Interfacing to memory ICs RAM, PROM/EEPROM Interfacing different peripheral ICs such as 8255. Instruction set covering data transfer, logical, Arithmetic, serial communication etc.	do	do
19	Write the RAM and ROM address ranges (internal and external) of the given	Differentiate Microprocessor and Microcontroller, Architecture of 8051 family of Microcontrollers, pin diagram	do	Areas of rectangle, circles, regular polygons, calculation

	<p>Microcontroller kit. Enter data into specific RAM locations and observe the volatility. Practice different commands to enter/edit and execute Assembly programs Identify different ICs used in the given Microcontroller kit and test vital signals on the ICs.</p>	<p>and various on chip resources . Types of memory with 8051 such as Onchip, external code memory, External RAM .</p>		<p>problems</p>
20	<p>Enter simple programs, execute and monitor the results Configure the port pins as input and output and apply inputs to activate/deactivate LEDs Initialize a Timer, Load a timer , and turn on a LED with delay.</p>	<p>Register Banks and their use Memory mapping of the microcontrollers, bit addressable registers (bit memories). Instruction set and various types of instructions</p>	<p>Inductors, series parallel, transformers, types, cores, types, lamination types, representation,</p>	<p>of areas, volumes & weight of simple solids, cubes, hexagonal prism. Shop</p>
21	<p>use the timer as an event counter to count external pulses. Execute a program to flash a set of 4 LEDs connected to port pins on the kit Write a program to use on board ADC and convert the analog voltage signal into digital value and store it memory</p>	<p>Special function registers (SFRs) and their configuration for various applications. Input / output ports and their configuration. Implementation of various Timer and counting functions, aspects of serial communication, Utilization of on chip resources such as ADC etc. Assembly software and compilers for 8051 Microcontrollers. 8052 and its difference with 8051</p>	<p><i>do</i></p>	<p><i>do</i></p>

22	Cutting, cleaning and preparing of fibre cable for splicing Splicing of OFC using splicing machine	Intro to optical fiber as a transmission media, its advantages over other media. Working principle of transmitter and receiver in fiber optic communication. applications and advantages of fiber optic communication.	<i>Capacitors series and parallel ckts</i>	Inductance: Inductance, mutual inductance, transformer, Inductances in series and parallel, Impedance, related problems.
23-24	Testing of OFC using OTDR Measure propagation , return and bending losses etc. Measure optical signal power using optical power meter Test the optical fiber cable using Visual Fault locator Make optical fibre setup to transmit and receive analog and digital data	properties of optic fiber, testing, losses , types of fiber optic cables and specifications Encoding of light Fiber optic joints, splicing, testing and the related equipments/measuring tools, precautions to be taken laying of cables, safety aspects while handling optical cables	<i>do</i>	<i>do</i>
25	Project Work / Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of Mechanic Industrial Electronics
Duration : Six Months

Third Semester

Semester Code: MIE: SEM III

<i>WEEK NO</i>	<i>TRADE PRACTICAL</i>	<i>TRADE THEORY</i>	<i>ENGINEERING DRAWING</i>	Vocational Science & calculation
1	Modulate and Demodulate various signals using AM and FM on the trainer kit and observe the waveforms. Construct and Test IC based AM Receiver Construct and Test IC based FM receiver Construct and Test IC based FM transmitter. Construct and Test HF Transistor based AM circuit.	Need for Modulation ,types of modulation. Demodulation techniques, Introduction to AM, FM & PM SSBSC & DSBSC FM Generation & Detection Radio Receivers: Types, Super heterodyne receiver Blocks, Principle, characteristics, advantages and disadvantages, Block diagram of FM Receives, Pre-emphasis and De-emphasis, AFC in FM Receivers RF, IF &AF Amplifier Sections	Free hand sketching of plan & elevation of simple objects hexagonal bar, sq. bar, circular bar tapered bar hollow bar etc.	Capacitance: Charge stored in capacitors, Farad unit and conversions, Capacitor colour coding, Series and parallel capacitances, Capacitive reactance, Impedance,
2	Assemble a dipole antenna and receive sky free satellite signal. Measure and establish relation of different elements of antenna with the frequency selection. Visit to any local cable TV Installation and study the dish antenna elements	AM/FM RF Alignment, Radio Wave Propagation – Principle, Fading, Fundamentals of Antennas, principles of radiation, antenna parameters, antenna gain, bandwidth, polarization. different elements and types of antennas dipole, yagi, parabolic reflector and their testing.	<i>do</i>	Simple problems on stress in bars. Concept of share modulus, bulk modulus & poisson's ratio
3	Modulate and Demodulate light source using AM/FM/PAM /PPM/ PWM techniques Multiplex/ Demultiplex transmit/receive and reconstruct a signal using fiber optic media	Digital modulation and demodulation techniques, sampling and quantization Concept of multiplexing and demultiplexing of AM/FM/ PAM/ PPM /PWM signals.	Capacitor structure, symbol, types, colour code, Variable capacitors,	<i>do</i>

4	<p>Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric) , load cells, strain gauge. LVDT by their appearance</p> <p>Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart.</p> <p>Measure temperature of a lit fire using RTD and record the readings referring to data chart</p>	<p>Basics of passive and active transducers – Role, selection and characteristics. Working principles of RTD, Thermocouple, pt-100. Sensor voltage and current formats</p>	do	<p>Resonance: Series resonance, Parallel resonance circuits, Resonance frequency, related exercise,</p>
5	<p>Detect a metal using Inductive proximity switch and indicate on LED. Observe the effect of distance.</p> <p>Detect a water level in a transparent glass using capacitive proximity switch and indicate on LED.</p> <p>Detect a transparent plastic glass using photo electric proximity sensor.</p> <p>Measure the weight on a strain gauge and record the output reading</p> <p>Detect direction of a movement of a motor by connecting it to a rotary encoder</p>	<p>Inductive, capacity sensors, photo – emission, voltaic and conductive cells and their applications Strain gauge, load cell and LDR – construction and working principles. Earthing and shielding-Safety measures</p>	do	do
6	<p>Measure speed of a motor by connecting it to a rotary encoder</p>	<p>Working principles of Rotary encoder, solenoid valves, float switches, LVDT,</p>	<p>Calculation of area of triangles, polygons with the aid of</p>	<p>AC circuits: Power, VA, KVA, Watts, KW, related exercise,</p>

	<p>and a frequency counter. Identify on/off solenoid valve and control the flow of water through it by turning it on off electrically. Transfer water from one tub to the other through two different pumps based on the Hi/Low level switches installed in both tubs. Monitor the position change of an object moving through LVDT and record the position.</p>	<p>Basics of transmitters and signal conditioning circuits.</p>	<p>trigonometry.</p>	<p>power factor,</p>
7-8	<p>PIC Family of microcontrollers: Write the RAM and ROM/EEPROM address ranges (internal and external) of the given PIC Microcontroller kit. Enter data into specific RAM locations and observe the volatility. Practice different commands to enter/edit and execute Assembly programs Identify different ICs used in the given PIC Microcontroller kit and test vital signals on the ICs. Enter simple programs, execute and monitor the results Configure the port pins as</p>	<p>Study of 16F/18F series of PIC Family of Microcontrollers. Architecture of PIC Microcontrollers Special features of PIC like OSC Options, Power on Reset, Power up timer, Watch Dog timer, Brownout Reset, Low Voltage Programming. Memory organization of PIC (Data meory, Flash memory and Return Address stack) I/O Ports and their control Registers Parallel Slave Port mode and its importance Timers / Counters in different modes. Timers as “ Ticks”, Timers for measuring Pulse Widths and Frequencies, Timers as PWM outputs. Timer for Capture and Compare operations Watch Dog timer concept ON CHIP peripheral resources like</p>	<p>Series RLC, Parallel RLC circuits,</p>	<p>Concept of shear forces, bending moment, torsion in shaft, simple problems.</p>

	<p>input and output and apply inputs to activate/deactivate LEDs</p> <p>Prepare a program , compile and Dump the code on to the on-chip flash memory of the PIC development kit and test the function.</p> <p><u>Use embedded C-programming for the following Tasks</u></p> <p>Control an LED connected to port pin using an input switch connected to another port pin</p> <p>Blink an LED connected to a port pin with a delay of 500 ms.</p> <p>Enable a siren using port pin to generate variable audio signals</p>	<p>Comparators, ADC.</p> <p>PIC s Instruction set</p> <p>I/O ports and their configuration</p> <p>PIC C-Programming Basics</p>		
9-12	<p>Identification of various indicators, connectors on the System unit and I/O devices, identify drives and their capacity, identify various connectors and cables inside the cabinet. Identify connections to rear side and front panel of the cabinet.</p> <p>Disable certain functionality by disconnecting the concerned cables (like USB,SERIAL, FDD etc as may be required in some cases)</p> <p>Replace the CMOS battery</p>	<p>Basic blocks of a computer, Hardware and software, I/O devices, HDD,FDD,CDD, DVD.</p>	do	do

	<p>identification and testing and troubleshooting of computer memory</p> <p>Replace/Extend a memory module</p> <p>configuring and troubleshooting display problems</p> <p>power supply testing and replacing,</p> <p>upgrading BIOS using flashing.</p> <p>Replace the given HDD on the system</p>	<p>Windows O.S., various types of files, folder concept, various ports in the computer, saving ,copying, deleting & retrieving files, POST Booting concept.</p>	<p>Symbols as per different semi-conductor devices- LDR, VDR, Thermister & their use in circuits.</p>	<p>Diodes: Rectifier, peak voltage, PIV, Rectifier efficiency,</p>
	<p>Replace the faulty SMPS</p> <p>Boot the system from different options</p> <p>Install a Printer driver software and take print outs</p> <p>Install antivirus software and scan the system</p>	<p>Different types of printers and their advantages, function and inter-connection</p>	do	do
	<p>Explore the configuration options in the antivirus software</p> <p>Create folder and files, use of search engines, Creation of email accounts, sending and receiving the mails</p> <p>configuration of email clients.</p>	<p>Concept of Internet, Browsers, Web sites, search engines, email, chatting and messenger service. Downloading the Data and program files etc.</p>	do	do
13	<p>Use start menu, check available programs in computer, use search, settings, run and options.</p> <p>Creation of short cuts</p> <p>Changing screen savers.</p> <p>Install MS office software</p> <p>Drawing pictures using paint, using menus of paint</p>	<p>MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management ,installation of program, setting and using of control panel., application of accessories, various IT tools and applications, Components of desk top</p>	do	<p>Voltage regulators, Voltage doublers, multipliers, Clipper circuits, related exercise.</p>

14	Explore different Menu/Tool/Format/status bars of MS word and practice the options Editing the text, saving the text, changing the font and size of text. Creation of brochures and taking the printouts.	Concept of word processing, MS word – Menu bar, standard tool bar, page setting, editing, formatting, advance features i.e. highlighting, cut & paste, subscript & super subscript	Diodes, Forward & Reverse bias, Rectifiers, Input & output waveforms, Regulator circuits, Clipper circuits, wave forms,	Properties of triangles, simple problem of height & distance
15	Practice the Mail merge options Prepare a power point presentation on any three known topics with various design features Invoke excel sheet from MS WORD and vice versa Prepare a power point presentation with different animation and visual effects. Convert the given PDF File into WORD File using a suitable software.	drawing features, mail merging, tables and borders, printing of document etc. Introduction to power point Basics of preparing slides, different design aspects of slides, animation with slides etc	do	do
16	Pneumatics: Identify different pneumatic and electro pneumatic components Construct and control a single acting cylinder Construct and control a double acting cylinder Construct and control single/double acting cylinder using series/ parallel circuits	Intro to pneumatic power source and measure of compressed air, storage and transmission of compressed air, applications of pneumatics in the industries Symbols of different pneumatic and electro pneumatic components Various supply elements such as compressors, reservoir, pressure regulating valve, service unit etc	do	do
17	Construct and perform bidirectional control of a cylinder	Various input elements such as push button valves, roller lever valves, proximity switches, Air barriers etc	do	do

	<p>Construct and control automatic return of a double acting cylinder</p> <p>Construct and control oscillating motion of a double acting cylinder</p> <p>Construct and control a latching circuit using single or double acting cylinder</p> <p>Construct and control automatic return initiated by a limit switch.</p> <p>Throttle a cylinder to adjust forward and return strokes.</p> <p>Adjust the pressure as per the requirements</p>	<p>Various pneumatic control elements, processing elements such as directional control valves, shuttle valves, non-return valves, pressure control valves, Timers and sequencers etc</p> <p>Function and application of solenoid valves</p> <p>Limit switches, memory valves, pressure dependent valves and time dependent valves</p>		
18	<p>Construct and test different electro pneumatic control circuits for various industrial applications.</p>	<p>Study different electro pneumatic components used in the industries</p> <p>Various pneumatic power components such as single acting, double acting cylinders and Rotary actuators such as air motors and rotary motors etc.</p>	do	do
19	<p>Identify different size of LEDs and measure voltage drop/ current drawn.</p> <p>Identify suitable LED holders and fix them.</p> <p>Identify common anode, cathode seven segments,</p> <p>Connect binary inputs through switches and display different numbers and characters.</p> <p>Identify display decoder/ driver IC by its number and connect to</p>	<p>Different types of seven segment displays, decoders and driver IC s for them. Concept of multiplexing and its advantages.</p> <p>Use of DPM (Digital Panel Meter) with seven segment displays to display different voltage & current signals.</p>	do	do

	<p>seven segment display. Connect a Thumb-wheel switch and display the set number on a Seven-segment display Construct and test a two digit Digitally Multiplexed display circuit using seven segment Display.</p>			
20	<p>Identify LCD display module and its decoder/ driver ICs. Display a word on to a two line LCD. Measure the voltage/ current flowing through a resistor and display it on a seven segment display module. (DPM) Measure the voltage/ current coming from a sensor and display it on a seven segment display module (DPM)</p>	<p>Principles of working of LCD. Different sizes of LCDs. Decoder/Driver ICs used with LCDs and their pin-out diagrams. Scrolling displays and its design. Use of DPM (Digital Panel Meter) with LCD to display different voltage & current signals</p>	<i>do</i>	<i>do</i>
21	<p>Identify solar power panels of different capacities Measure the voltage and maximum load that can be connected to the panels. Aware of the installation of solar panels Identify the cables/connectors used to interconnect a solar panel to the indoor equipment Measure the connection losses</p>	<p>Need for renewable energy sources, Global warming and its impact. Solar energy as a renewable resource. Solar energy applications. Solar radiation fundamentals. Solar radiation measurement using pyrometers Basics of photovoltaic's and Arrays. Materials used for solar cells.</p>	<i>do</i>	<i>do</i>
22-24	<p>Connect and test solar panel to the inverter and run the load. Measure the discharge current</p>	<p>Principles of conversion of solar light into electricity. Types of solar cells. Monocrystalline and poly crystalline PV</p>	<i>do</i>	<i>do</i>

	<p>Mount a solar panel anchor system to an asphalt single roof</p> <p>Attach a solar panel rail system to roof anchors</p> <p>Mount a solar panel to a roof anchor system</p> <p>Wire a solar panel to a solar controller</p> <p>Wire a solar controller to a battery storage station</p> <p>Connect storage batteries in a series circuit</p> <p>Connect storage batteries to a power inverter</p> <p>Wire a power inverter to an electrical service panel</p> <p>Test circuits for voltage</p> <p>Calculate the voltage of all</p> <p>Disassemble solar panels</p> <p>Take the trainees to the nearest solar power installation and demonstrate various aspects to cover skills as specified above</p>	<p>cells.</p> <p>Define Components like Solar cell, Module, panel and Arrays.</p> <p>Factors that influence the output of a PV module.</p> <p>SPV systems and the key benefits</p> <p>Difference between SPV and conventional power.</p> <p>Define solar charge controller or regulator and its role.</p> <p>Safety precautions while working with solar systems.</p>		
25	Project Work / Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of Mechanic Industrial Electronics
Duration : Six Months

Fourth Semester

Semester Code: MIE: SEM IV

Week NO	Trade practical	Trade Theory	Engg Drawing	Vocational Science & calculation
1	<p>Identify and measure various sensor signal outputs and test their healthiness. Connect a sensor output to a transmitter and configure for a specific output format (Voltage or current). Identify and wire with 2-wire, 3-wire and 4-wire devices Demonstration on closed loop control system and servo mechanism. Observe the output of the thermocouples and RTDs at various temperatures and plotting the graphs. Observe the output of various transducers like strain gauges, load cells, LVDT, Tacho generators, Flow sensors, Capacitance probe, DP cell etc.</p>	<p><u>Control systems</u> Control system- open loop control system and closed loop control system, merits of closed loop control system, block diagrams, process variables and standards. Feedback systems and Transducers Feedback systems- Transducers, various types of transducers used for measurement of process variables like temperature, flow, pressure, level and speed- their types, functions and their working principle.</p>	<p>Drawing of A.F. amplifiers circuit with stage & with types of O/P, p-p.</p>	<p>Transistors: Biasing of transistors, CB, CE, CC, DC & AC Load line , operating/ 'Q' point, problems.</p>
2	<p>Identifying parts of Solenoids and different types of Industrial Control Valves and working with them. Connect the PID Controller to the process plant and observe output of Proportional, Integrator and Derivate Controls and compare the response</p>	<p><u>Control Valves</u> Control valves used in industries, their types and specific applications, construction details. <u>PID Control</u> Proportional amplifier, Integrating and Differentiating amplifiers, Instrumentation amplifiers. P,PD,PI and PID control systems</p>	<p>do</p>	<p>do</p>

3	<p>Study on phase failure relay / 1 phase preventer Study on 1 phase and 3 phase MCBs Study on circuit breakers Demonstration of protective relays and their current /voltage setting Familiarization with ELCB and single phase preventer</p>	<p>ELECTRICAL PROTECTIVE DEVICES Calculation for selection of current, wires and cables size, Fuses and MCBs/Main switches for AC 1 phase / 3 phase motor and DC motors Circuit breakers – Oil circuit breaker, Air circuit breaker, Vacuum circuit breaker. SF6 circuit Breakers Over load relay – Over current & Over voltage relay ELCB – Single phase preventer</p>	<p>Symbols of transistors, CB, CE, CC configurations, biasing circuits</p>	<p>Power transmission by shaft, belts & ropes</p>
4	<p>Disassemble, identify and rectify faults of a Relay/contactor/Timer and test them. Construct a self hold contactor circuit and run a 3-Phase Induction Motor. Familiarization with different types of motor and identification of their different parts Identification of (unmarked) terminals of 3 phase induction motors Study & connect the motor and run (below 5hp) in star, note phase voltage line voltage and current Study and connect and run the motor in Delta and note phase current line current. Phase voltage and line voltage.</p>	<p><u>AC & DC Motors</u> Basic control components such as switches, relays and contactors and Timers. Study of different layout diagrams, wiring diagrams and schematic diagrams. Reading electrical motor control circuit diagrams. Basics of AC motor, AC motor speed and torque equations. Speed torque characteristics. Types of motors: Advantages & Disadvantages among each others. AC motor, 1phase & 3 phase induction motor, DC motors, Stepper motors.</p>	<p><i>do</i></p>	<p><i>do</i></p>
5	<p>Connect and operate an induction motor using DOL starter in local and remote modes. Connect and run a 3-phase motor</p>	<p>Working principles of DOL and star-delta starters. Working of forward , reverse and jogging of motor.</p>	<p>Block diagram of an oscillator, symbols for different wave shapes, Sq., saw tooth, sine, triangular etc.</p>	<p>Transistor amplifiers, Voltage Gain, Current gain, power gain, decibel.</p>

	<p>using manual and automatic star and delta starters.</p> <p>Construct and operate induction motor in forward and reverse directions.</p> <p>Sequential switching of induction motors (conveyor belt) using relays, contactors etc.</p> <p>Construct, run, stop and jog in both directions of an induction motor.</p>	<p>Working of overload relays and overload current adjustment techniques.</p> <p>Overload Relay adjustments and connections in a control circuit.</p>		
6	<p>Identify the Battery charging circuit, testing the charger, rectify the battery and charger related problems.</p> <p>Test the mains sensor, overload sensor, Displays and Indicators, Installation of Inverters.</p>	<p>Batteries & UPS Maintenance</p> <p>Lead acid cell, AH rating, calculation of discharge/back up time, Tubular batteries, methods of charging batteries.</p> <p>Simple charger, current controlled charger, SCR charger circuit, charging Cycle, Selection of batteries.</p> <p>Change over period, Over load sensing and PWM correction, short circuit protection.</p>	<i>do</i>	<i>do</i>
7	<p>Study various components of an UPS with the help of a schematic diagram, fault finding and rectification in a commercial UPS.</p>	<p>UPS: working of an UPA, various components of an UPS, types of UPS, Off-line UPS, on-line UPS and line-interactive UPS.</p>	<p>Single stage amplifiers, Multistage amplifiers, Class 'A', Class 'B', Push pull, Complimentary symmetry circuits,</p>	<p>Oscillators, Frequency calculations, Relaxation oscillator problems, related exercises,</p>
8	<p>Detect surface cracking of a motor part using eddy current tester (NDT based) Method.</p> <p>Use ultrasonic flaw detector to detect deformities in metals.</p>	<p>Non Destructive Testing (NDT)</p> <p>Intro to NDT, methods of NDT such as Visual, X-ray, ultrasonic, eddy current, Microwave, Magnetic particle etc. Uses of NDE methods, when to use NDT</p>	<i>do</i>	
9	<p>Identify front panel indicators, controls and connectors on a welding rectifier source.</p> <p>Identify front panel indicators,</p>	<p>Industrial welding & Heating</p> <p>Welding rectifiers and their specifications, welding rectifier and control equipment block diagrams</p>	<i>do</i>	<p>Concepts of lifting machine, velocity ratio, mechanical advantage, relation between them</p>

	controls and connectors on a welding equipment controller. Dismantle the controller and identify major functional blocks and measure voltages at vital test points. Assemble back the welding control equipment.	and working principles Industrial heating equipment, working principles, types, specifications and applications.		
10	Study the AC Drive set up and its connections Identify different cables and connectors used in the AC DRIVE setup Identify various input and output terminals the DRIVE unit, Operator panel and display unit.	AC DRIVES Block diagram of AC Drive – Sources of supply – Converter / Rectifier – DC Link – Inverter – Motor Load. Converter bank. 1 phase & 3 phase diode rectifier (full wave) and filters Chopper – (Fixed voltage dc to variable voltage dc) Inverter – 1 phase Inverter	Oscillators circuits, Multi vibrators, UJT oscillator, FET, MOSFET symbols, DIAC, TRIC	do
11	Familiarization with PMU & different terminals of Micro – Master AC Drive Demonstration – Access parameter number & values Familiarization with parameters – Parameter values for various function/operation Commissioning parameter numbers and values	3 phase Inverter – Switching circuit (Sequence and Switching timing control – PWM Technique & Switching Devices Square wave to Sin- wave input for motor. Microprocessor / Microcontroller) – VFD (Variable Frequency Drive) VV VF Control – (3 phase induction motor) Speed control. ON / OFF Control – PID Control and Applications	<i>do</i>	Digital Electronics: Binary numbers, Binary arithmetic, Basic logic gates, other logic gates,
12	Installation of AC Drive MM-420/440 Familiarization with:- Commissioning & Quick Commissioning (MM-4) Reset to default value / Factory setting values MM Drive Programming / Parameterization for different control	Installation of AC Drive / Siemens Micro master Drive – MM-420/440 Commissioning / Quick commissioning of MM – 420/440 Micro – Master Drive – Programming (Parameterization)	Drawing of AM&FM modulated wave at various modulation 100 pc., 50 pc etc.	

	operation. ON/OFF, Forward, Reverse, Jog (R) Jog (L) braking and speed control			
13	Familiarization with different parts and terminals of DC Drive Familiarization with parameters and operation for accessing parameter number and values Start up procedure demonstration Parameterization for variation of motor speed through POT with Armature voltage feed back (with internal setting) Parameterization – Control drive through POT with encoder feedback (with internal setting) Parameterization – Control the drive speed through external speed raise / lower buttons	DC Drives DC Motor fundamentals – Speed & Torque equation – and characteristics. Speed variation technique of DC motor (Armature control & Field control) – Fundamentals of DC Drive – Open loop DC Drive Close Loop DC Drive. Breaking & Reversal of DC drive. Techno/Encoder technical data related DC drive. Block diagram of DC Drive. Converter bank – Gate Trigger set circuit Hardware description of DC Drive. Description of 6RA70 Siemens (or similar)master drive. Start up procedure (Quick Commissioning)		Vector – definition of scalar, and vector, notations and representation of vectors
14	Parameterization – Operating the drive through fixed set point Operating the drive through Jog/inch set point Operating the drive through crawling point Familiarization with function diagram. Connect a DC motor to the given DC Drive and run the motor with default factory settings. Control various motor parameters of the DC Drive using the software. Study function diagram for BICO parameterization. Demonstration/Practice for various	Terminal Diagram of 6RA70 DC Drive Function of 6RA70. BICO Technology. Parameterization of DC Drive – 6RA70 – BICO Parameterization Study of Function Diagram with applications Breaking of single quadrant drive and 4 quadrant drive – Drive faults – faults and alarm messages DC Drive: various parameters to be controlled for different applications Familiarization with function diagram of DC drive. Bioco parameterization technique	Logic gates, Combinational gates, other circuits.	do

	control using BICO parameterization Connect and run the BLDC motor. Fault finding in the Inverter section and control section of the BLDC drive	<u>Brush-less DC Motors</u> BLDC Motors and their drives – construction and working, Hall sensor, Speed control of BLDC Motors		
15	control of cylinder using NRV, continuous observation of working of single acting / double acting cylinders, position control of valves, familiarization with electro pneumatic valves, triggering of single acting / double acting cylinders using electro solenoid valves control of cylinders using electrical push button switches, contactors and control circuits, interfacing of cylinder with PLC using electrical actuators.	<u>Industrial Electro Pneumatics</u> overview of electro pneumatic components, electro pneumatic systems Multiple actuator circuit , different cylinder valves, interfacing actuators with sensors, controlling cylinders with PLC.	Exercise on blue print reading/ circuit. Reading of house service connections & small power circuits, Connections of ammeter, voltmeter, KWh-meter with ISI symbols, circuit,	Digital Electronics: Combined logic gates, other digital circuits.
16	Identify different PLC modules and interpret LED indicators on it Wire various digital input and output devices to the digital input/output modules and record their address Configure the hardware of PLC with PLC Software on programming terminal Configure the required drivers to establish communication with PLC using various industrial communication protocols. Create a new project and monitor the status of input devices. Develop ladder programs to implement simple electrical control circuits	<u>Industrial Automation with PLCs</u> Hard wired logic & programmable logic- comparison. Components of a PLC - CPU, Power supply, Digital I/O and Analog I/O . Types of digital and analog sensors, Encoders, and actuators, their connection to I/O modules	<i>do</i>	

17	Prepare ladder program using Binary bits Prepare ladder program using Timers Prepare ladder program using Counters	Programming PLC- Ladder Logic . Programming bits and byte oriented operations, Timers, Counters and their applications. Compare , arithmetic, data copy instructions and their utility.	do	Addition and subtraction of vectors. Scalar and cross product. Simple problems
18	PLC programming for various control applications like Stepper motor control. bottle filling plants, conveyor belt control, elevator control, batch process control (any two applications)	Industrial control applications such as bottle filling plant, elevator, conveyor belt control, batch process control etc. stepper motor drive, sequential switching etc,	Reading & drawing of different stages of R/R/ free hand sketches of trade objects	do
19	PLC programming for PID control applications like speed control of motor, temperature control, Level/flow control (any two applications) Connect an AC Drive to PLC and monitor and control various motor parameters.	PID Module, PID Tuning. Various Communication protocols used in PLCs. MODBUS, profibus, Ethernet, control net Communication , REDUNTANCY, PLC application in CNC machine. Motor control / Motion control using PLC and AC Drive. PLC & AC drive applications	do	do
20	Prepare a SCADA project using a communication channel., remote nodes and master unit. Configure SCADA software to establish communication with PLC. Monitor digital input/output devices status on a SCADA screen. Give set points to PLC. Control a process by issuing commands from SCADA	SCADA system and its components, Concept of Tags, analog/digital Animation, supervisory control, control of process parameters from SCADA screens. Security features Controlling Drives from SCADA.	do	do

21-24	Operation and Maintenance of Auto Mains Fail (AMF) panels in Diesel Gen Set. Observe the functions of various sensors used in AMF panel	<u>AMF Panels</u> Auto Mains Fail (AMF) Panel, basic working principle of AMF. Engine safety, Various sensors used along with the AMF	<i>do</i>	<i>do</i>
25	Revision			
26	Examination			

TRADE: MECHANIC INDUSTRIAL ELECTRONICS
LIST OF TOOLS & EQUIPMENT
A. TRAINEES TOOL KIT FOR 16 TRAINEES +1 INSTRUCTOR

Sl. No.	Specification	Quantity
1	Connecting screwdriver 100 mm	17 Nos.
2	Neon tester 500 V.	17 Nos.
3	Screw driver set (set of 5)	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	17 Nos.
9	Tweezers 100mm	17 Nos.
10	Digital Multimeter	17 Nos.
11	Soldering Iron Change able bits 15 W	17 Nos.
12	De- soldering pump	17 Nos.

B. General Machinery Shop outfit

1	Steel rule 300mm	4 Nos
2	Steel measuring tape-3 m	4 Nos
3	Tools makers vice 100mm (clamp)	1 No
4	Tools maker vice 50mm (clamp)	1 No
5	Crimping tool (pliers)	2 Nos
6	Soldering Iron 10W,25W,50 W	4 Nos each
7	Magneto spanner set	2 Nos
8	File flat 200mm bastard	2 Nos
9	File flat 200mm second cut	2 Nos
10	File flat 200mm smooth	2 Nos
11	Screw driver 150mm	4 Nos
12	100mm flat pliers	4 Nos
13	100mm round nose pliers	4 Nos
14	Hacksaw frame (tubular)	4 Nos
15	Scriber straight 150mm	2 Nos
17	Hammer ball pin 0.5Kg	1 Nos
18	Allen key set (set of 9)	2 Nos
19	Tubular box spanner (set of 6nos)	1 No
20	Magnifying lenses 75mm	3 Nos
21	Drill bit 5/16" (7.9mm)	2 Nos
22	Continuity tester	4 Nos
23	Scissors 200mm	1 No
24	Handsaw 450mm	1 No
25	Hand Drill Machine	2 Nos
26	First aid kit	1 No
27	Fire Extinguisher	2 Nos
28	Bench Vice	3 Nos
29	Bench Grinder	1 No
30	Dual DC regulated power supply 30-0-30 V, 2 Amps	2 Nos
31	Dual Tracking DC regulated power supply 30-0-30 V, 2Amp	1 No
32	DC regulated power supply 0-300 V, 500 mA,	1 No

33	DC regulated power supply 0-24 V, 1Amp	2 Nos
34	LCR meter (Digital)	1 No
35	CRO single trace-20 MHz.	2 Nos
36	CRO Dual Trace 30 MHz	1 Nos
37	Pulse Generator 0.1 Hz to 100Mhz.	2 Nos
38	Signal Generator, 0-100 KHz	1 No
39	Battery Charger	1 No
40	Digital Multimeter and Analog multimeters	6 & 3 Nos
41	Function generator 0.001 Hz to 100Mhz	2 Nos
42	Dimmerstat, 8 Amps	6 Nos
43	Analog Component Trainer	4 Nos
44	Op Amp trainer	3 Nos
45	Digital IC Trainer	3 Nos
46	Personal Computer System with latest configuration	2 Nos
47	Laser Printer	1 No
48	Digital IC Tester	1 No
49	Digital and Analog Bread Board Trainer	4 Nos
50	Soldering/De soldering Station	2 Nos
51	Assorted values of Resistors, capacitors and Inductors	As reqd.
52	Hot air soldering station –cum-De-soldering Station for SMD	1 No
53	Commercial Radio receivers portable with FM/FM.	6 Nos
54	Rheostats various values and ratings	6 Nos
55	Soldering Gun with changeable bits 25 watts	3 Nos
56	Resistance Bridge(Including P.O. Box)	2 Nos
57	Capacitance test Bridge	2 Nos
58	Inductance Bridge	2 Nos
59	SMPS TRAINER	2 Nos
60	UPS TRAINER	2 Nos
61	POWER ELECTRONICS TRAINER with at least 6 no's of onboard applications	1 No
62	LINEAR IC TRAINER with at least 6 no's of onboard applications	1No
63	FIBRE OPTIC TRAINER	1 No
64	MICROPROCESSOR TRAINER KITS with 6 different application interfaces	1No
65	MICROCONTROLLER TRAINER KITS with 6 different application interfaces	1 No
66	CRO Trainer	1 No
67	Different types of electronic and electrical cables, connectors, sockets, terminations.	As Required
68	Different types of Analog electronic components, digital ICs, power electronic components	As Required
69	COMMUNICATION TRAINER with atleast 4 no's of onboard applications	1 No
70	Transducer Trainer	1 No
71	CNC trainer	1 No
72	Seven segment DPM	2 No
73	LCD based DPM	2 No
74	5KVA online UPS	1 No
75	LAN Cards	4 Nos

76	Motherboards (of different make)	2 Nos
77	Crimping Tools	2 Nos
78	Hard Disk (500 GB or better)	2 Nos
79	Pen Drives	2 Nos
80	External Hard disk	2 Nos
81	Computer Spares	As Required
82	Different types of memory cards	3 Nos
83	Blue-Ray drive and player	1 No
84	Industrial Electro-pneumatic trainer	2 Nos
85	Fiber optic communication trainer	2 Nos
86	PCB DESIGN SOFTWARE and PCB making materials	4 LICENSES
87	Low wattage solar panel based inverter	1 No
88	Dish antenna set	1 No
89	Closed loop control Trainer for temperature, flow and Level	1No
90	Online UPS 1KVA or higher	2 Nos
91	AC Drive for 1HP with 3 Phase motor	1 No
92	DC Drive with DC Motor	1 No
93	Electro pneumatic trainer kits (with components)	1 No
94	AMF Panel for 1KVA DGSET	1 No
95	Proximity sensors (Inductance type, Capacitance type) Encoders and Decoders	4 Nos
96	Limit Switches	6 Nos
97	Thermocouple J-Type, K-Type	4 Nos
98	Load cell up to 1Kg	4 Nos
99	Temperature controller - PID Type	1 No
100	Rotary Encoder	2 Nos
101	PLC on Ethernet with digital I/O, analog I/O Communication module	2 sets
102	PLC based applications stepper motor control, bottle filling plant, batch process reactor, pick and place arm, conveyor belt control	1 No each
103	PID Controller	1 No
104	Eddy current based NDT tester	1 No.
105	BLDC drive with motor	1 No.
106	DOL starter with 1 HP INDUCTION MOTOR	1 No.

C.WORKSHOP FURNITURE:

Sl. No.	Name of the items	Quantity
1	Instructor's table	1 No
2	Instructor's chair	2 Nos
3	Metal Rack 100cm x 150cm x 45cm	4 Nos
4	Lockers with 16 drawers standard size	2 Nos
5	Steel Almirah 2.5 m x 1.20 m x 0.5 m	4 Nos
6	Black board/white board	1 No