Syllabus for the trade

of

MECHANIC MEDICAL ELECTRONICS
(SEMESTER PATTERN)

UNDER

CRAFTMAN TRAINING SCHEME (CTS)

Designed in 2013

by

Government of India

Central Staff Training and Research Institute
Directorate General of Employment & Training
Ministry of Labour & Employment
EN-81, Sector-V, Salt Lake City,
Kolkata-700091

List of members of Trade Committee meeting for trade of "Mechanic Medical 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-Chemestry	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. Muhkerjee, 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 MEDICAL ELECTRONICS**

2. **NCO Code No.**

3. **Duration of Craftman Training :-**   02 years (FOUR SEMESTERS-6 months each)

4. **Entry Qualification :**   Passed 10th class examination under 10+2 system of education with Physics, Chemistry & Mathematics

5. **Unit Strength :-**   20 Trainees

6. **Space Norm :**   **120*** Sq. mtr (inclusive 10 sq. mtr dark room area)

7. **Power Norms :**   **2 kW**

8. **(A) Trainer's Qualification :**

   a) B.E./B.Tech in Electronics/Electronics & Telecommunication with 1year. experience in the relevant field

                 OR

   b) Diploma in Electronics/Electronics & telecommunication/from recognized board of technical education with two years experience in the relevant field.

                 OR

   c) NTC/NAC in the trade with five years or Four years experience respectively in the relevant field

8. **(B) Desirable qualification**   **:** Preference will be given to a candidate with Craft Instructor Certificate.

Note: At least one Instructor must have Degree / Diploma in the relevant field.

Syllabus for the Trade of "Mechanic Medical Electronic"
Duration : Six Month

First Semester
Semester Code: MME: 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. Free hand sketching of tools, reading of simple drawings and concepts of dimensions and dotted lines, chain lines etc. Magnifying glass.	Quadratic equation, Simultaneous linear equation in two variables.
2-3	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	**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	-do-	Electricity: Negative & positive polarities, structure of Atoms, Electrons & protons, coulomb, unit of charge, volt, unit of potential difference, and charge in motion is current.

	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 Multimeters.	power, terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties Different type of electrical cables and their specifications. Different types of Cables used in the electronic industries. Ohm's law and its variables.		
4	Measure and Test the voltage of the given primary/secondary 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 contactor. Operate a Three phase Induction Motor with three pole EM Contactor having 1 NO + 1 NC auxiliary contacts	**Battery /Cells**: construction, types of primary and secondary cells, 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.	Atomic Structure, Different components.	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.
5	Identify different transformers Measure the primary and secondary winding	Working principle of a Transformer, Transformer construction , Types of	-do-	-do-

	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 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	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. **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.		
6	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	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. Types of Contactors, contactor coils and working voltages, contactor	Reading of simple drawing, free hand sketching of simple solids with dimensions, free hand sketch of solids viewed perpendicularly to their surface and axes.	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,

	Fan(permanent capacitor motor). Connect, set proper direction of rotation and Run. Remove the ceiling Fan motor and test it Remove the Fan capacitor and test it	contact currents, protection to contactors and high current applications.		Polarity of IR voltage drops, Total power in series circuits, related exercise.
7	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	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.	-do-	-do-

8	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, fullwave 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.	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.	-do-	Arithmetic and geometric progression, sum of n-terms, simple calculations.
9	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 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**)	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, Discuss a Transistor application as a	Electronic Component symbols, Series circuit, Representation of IR voltage drops.	-do-

	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.	switch. Discuss a Transistor application as an amplifier. Define input impedance and output impedances		
10	Identify any five FET Transistors and record main parameters from the Data book Test the given FET (atleast 5 no's) and record the impedances. Construct and test a FET Amplifier Identify SCRs of different ratings by their number. Test different SCRs (atleast 5 no's) for healthiness using a Multimeter. Construct SCR test circuit with a small load and test. Identify different heat sinks used with various SCRs. Identify and test a DIAC(atleast 3 no's) by its number. Use an RC circuit to fire and change the firing angle of SCR. Construct a circuit using DIAC as trigger device to fire SCR Identify and Test a UJT by its number Construct UJT based free running oscillator and change its frequency. Identify and test a DIAC(atleast 3 no's) by its number Construct a circuit using DIAC as trigger device to fire TRIAC for phase control application. Identify and test a power MOSFET (atleast 3 no's) by its number	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. Working of power electronic components such as SCR, TRIAC,DIAC,UJT ,MOSFET and IGBT.	-do-	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 circuit across parallel branches, related exercise.

	Identify different heat sinks used with various power MOSFET devices. Construct MOSFET test circuit with a small load and test Identify and test a IGBT (atleast 2 no's) by its number Construct IGBT test circuit with a small load and test			
11	Dismantle an Analog multimeter and identify components /sections and trace path for measurement of V, I & R. Measure the indicator coil voltage corresponding to different measurements. Assemble and test the meter Dismantle Digital Multimeter and Identify components /ICs/sections and Trace circuit path for measurement of V, I (AC & DC) & R. Measure the Signal voltage to the display IC corresponding to different measurements. Assemble and test the DMM.	Working principle of PMMC type ammeter. Conversion of ammeter into voltmeter. Working principles and study of Block diagrams / Schematic diagrams of Analog multimeter, Digital Multimeter, Digital LCR meter.	-do-	-do-
12	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 atleast 12 different type of cables (including FRC) used in electronic industries. Identify atleast 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	Free hand sketches of nuts with dimensions from samples. Circuit s and wiring diagrams.	-do-

14	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.	-do-	Temperature, pressure. Newton's law of motion, applications, momentum. Simple problems
15	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, Iogic 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-	-do-
16	Wire and illuminate LEDs of different sizes and observe the current drawn. Expose LDR different lights and Record the	IR LEDS, Photo diode for photo transistor, its characteristics and application, optical sensor, opto-	Parallel circuits, Branch currents, representation.	Series-Parallel circuits: Finding Total resistance for

	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.	couplers, circuits with opto isolation, characteristics of LASER diodes		series-parallel resistances, Whetstones' bridge.
17	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	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	-do-	-do-
18	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.	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	Explanation of simple orthographic projection 3rd angle.	Resistor types, their colour codes and tolerance, series and parallel combination of resistors, power rating of resistors.
19	Construct an emitter follower, RC coupled amplifier Construct and test push pull power amplifier Construct and test oscillator using a HF transistor. Construct and test RC Phase shift oscillator	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	-do-	**-do-**

		transistors, in-circuit testing of transistor, introduction to positive feedback and requisites of an oscillator		
20	Construct and test astable multivibrator circuit Identify and test Transistors of different packaging styles. Identify and pick a suitable heat sink for Transistors of different packaging styles Test various analog electronic components using linear IC Tester.	Types of multivibrators and study of circuit diagrams Transistor power ratings & packaging styles, use of different heat sinks. Study of a Linear IC Tester	-do-	Static and dynamic friction. Gravitational forces. Force-definition, units, and fractional, forces. Problems on force and frictional forces.
21	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 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 DeMultiplexer and test	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 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 Demultiplexing. IC 74154 as a Demultiplexer.	-do-	-do-
22	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.	S-R Latch, Gated S-R Latch, DLatch. 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	Types of resistors, colour coding, tolerance representation,	Voltage dividers, & current dividers: Series voltage dividers, current divider with two parallel resistances.

	Familiarization with front panel controls and display system of Digital IC Tester Testing of : TTL , CMOS ,Memory Peripheral ICs	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)		
23	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 synchronous decade counter using 74190 and monitor the output on LEDs. Display the count value on seven segment display using decoder/driver ICs.	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		-do-
24	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.	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 of a Digital IC Tester	-do-	-do-
25	Project work / Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of "Mechanic Medical Electronic"
Duration : Six Month

Second Semester
Semester Code: MME: SEM II

Week no.	TRADE PRACTICAL	TRADE THEORY	Engg. Drawing	Vocational Science & Calculation
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 3rd angle.	Direct-current meters: Moving coil meter, design of voltmeter, ammeter, loading effect of voltmeters, related 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	-do-	-do-

3	Instrumentation Amplifier. Construct the comparator using OP-AMP Construct and test monostable 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 monstable, astable and vco operations for various application	-do-	Complex numbers. Simple problems Work, power and energy- definition, units, and simple problems and on shop floor practices. Conservation of momentum and energy
4-5	Measure using CRO – DC Voltage, AC voltage, Period & Frequency & and observe different wave forms Troubleshooting CRO Vertical Preamplifier & all other sections (a) to (c). Troubleshooting CRO Vertical Preamplifier & all other sections (d) to (f). Familiarize and doing measurement using Digital storage oscilloscope Interfacing DSO with a PC (IEEE)	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 (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-	-do-
6-7	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. Construct and test a lamp dimmer /fan	Power MOSFET, IGBT - their types, characteristics, switching speed, power ratings and protection	-do-	Kirchoff's laws: Kirchoff's voltage& current law, Branch currents, node voltages, Mesh currents, related problems.

	regulator circuit Construct a flashing lamp circuit using a thryristor Construct a UJT based Time delay circuit to turn on a lamp load with delay of 5 seconds Control the speed of a universal motor using a TRIAC based circuit.			
8	Identify different fixed +ve and –ve voltage regulator ICs of different current ratings (78/79 series) along with i/o, reference pins. Wire a fixed voltage regulator as a variable one by floating the reference. Identify proper heat sinks for different IC based voltage regulators. Vary the input voltage and observe the fixed output for the above mentioned series Construct a dual power supply using above regulator ICs with current limiting and short circuit features.	Regulated Power supply using 78XX series, 79XX series, Op-amp regulator, 723 regulator, (Transistorized & IC based) voltage regulation, error correction and amplification etc.	-do-	Trigonometry – identity & solve
9	Identify different front panel controls and connectors of the given power supply. Test the given power supply and limit the output for a specific voltage and current.	Specifications & block diagram of Linear power supplies. Front panel controls and features of various power supplies. Different types of power switches and heat sinks used in power supplies.	Moving coil meter, Moving Iron meters, voltmeter, Ammeter, Ohm meter.	-do-

	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			
10	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.	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.	-do-	Network theorems: Thevenin's, Norton's theorems, conversion of voltage and current sources.
11	Construct and test step up type chopper circuit Construct and test step down type chopper circuit Construct and test inverter type chopper circuit Construct and test IC Based DC-DC converter for different voltages	Various types of chopper circuits step-up, step down, inverting types. Introduction to DC-DC Converters ICs used for converting DC- DC , block diagrams and their pin outs. Applications of DC-DC converters	Different types of series parallel circuits, representation of nodes, etc.	-do-
12	Identify various input and output sockets/connectors /indicators on the given UPS.	Electrical wiring for Single phase and Three phase systems, Earthing and earth resistance measurement,	**-do-**	Moment of inertia of simple shapes like disc, cylinder & sphere.

	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	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.		
13	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 according to backup. Identify the semiconductor power modules and measure voltages. Perform a load test to UPS	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 controller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits.	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.	-do-
14	Identify and draw different active, passive components using symbols Draw schematic diagrams for	Identify different active, passive components using symbols Draw schematic diagrams for basic analog circuits	-do-	Batteries: Cells & Batteries, Series and parallel cells, related exercise,

	basic analog circuits Draw schematic diagrams for basic Digital circuits Draw schematic diagrams for Microprocessor and Microcontroller based circuits	Draw schematic diagrams for basic Digital circuits Draw schematic diagrams for Microprocessor and Micrcontroller based circuits.		
15	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).	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).	**-do-**	-do-
16	Identification of 2/3/4 terminal SMD components Soldering / de-soldering of above components Identification of PGA packages Soldering / Desoldering of above PGA components Cold/ Continuity check of PCBs Identification of lose /dry solders, broken tracks on printed wiring assemblies.	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, broken tracks on printed wiring assemblies	Symbols, Cells, batteries, series, parallel, representation, Magnets, Electromagnets, symbols,	Logarithm definition, properties, simple problems.
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	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	-do-	-do-

	different memory IC s and peripheral ICs on the kit Enter data to different memory locations in RAM Enter simple programs and execute using assembly language			
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, Arithmatic , serial communication etc.	-do-	Magnetism & Magnetic units: The magnetic field, flux, flux density, Ampere-turns,
19	Write the RAM and ROM address ranges (internal and external) of the given 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.	Differentiate Microprocessor and Microcontroller, Architecture of 8051 family of Microcontrollers, pin diagram and various on chip resources . Types of memory with 8051 such as Onchip, external code memory, External RAM .	**-do-**	**-do-**
20	Enter simple programs, execute and monitor the results Configure the port pins as input and output and apply inputs to	Register Banks and their use Memory mapping of the microcontrollers, bit addressable registers (bit memories).	Microprocessor 8051 architectural configuration	Angular momentum & torque simple problems

	activate/deactivate LEDs Intialise a Timer, Load a timer , and turn on a LED with delay.	Instruction set and various types of instructions		
21	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	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.	Familiarization and sketching the details of components	-do-
22-24	Cutting, cleaning and preparing of fibre cable for splicing Splicing of OFC using splicing machine. 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.	Intro to optical fibre as a transmission media, its advantages over other media. Working principle of transmitter and receiver in fibre optic communication. applicaitons and advantages of fibre optic communication. properties of optic fibre, testing, losses , types of fibre optic cables and specifications Encoding of light, Fibre optic joints, splicing, testing and the related equipments/ measuring tools, precautions to be taken laying of cables, safety aspects while handling optical cables .	-do-	Alternating voltage and current: AC fundamentals, RMS, Average values, Frequency, time period, wavelength, related problems,
25	Project work / Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of "Mechanic Medical Electronic"
Duration : Six Month

Third Semester
Semester Code: MME: SEM III

Weeks	Trade Practical	Trade theory	Engg. Drawing	Vocational Science & Calculation
1 - 3	Bio medical Charts	History of Biomedical Engineering, Instrumentation, Man Instrumentation system, Physiological system of the Body, Medical Terminology. Various departments in Hospital, Classification of Hospitals, Introduction to anatomy, Human Physiology, Electrophysiology	Drawing of various electrical circuits with B.I.S. symbols of circuits, series& parallel circuits, power transformer instrument transformer etc.	Areas of rectangle, circles, regular polygons, calculation of areas, volumes & weight of simple solids, cubes, hexagonal prism. Shop problems
4 - 7	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, Enter simple programmes and execute using assembly language. Write the RAM and ROM address ranges (internal and external) of the given Microcontroller kit. Enter data into specific RAM locations	Intro to 8085 Microprocessor, Architecture, pin details, Function of different ICs such as decoders, buffers, latches etc used with 8085 processor, Interfacing to memory ICs RAM, PROM/EEPROM Interfacing different peripheral ICs such as 8255. Differentiate Microprocessor and Microcontroller, Architecture of 8051 family of Microcontrollers, pin diagram and various on chip resources. Types of memory with 8051 such as Onchip, external code memory, External RAM, Register banks, Memory mapping, SFRs, I/O ports, 8052 and its difference with 8051	AC wave form, frequency, wavelength representation, Inductors, series parallel, transformers, types, cores, types, lamination types, representation,	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

	and observe the volatility. Practice different commands to enter/edit and execute. Assembly programs. Identify different ICS used in the kit, Enter simple programmes, Execute and monitor the results, Configure the port pins as input and output and apply to LEDS to activate/ deactivate, Initialise timers			
8- 10	Identification of different types of transducers and sensors. Testing the condition of the different types of transducers and sensors.	The transducer principles, Active Transducers. Passive Transducers, Displacement Velocity & Acceleration, Pressure Transducers, Sensors, etc. Electrode theory, Bio-potential Electrodes, Biochemical electrodes & Other electrodes.	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,	Capacitance: Charge stored in capacitors, Farad unit and conversions, Capacitor colour coding, Series and parallel capacitances, Capacitive reactance, Impedance,
11 -14	Charts, Identification of different types of components used in Bioelectric amplifiers. Construction & Testing of Operational Amp. Circuits, Differential amps., Instrumentation amplifiers.	Cells and their structure, Bioelectric potentials, Sources of Bioelectric potentials, Resting & Action potentials, ECG, EEG & Other Bioelectric potentials, Bioelectric amplifiers: Different configurations, Need of bioelectric amplifiers, Differentials amplifier, Instrumentation amplifiers, etc	-do-	Simple problems on stress in bars. Concept of share modulus, bulk modulus & Poisson's ratio
15	Identification of different cables & Connectors used in Biomedical equipment, Practice on assembling & Dismantling techniques, etc	Different cables, connectors for various Bio-medical equipment applications.	Calculation of area of triangles, polygons with the aid of trigonometry. Series RLC, Parallel RLC circuits,	Resonance: Series resonance, Parallel resonance circuits, Resonance frequency, related exercise,

16 to 19	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. #Troubleshooting & Maint. aspects.	Introduction, Balances, Hot plate and Magnetic Stirrer, Centrifuges, Hot air oven, Incubator, Water bath, Microscope, Colorimeter and Spectrophotometer (Both VIS & UV), Laboratory tests based on Colorimeter and Photometry, Flame photometry, Electrophoresis, Densitometry, pH meters, Semi auto analyzers, Blood cell counter, Blood gas analyzer.	-do-	AC circuits: Power, VA, KVA, Watts, KW, related exercise, power factor, Concept of shear forces, bending moment, torsion in shaft, simple problems.
20 to 22	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	Electromagnetic Spectrum, Vacuum tubes, Electric shock, Electric stimulation of Nerve & Muscle, Faradic-type current, Interrupted Direct current, Iontophoresis, TNS or TENS, IFT, Methods of heating the tissues, Diathermy, Infra-Red radiation, LASER, Ultrasonic Therapy, Ultra-violet Radiation, Cold therapy, Mechanics.	Symbols as per different semi-conductor devices-LDR, VDR, Thermister & their use in circuits.	Diodes: Rectifier, peak voltage, PIV, Rectifier efficiency, Voltage regulators, Voltage doublers, multipliers, Clipper circuits, related exercise.
23-24	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	Sterilization & disinfection, Central sterilization, methods of sterilization, Maintenance, Inspissator, A candle jar, Sterilization in Autoclave.	Diodes, Forward & Reverse bias, Rectifiers, Input & output waveforms, Regulator circuits, Clipper circuits, wave forms,	Properties of triangles, simple problem of height & distance
25	Project work / Industrial visit (optional)			
26	Examination			

Syllabus for the Trade of "Mechanic Medical Electronic"
Duration : Six Month

Fourth Semester
Semester Code: MME: SEM IV

Week (s)	Trade Practical	Trade Theory	Engg. Drawing	Vocational Science & Calculation
1 - 3	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	X-Ray: Basic physics. Different components of X-ray machine, Block diagram of X-ray machine, H.T. Generator, X-ray tubes, Scattered radiation & Secondary radiation controls, Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits, Digital X-ray concepts, X-ray films, Screens, Darkroom system & Procedure, Dental X-ray machine..	Drawing of A.F. amplifiers circuit with stage & with types of O/P, p-p. Symbols of transistors, CB, CE, CC configurations, biasing circuits,	Transistors: Biasing of transistors, CB, CE, CC, DC & AC Load line , operating/ 'Q' point, problems.
4 - 6	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	Ultrasound scanners: Basic physics, Block diagram of Ultrasound scanner, Transducer theory & types, Different modes i.e. A, B, M- mode etc. Colour Doppler Ultrasound scanners	Block diagram of an oscillator, symbols for different wave shapes, Sq., saw tooth, sine, triangular etc.	Power transmission by shaft, belts & ropes
7 - 10	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	The Heart & Cardiovascular system, Electrocardiography: ECG amplifiers, Electrodes & Leads, ECG recorder principles, Types of ECG recorders, Blood Pressure measurement: Indirect	Single stage amplifiers, Multistage amplifiers, Class 'A', Class 'B', Push pull, Complimentary symmetry circuits, Oscillators circuits, Multivibrators, UJT oscillator, FET, MOSFET symbols, DIAC,TRIC	Transistor amplifiers, Voltage Gain, Current gain, power gain, decibel. Oscillators, Frequency calculations, Relaxation oscillator problems, related exercises,

		measurement, Direct measurement, Blood flow measurement: Magnetic blood flow meter, Ultrasonic blood flow meter, Measurement of Heart Sound,		
11-14	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	Elements of Intensive-Care Monitoring, Patient monitoring displays, Defibrillators, Pacemakers, EMG, EEG, Monitors: Video monitors, Recorders: Strip chart recorders, Galvanometric recorders, Ultraviolet recorders, and other recorders.	Drawing of AM&FM modulated wave at various modulation 100 pc., 50 pc etc.	Concepts of lifting machine, velocity ratio, mechanical advantage, relation between them
15 - 18	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	The physiology of respiratory system, Instrumentation for the mechanics of breathing, Inhalators, Ventilators and Respirators, Humidifiers , Nebulizers, Aspirators, Surgical diathermy, Suction apparatus, Pulse Oximeter, Theatre lighting, Operating microscope.	Logic gates, Combinational gates, other circuits.	Digital Electronics: Binary numbers, Binary arithmetic, Basic logic gates, other logic gates,
19-21	Identification & Testing of different controls of the related equipment. Operate the different controls of the related equipment. Troubleshooting & Maint. aspects.	Principles of air conditioning and refrigeration, Types of pumps and compressors, Principle of operation.	Exercise on blue print reading/ circuit. Reading of house service connections & small power circuits, Connections of ammeter, voltmeter, KWh-meter with ISI symbols, circuit, Reading & drawing of different stages of R/R/ free hand sketches of trade objects	Vector – definition of scalar, and vector, notations and representation of vectors

22 to 24	Safety aspects Study of all types of shocks and effects. How to prevent these shocks?	Clinical safety and chemical safety. Complete House wiring layout, Circuit splitting load wire, I.E. rules, Multistoried house wiring system, Earthing as per I.E. rules, Fault finding techniques, Electrical safety and leakage current in Medical Equipment, EMI, and ESD. Physiological effects of Electrical current, Shock hazards from Electrical equipment, Microshock and Macroshock, Earthing for Grounding, Double Insulation, Protection by low voltage, Ground-fault circuit interrupter, Isolation of patient-connected parts, Isolated power distribution system.	-do-	Digital Electronics: Combined logic gates, other digital circuits. Addition and subtraction of vectors. Scalar and cross product. Simple problems
25	Revision			
26	Examination			

TRADE: MECHANIC MEDICAL ELECTRONICS

LIST OF TOOLS & EQUIPMENT
A. TRAINEES TOOL KIT FOR 20 TRAINEES +1 INSTRUCTOR

Sl. No.	Description	Quantity
1.	Connecting screwdriver 100 mm	21 nos
2.	Neon tester 500 V.	21 nos
3.	Screw driver set (set of 5)	21nos
4.	Insulated combination pliers 150 mm	21nos
5.	Insulated side cutting pliers 150 mm	21nos
6.	Long nose pliers 150 mm	21nos
7.	Soldering iron 25 W. 240 V.	21nos
8.	Electrician knife	21nos
9.	Tweezers 100mm	21nos
10.	Digital Multimeter	21nos
11.	Soldering Iron Change able bits 15 W	21nos
12.	De- soldering pump	21nos

B. General Machinery Shop outfit

1.	Fire extinguisher	1no
2.	First aid kit	1no
3.	Artificial Respiration Chart	2nos
4.	Rubber mat - 180x45x2.5 cm	3nos
5.	Rubber gloves pair	1 set
6.	Steel ruler 30 cm	10nos
7.	Scriber 15 to 20 cm	4nos
8.	Center Punch 10 cm	4nos
9.	Hammer cross pane 110 cm with handle	4nos
10.	Hammer ball pane 220 cm with handle	4nos
11.	Spanners double ended (metric system) 6mm to 19mm by 1.6mm	4 sets
12.	Spanners single ended 6mm to 25mm by 1.0m	2 sets
13.	Box spanner set of (4-15) mm	1 set
14.	Mallet 8 oz	2nos
15.	Gimlet	2nos
16.	Saw tenon 25 cm	2nos
17.	Chisel wood 15cm set of 6mmto 25mm	2 sets
18.	Chisel cold flat 10mm	2nos
19.	Bradawl	2nos
20.	Ratchet brace drill 10mm	2nos

21.	Electric drill 10mm	2nos
22.	Hacksaw 20-25cm (adjustable)	4nos
23.	Junior saw 20cm	2nos
24.	File flat 20cm 2nd cut	4nos
25.	-do- 15cm bastard	4nos
26.	File half round 20cm bastard	4nos
27.	File round 20cm 2nd cut	4nos
28.	Instrument files (needle) set of 12	2nos
29.	Vice bench 10cm jaw	2nos
30.	- do - 5cm jaw	2nos
31.	Taps set 3mm to 10mm (set of 9)	2nos
32.	Dies set 3mm to 10mm	2nos
33.	Grinder bench electric	1no
34.	Soldering iron 25 Watt	10nos
35.	-do- 10 Watt	10nos
36.	-do- 65 Watt	10nos
37.	-do- 250 Watt	2nos
38.	Temperature controlled soldering station 15 Watt	2nos
39.	De-soldering pump	2nos
40.	Wire gauge set	2nos
41.	Feeler gauge	2nos
42.	Permanent bar magnet 15cm	2nos
43.	Solenoid with core	2nos
44.	Electric bells	4nos
45.	Battery eliminator	8nos
46.	Batter storage lead acid	2nos
47.	Hydrometer	2nos
48.	Rheostats asserted values and ratings	10nos
49.	Variable resistors/Potentiometer	10nos
50.	Fractional H.P. AC meters	2nos
51.	-do- DC meters	2nos
52.	Constant voltage transformer/Auto	4nos
53.	Auto Coil winding m/c. (manual)	1nos
54.	D.C./A.C. Ammeter 0-1mA	4nos
55.	-do- 0-5mA	4nos
56.	-do- 0-50mA	2nos
57.	-do- 0-100mA	2nos
58.	-do- 0-500mA	2nos
59.	Digital multi-meter	10nos
60.	Thermo-couple meter R.F. 0-100mA	1no
61.	-do- 0-500mA	1no

62.	D.C/A.C. Voltmeter 0-5V	4nos
63.	-do- 0-10V	4nos
64.	-do- 0-50V	4nos
65.	-do- 0-500V	2nos
66.	-do- 0-5KV	2nos
67.	Watt meter 5/250V	2nos
68.	Insulation Tester	2nos
69.	Service Oscillator	4nos
70.	Signal tracer	4nos
71.	A.F. Oscillator	4nos
72.	Micro Wave Diatherrmy	1
73.	Ultra sonic diathermy	1
74.	ECG Recorder	2
75.	Bed side monitor	2
76.	Defibrillator	1
77.	Pace maker	2
78.	60mA Mobile x-ray equipment	1
79.	Dental x-ray equipment	1
80.	Dental Chair	1
81.	Portable Ultra sonic scanner	1
82.	Surgical diathermy	1
83.	Pulse Oximeter	1
84.	Theatre lighting system	2
85.	Refrigerator	1
86.	Baby incubator	1
87.	Conductivity meter	2
88.	Ventilators	1
89.	Simple sterilization equipment	4
90.	U-V/ IR lamps	4 each
91.	C.R.O (20 MHz)	5
92.	Digital storage oscilloscope (20MHz)	1
93.	Function Generator	5
94.	Power supply 0-30V/D.C.	2
95.	-do- 0-300V/D.C	2
96.	A.C. Bridge	1
97.	Transistor Tester	1
98.	I.C. Tester	1
99.	Signal Injector	2
100.	Strain gauge with load cell	2
101.	Linear IC trainer	5
102.	Personnel computer with latest configuration	4 nos
103.	Laser Printer	1 no
104.	Micro Processor Trainer 8085 (with medical application card).	4
105.	Microcontroller Trainer Kit	2 Nos
106.	Digital I.C. trainer	4
107.	Logic Probes	4
108.	Frequency counter	1

109.	A.F./R.F. Oscillator	2
110.	Inter Com. System for 12 lines.	1
111.	Human body charts	2
112.	Microscope	2
113.	Analytical Balance	2
114.	Centrifuge	2
115.	Water Bath	1
116.	Hot air oven	2
117.	Incubator	2
118.	Spectrophotometer	1
119.	Colorimeter	1
120.	PH meter	2
121.	Flame Photometer	1
122.	Blood gas analyzer	1
123.	Short Wave Diathermy	2
124.	B.P. Apparatus (Sphygmo manometer)	4
125.	Stethoscope	4
126.	Wax bath	2
127.	Muscle Stimulator	2
128.	Suction apparatus	1
129.	Fetal monitor	1
130.	Refrigeration and Air conditioning Tutor	1
131.	Air conditioners	2
132.	Earth leakage tester	1
133.	Blood cell counter	1
134.	DARK ROOM ACCESSORIES: a) Film viewer (18" x 15")	1
	b)　　Cassettes　(12" x 15", 10" x 12"and 10" x 8") c)　　Safe light d)　　Set of tanks for 18 liters capacity Stainless Steel 　　　(Master tank, Developer tank, separator tank and Fixer tank.) e)　　Hangers (12' x 15", 10" x 12" and 10" x 8") f)　　Stainless steel clips g)　　Lead Apron h)　　Lead protection screen 4' x 6' with lead glass window	1 each 1 1 set 1 each 1 Doz 1 1
	Consumables (i)　　. Electrical fuses - Assorted/ different types (ii)　　. Thermal paper roll for ECG recorder. (iii)　　. Conductivity gel for ECG (iv)　　. Disposable skin surface electrodes. (v)　　. Chemicals for pathology lab (vi)　　. Medicated cotton.	As required

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	2 Nos
6	Black board/white board	1 No
7	Computer table	4 Nos.
8	Computer chair	8 Nos.
9	Printer table	1 No