

Syllabus of

## **MEDICAL ELECTRONICS TRADE**

Under

CRAFTSMEN TRAINING SCHEME

Under the aegis of

NATIONAL COUNCIL OF VOCATIONAL TRAINING

Prepared by:

**ADVANCED TRAINING INSTITUTE FOR  
ELECTRONICS AND PROCESS INSTRUMENTATION,**  
Ramanthapur, Hyderabad-500 013

**LIST OF THE MEMBERS OF TRADE COMMITTEE WHO ATTENDED THE MEETING ON 18-04-2002 AT ATI-EPI, RAMANTHAPUR, HYDERABAD-500 013 FOR FINALIZING THE SYLLABUS OF “MEDICAL ELECTRONICS “  
TRADE TO BE INTRODUCED UNDER CRAFTSMEN TRAINING SCHEME:**

**S/Shri:**

- |  |                   |
|--|-------------------|
| 1) M.Singa Raju, Director  | Chairman          |
| 2) R.V.Sudhakar, Addl. Director, C.E.T.E.  | Member            |
| 3) Ms.K.Sujatha, Lecturer, Govt. Institute of Electronics  | “                 |
| 4) Smt.D.Sreelakshmi, Head Bio-Medical Engg. Dept.,Govt. Institute<br>of Electronics, East Madrredpally, Secunderabad. | “                 |
| 5) P.Sridharnarayan, Director., Hyderabad Nursing Home   | “                 |
| 6) K.Satyanarayana, Associate Professor, Bio-Medical Engg. Dept., O.U.   | “                 |
| 7) Dr.C.N.Rao, Chief ExecutiveM/s UB Electronic Instruments Ltd  | “                 |
| 8) G.P.Rama Rao, Bio Medical Engineer, Medwin Hospitals  | “                 |
| 9) Sri A.Vijay, Bio Medical Engineer, Medwin Hospitals.  | “                 |
| 10) G.S.Murthy, Sr. Executive, Medical System Div., SHIMADZU India Pvt.Ltd.  | “                 |
| 11) R.J.Rumale, Jt. Director of Training   | “                 |
| 12) V.M.Rao, Jt. Director of Training  | “                 |
| 13) Yogesh Kumar Bangia, Dy. Director of Training  | “                 |
| 14) V.Subramanyam, Asst. Director of Trg.  | “                 |
| 15) N.Ramesh Babu, Asst. Director of Trg.  | “                 |
| 16) S.Srinivasu, T.O.  | “                 |
| 17) P.Premchand, T.O.  | “                 |
| 18) T.V.S.Rama Murthy, Jt. Director  | Member /Secretary |

## **GENERAL INFORMATION**

1. Name of the Trade : **MEDICAL ELECTRONICS**
2. N.C.O. Code :
3. Duration of Craftsmen Training : 2 Years (104 weeks)
4. Total working hours : 42 hours per week.
  - a) Practical instruction - 28 hours per week
  - b) Theoretical instruction - 10 hours per week out of which
    - (i) Trade Theory - 4 hours per week
    - (ii) Workshop Calculation and Science - 2 hours per week
    - (iii) Engineering Drawing - 2 hours per week
    - (iv) Social Studies - 2 hours per week
  - c) Extra Curricular Activities including visits to hospitals, library studies and physical training - 4 hours per week
5. Entry qualifications : Passed in matriculation examination/10<sup>th</sup> of 10 + 2 system of education with Mathematics and Science or its equivalent.
6. Workshop area : 120 sq. mts. (inclusive of 10 sq. mts Dark room area)
7. Power supply : 5 KVA (recommended)

### **SYLLABUS FOR THE TRADE OF MEDICAL ELECTRONICS UNDER CRAFTSMENSHIP TRAINING SCHEME**

#### **OBJECTIVES:**

After completion of the course, the candidate shall:

1. Attain the skills to operate the medical equipment used in Hospitals/ Nursing Homes/ Diagnostic centers.
2. Undertake maintenance and servicing of this medical equipment.
3. Carry out minor repairs of such medical equipment.

**NOTE:** The syllabus given below is a guide for the Instructors to prepare their own schedule of training. The portion in respect of different subjects which has been indicated against different weeks may be adjusted according to the training schedule prepared by the Instructors concerned. While teaching Engineering Drawing, emphasis should be laid on free hand sketching, blue print reading, drawing of circuits and parts related to the trade. Similarly emphasis should be given on problems related to the trade according to the syllabus given for Workshop Calculation and Science.

No. of Weeks	Syllabus List	Theory	Practical	Equipment Required	Engineering Drawing	Work Shop Calculation & Science
1	Know your Institute.	Organization of the Institute, Departments various trades & functions. Types of work, responsibility to be undertaken, incentives and future planning of profession. Safety precautions to be observed in the trade both during 'theoretical Periods' and 'Practical hours/workshop hours' Elementary First Aid. Earthing types and importance.	Visit to the Institute Introduction with the Principal & other teaching staff. Demonstration of various systems of the 'Trade' like Medical Electronics. Care & Safe working habits, safety precautions to be demonstrated to the trainees. 'Elementary First Aid' practice, Artificial respiration practice.	Power Supply Switch Gear. Fire extinguishers. First Aid kit First Aid Chart Artificial Respiration Chart Instrument boxes and Drawing materials. Student's tool kits and work-shop tools.	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 concept of dimensions and dotted lined, chain line etc. Magnifying glass.	Introduction to electricity supply system.

2 & 3	Hand Tools	Identification, specifications, uses and maintenance of hand tools.	Demonstration & uses of trade hand tools-screw driver, plier etc. Simple mechanical fixtures, types of screws, bolts washers, clamps, rivets, taps, connectors. Simple fitting and drilling practice. Simple threading practice. Simple sheet metal works. Demonstration on pneumatic screw driver.	All types of Hand tools	Draw the all types of Hand tools	Properties and uses of metals and non-metals related to trade. Copper, Zinc, Tin, aluminium, Brass and Bronze.
4.	Introduction to Electricity.	Matter, molecule, atom, conductor, Insulator, Semi-conductor, Classifications. Voltage, current, resistance, Ohm's Law, specific resistance & Standard wire gauge (SWG).	Identification of conductors, Insulators, with specifications. Use of S.W.G. demonstration of different soldering irons, Practice of soldering & de-soldering. Practice of simple series and parallel ckts. & mixed. Verification of Ohm's Law.	S.W.G. Multi-meter soldering iron, Temp. controlled soldering station.	Reading of simple drawing, Free hand sketching of simple solids with dimension.	Solder Timber, Rubber different types of P.V.C. materials used in Electronic Industry.
5 & 6	Resistors	Classification of resistors with specifications & use. Construction of resistors. Colour code. Kirchhoff's Law and its application. Explanation and use of multi-meter.	Identification of resistors. Colour code practice. Use of multi-meter, measurement of voltage, current and resistance. Experiments on positive temperature coefficient (P.T.C). resistors, Negative temperature coefficient (N.T.C). resistors, Thermister Voltage controlled resistor (V.C.R). , Light dependent resistor (L.D.R), Testing and use of classified resistors Carbon (various Wattages) wire wound (w/w), PTC, (Log & Linear) Pre-set etc.	S.W.G. Multi-meter Soldering iron. Lead acid battery, cells,	Free hand sketch of solid viewed perpendicularly to their surface and axes.	Use of different sheets, ferrous and non-ferrous. Decimals addition, subtraction, multiplication, division, conversion of decimals to common fractions and vice versa.
7.	Battery	Explanation of cells. Leclanche cell. Primary cells, Battery	Testing of primary and	Assorted cells and batteries Assorted rheostat	Free hand sketches of nuts & bolts with dimensions	Reduction of common

		cell. Primary cells, Battery construction-charging rate. Efficiency- Amp.hr. capacity. Types of charging Silver oxide L.C.R. button cells. Alkali cells, Nickel cadmium, Lithium ion and maintenance free batteries - construction-charging efficiency-use, advantage.	secondary cells. Use of cells and battery in ckts. Preparation of electrolyte. Preparation of Charging by a charger. Use of Sp. gr. tube/ hydrometer.	Assorted rheostat, Hydrometer. Battery charger, Battery tester, Cells Tester.	& bolts with dimensions from samples. Ckts. And wiring diagram.	common fraction to decimals fractions. Brief description of manufacturing process of Steel, Copper, Aluminium.
8 & 9	Electro-Magnetism	Explanation of magnetism. Classification of magnets and their materials. Properties of magnets. Uses of preparation of artificial magnets. Magnetic needle. Magnetic keepers. Explanation of Electro-magnetism. Properties advantages, disadvantages-application-types of cores. E.M. relays-types-uses. Concept of generators & motors . Principle classification. To build up E.M.F. in a generator starting of D.C. motor miniature motors.	Demonstration on the properties of Permanent magnetism. Use of magnetic needle. Simple practice of converting a magnetic material into a magnet by a bar magnet. Preparation of a solenoid. Use of magnetic needle. Preparation of electro-magnets for a calling bell / buzzer. Preparation of E.M. relay. Testing of types of relays. Rewinding of E.M. relays & small repairs. Building of E.M.F. in a Generator starting of a D.C. Shunt motors.	Assorted permanent magnets, Magnetic needles. Assorted Bells & Buzzers. Assorted relays. D.C. Shunt generators/ motor. Small assorted D.C. motors.	Expl. Of simple orthographic projection 1 <sup>st</sup> angle.	Metric system metric weights and metric measurements, units conversion factors. Manufacture of plastic and resins
10 & 11	Alternating Current.	Explanation of A.C, Comparison with D.C, Expl. Of Induction & induced E.M.F. Faraday's Law, Lenz's Law A.C. Generator-Left hand and Right hand rules. Instantaneous values R.M.S. values – Phase – Cycle – Time period - Frequency. Principle classification uses of Single phase motor, three phase motor. Fractional H.P. Motors, Capacitor motors.	Demonstration of A.C. & D.C. Demonstration on Induced E.M.F. Demonstration on L.H. & R.H. Rules. Demonstration on Instantaneous values and R.M.S. values. Demonstration on phase, cycle, frequency Measurement A.C. voltages and current. R-Y-B concept	Oscilloscope A.C. Auto var. Models on L.H. & R.H. rules Low frequency oscillator Multi meter, frequency counter.	Explanation. Of simple orthographic projection 3 <sup>rd</sup> angle.	Meaning of tenacity, elasticity, malleability, brittleness, hardness compressibility and ductility with examples.
12	Inductance	Define-Inductance. Explanation	Identification of assorted	Oscilloscope A.C. Auto Var	Explanation Of simple	The weight of

		of Inductive reactance, -types, specification. Behavior with A.C. Impedance. Coil concept-power factor. Self & mutual induction co-efficient of coupling. Expl. Of Transformer-types-turns ratio-uses-losses-efficiency. Auto transformers. Hysteresis & eddy current, types of cores to be used for L.F., H.F. & V.H.F. transformer.	inductive reactance-checking, testing & rewinding up to a specification. Impedance & Power factor measurements. Demonstration on self and mutual induction. Identification of assorted transformers-testing and rewinding to a specification.	models on L.H.& R.H. rules. Low frequency oscillator. Multi meter frequency counter.  Assorted Inductive reactance. Assorted Transformers.	orthographic projection 3 <sup>rd</sup> angle.	a body. Units of weights percentage & its application. Shop problems.
13	Capacitance	Expl. Of capacitance & capacitive reactance. Classification of capacitors with specification Electrostatic action dielectric constants, materials used. Series and parallel connection. Colour codes uses.	Identification and testing of different types of different types of capacitors. Colour code practice. Behaviour of capacitor at different frequencies.	Bridges-RCL, Digital Multimeter. Power supply, Oscillator, E.V.M.	Expl.of simple orthographic projection 3 <sup>rd</sup> angle.	C.G.S. / M.K.S. and their conversion problems.
14	Resonance	Expl. of resonance. Importance - equations. Series and parallel resonance. Ckt., elements-natural resonance, tuning, voltage gain. Anti resonance Ckt. Of faster. Uses in electronic ckts.	Determination of resonance. Characters For series and parallel. Tuning to a given frequency.	Oscilloscope, signal generator E.V.M.	Simple iso-metric drawings, isometric views of simple objects such as square, cube rectangular blocks. Detailed diagram of Electromagnets.	
15 TO 16	Simple Analogue Meters.	What is meter? Importance of meter. Classification of meter. Forces necessary to work a meter. Principle of operation of Galvanometer. M.C. Instruments. M.I. Instruments. Range Extension of meters. Need of calibration Multi-meter Characteristics of meters. Uses of meters different ckts. Uses of multi meters. Servicing, care &	Demonstration on the function of M.C.& M.I. meters. Measurement of resistance, voltage, current frequency, . by Am-meter, Voltmeter, ohm-meter. Expts on 'range extension' of meters. Use of multi meters. Servicing of multi meters. Demonstration on calibration of meters.	Assorted analogue meters. Multi-meters. Models/kits for assorted ckts. Shunt & series resistors. Standard meters, Insulation Tester.	Familiarising and sketching the details of components.	Ratio and proportion shop problems, plotting and reading of simple graphs. Works unit of work, energy power.

17	Semi-Conductors	<p>maintenance. Use of Insulation tester.</p> <p>Define 'Semi-Conductor' Intrinsic &amp; Extrinsic semi-conductors. Temperature coefficients. Definition of 'P' and N types of semi-conductor. Development of P.N. Junction-Barrier potential – symbol. Symbols as per B.I.S. / graphic.</p>	<p>Demonstration on insulation tester.</p> <p>Video film on semi-conductor. Video film on P-N. Junction. Demonstration on Barrier-potentials for Germanium &amp; Silicon.</p>	<p>Video Films on Semi-conductors, P.N. Junction, Digital multi-meter.</p>	<p>Use of drawing instruments 'T' square, drawing board construction of simple figures &amp; solids with dimensions</p>	<p>Applied problems Algebra, Algebraic symbols addition, subtraction, multiplication division. Standard algebraic formula <math>(a+b)^2</math>, <math>(a-b)^2</math>.</p>
18 & 19	Diode	<p>Expl. Of diode, Classifications of Diodes characteristics of diodes Varactor diode, Zener diode. Temperature effect. Diode as rectifier- Half wave, Full wave Bridge. Coding of Diodes. Study of the diode junction parameter.</p>	<p>Testing of a Diode. Characteristics of Diode. Characteristics of Zener-diode. Half wave rectifier ckt. Full wave rectifier ckt. Bridge rectifier ckt.</p>	<p>Multi-meter, E.V.M., Oscilloscope.</p>	<p>Use of different Types of scales in inch&amp; millimeters. Lettering numbers and alphabets.</p>	<p>Simple simultaneous equations with two unknown measuring of friction examples, meaning of Center of Gravity.</p>
20	Filter Circuits	<p>What is a filter circuit? Types of Filter circuits. Expl. Of XC, XL Hi-pass, Low-pass, Band pass filters.</p>	<p>Demonstration on various filter ckts. Assembly, testing &amp; 'L' 'T' &amp; PAI filters. Demonstration on H.P., L.P. &amp; B.P. filter circuits.</p>	<p>Multi-meter, oscilloscope.</p>	<p>Drawing of various electrical ckts., with B.I.S. symbols ckt. Series and parallel ckt. Power transformer, instrument transformer etc.</p>	<p>Specific gravity Balancing examples.</p>
21 to 23	Transistor	<p>Bi-polar junction Device. Expl. Of transistor Types of transistor. Symbol as per B.I.S. Biasing of Transistor &amp; mode of application.</p>	<p>Identification and testing of a transistor. To study alpha &amp; Beta of a transistor. characteristics of a transistor (Static and Dynamic). To</p>	<p>Multi-meter, milli-ammeter, micro-ammeter, milli-voltmeter. Transistor testers. Signal Generator, Oscilloscope.</p>	<p>Free hand sketching of plan &amp; elevations of simple objects- hexagonal bar, Sq. bar circular bar, tapered bar, hollow bar etc.</p>	<p>Areas of rectangles, circles, regular, polygons.</p>



24 to 26	Amplifier	<p>Arrangements of a transistor in a ckt. Conditions for the use of a transistor. Current flow in a transistor. ALPHA &amp; BETA of a transistor. Thermal run way, Transistor CB, CC, CE amplification. Introduction to FET, IGBT, MOSFET and solid state relays.</p>	<p>study the function of a transistor as an amplifier.</p>			<p>Calculation of areas, volume, weight of simple solid cubes, squares, hexagonal prisms, shop problems.</p>
		<p>Explanation of Amplifier. Frequency spectrum. Classification of Amplifiers. Class A,B,C, A-B, A.F. amplifier Wave-length, propagation, Velocity of sound, Hi-fi. R.F. amplifier. Voltage amplifier. Small signal, Signal to noise ratio. Power amplifier-types push-Pull, Complementary symmetry (transformers out put). Thermal stability and heat dissipation. Biasing and couplings Frequency compensation, pre-amplifier.</p>	<p>Demonstration, assembly and testing of a transistor amplifier in Class A,B,C,P-P complementary symmetry modes. Assembly, testing and frequency response of a single stage A.F. amplifier and R.F. amplifier. Assembly, testing and frequency response of a five stage amplifier with voltage amplifier and power amplifier. Study of P.C.B. of an amplifier. Fault location and servicing of an amplifier.</p>	<p>Multi-meter, D.C. Low voltage power supply. Signal generator, A.F., R.F., HF oscilloscope output meter.</p>	<p>Calculation of areas of triangles, polygons with the aid of trigonometry</p>	<p>Heat and temperature thermometric scales – Fahrenheit, centigrade and their conversion, Kelvin Reamer Celsius.</p>
27 to 30	Power Supply	<p>Explanation of power supply, Importance, types-un regulated, regulated-types of regulation. Stabilizers-types. On S.M.P.S. Blocks invertors ckt. And converters ckt. Blocks of U.P.S.</p>	<p>Demonstration of various power supply. Assembly &amp; testing of an unregulated power supply. Assembly &amp; testing of a series regulated, shunt regulated PS. Assembly &amp; testing of a voltage stabilizer as per specifications to be used for a Refrigerator. Demonstration on U.P.S.</p>	<p>Reading of simple ckt.</p>	<p>Drawing of A.F. amplifier ckt. With six stage and with types of out- put p-p.</p>	<p>Meaning of stress, strain modules of elasticity, ultimate strength B-II curve.</p>

31	Intercom	Demonstration of 'Intercom' system. Block diagram of 'Intercom' system. Explanation of cradles/Receiver types, function and testing. Explanation of 'Explanation of power supply.	system. Assembly, testing and trouble shooting of a S.M.P.S.  Demonstration of 'Intercom' system. Study of cradles/Receiver study of Exchanges. Study of power supply of 'Intercom' system. Fault finding and Servicing of 'Intercom' System.	12 line intercom system with 'exchange' Multi-meter.	Block diagram of an oscillator. Symbols for different wave shapes – square, saw tooth, sine, triangular etc.	Simple problems on Lines, angles, triangles and circles.
32 to 34	Oscillator	Define Oscillator, Importance, applications to electronic ckts. Explanation of vibration and oscillation. Factors controlling oscillations Types-A.F.-R.F. Feedback, Tank ckts, crystal oscillator. Function Generator other applications of oscillators. Tone generation, Remote etc.	Demonstration on various oscillators. Study of Feed back in an oscillator ckt. Assembly of an A.F. oscillator testing & measuring the 'f' of generated oscillations. Study of an R.F. oscillator. Fault finding and servicing of Oscillator.	Various AF & RF oscillators. Multi-meter oscilloscope. Frequency counter. Remote control devices-Toys. Function Generator.	Drawing of AM & FM modulated wave at various modulation 100cps, 5cps etc.	To calculate current in different resistive net works using Diode, Zener in Forward Bias and Revers Bias.
35	Modulation	Define modulation types of modulations-A.M., F.M. application Broadcasting. Bandwidth mode index. Definition and importance and demodulations.			Details of electrical control Panel.	Calculation of Frequency, Time period Giga Hertz, Mega Hertz, Micro Hertz etc.
36	Audio Stage	Explanation of audio stage, types of amplification, driver stage output stage. Transistors used. Tone control, Vol. Control.	Study of Audio stage, driver stage, output stage, tone and vol. Control stage. Fault finding and servicing.	R/R-both P.N.P and N.P.N. Multi-meter Oscilloscope.	Drawing of U.J.T. triggered ckt. With I.S.I. symbol. Power amplifier ckt. With F.E.T., I.S.I. symbols of S.B.S., S.C.S. voltage regulator ckt. Motor control ckts. A.F. amplifier ckt.	Determination of velocity ratio, mechanical advantage & efficiency.
37 to	Special	Expl. Of characteristics, uses of	Study & assembly of a U.J.T.	Models of U.J.T. triggered	Drawing of ckt. Of signal	Calculations of

39	Semiconductors	– U.J.T., F.E.T., S.C.R., S.C.S., S.B.S., C. DIAC/TRIAC, I.C.	triggered ckt. Study and assembly of F.E.T. amplifier ckt. Study of a ckt. Using MOSFET Study a ckt. S.B.S. Study of S.C.R. in D.C. Study of S.C.R. in A.C. Study of voltage control by S.C.R. Study of TRIAC&DIAC. Study of I.C. ckts – amplifier, switching ckt.	ckt. FET as power Amplifier. Models as S.B.S.S.C.S. Electronic power regulator. Analogue I.C. tester, Microprocessor kit, oscilloscope, Multi meter . E.V.M. Function Generator.	generator. E.V.M. Function generator. D.C. speed control ckts. With I.S.I. symbols.	bias. Determination of gain at different loads.
40 & 41	Transmitter	Example of transmission systems. Block diagram. Frequency multiplier. Feeders & Antenna & Phase modulation, High voltage power units phase modulation. Police wireless, microwave link and satellite communication. (Example & Block dia only)	Demonstration on various transmitting systems. Study in blocks the ckts. of transmitters.		Draw the Block diagram of Transmitter.	Problems on mensuration problems. Atmospheric pressure. Pressure gauges. Absolute pressure.
42 & 43	Oscilloscope	Expl. Of oscilloscope, Importance, applications. Block diagram Introduction to Valve only. Construction & function of C.R.T. - C.R.O. Use of C.R.O., Care and maintenance. Lissejus figures. Use of digital storage oscilloscope.	Demonstration of a C.R.O. Example of 'X' 'Y' axes controls. Measurements of D.C. voltages, A.C. voltages frequency etc. Comparison of waver. Use of 'Scope' in testing & fault location. Practice on scope for measurements. Test on Lissejus pattern.	C.R.O., L.F. & H.F Signal generation 'VIDEO FILM' Oscilloscope	Drawing of block diagram of oscilloscope, C.R.T circuits diagram of oscilloscope.	Properties of matter. The molecule and atoms. Difference between mass and weight.
44 to 46	Communication system	Function Block diagram & Example of Telegraph system.- do- "Telephone" -do- Radio Photo -do- Trans Receivers -do- U.H.F., V.H.F., micro wave and Radar system. -do-	Study/demonstration on Telegraph system. -do-Telephone -do- Digital phone -do- Trans receiver VISIT to Different Transmitting Stn. (If possible)	Model of Telegraph & Telephone system. Trans receiver. Video films.	Drawing of separated sync. Pulses, A.G.C. and sync separator ckt.	Representation of forces by vectors, simple problems on lifting tackles- Jig, wall cranes solution

47 to 50	D.C. Motors	Navigation I.L.S. Introduction to fiber optics.  Expl. D.C. motors, parts required principle of operation, types, speed control by S.C.R./Diac and Triac. Example of micro meters. Introduction to stepper motor.	Video Film show on satellite communication.  Demonstration different types of motors study of speed control by S.C.R. by Diac & Triac Speed control of micro-motors.	D.C. motors, series, shunt Micrometer, speed control by S.C.R. by Diac & Triac Speed control of micro-motors.	Power supply ckts. Solid state.	by vectors.  General condition of equilibrium for series of forces on a body. Plotting of graph. Simple equation of graphs.
51	A.C. Motors	Expl. Of principle A.C. single phase motors, types, construction.	Identification, testing & running of single phase motors.	Capacitor motor. Electric Fan, Grinder, Washing machine.	Drawing of different wave shaping ckt., timer ckt. of amp. Etc.	Simple calculation of compensating components values for frequency ranges.
52 to 54	Operational Amplifier	Difference between linear and non – linear ICs. Use of op-amps in bio-medical applications. Example of op-Amplifier in different modes.	Study of different pulse shaping ckts. Assemble & testing of a differentiation and a integration ckt.	Function Generator oscilloscope.	Block diagram of Digital clock.	Calculation of voltage dividing network using resistance.
	Wave Shaping Ckt.	Expl. Of pulse/wave shaping ckts. -do- Differentiation and Integration ckt.	Study of relay ckts. -do- D.C. timer. -do- A.C. timer. -do- op. Amp. ckt.	Assorted relay. S.C.R. driven timer.		
	Timer	Expl. Of Timer Types of Time constant etc.				
55 to 57	Digital Electronics.	Explanation Of digital system, comparison with analogue. Advantages-application. Number Systems-Binary, Hex. Dec. . Octal and conversions. Basic logic gates, Truth Table,	Study of digital ICs. Verification of logic gates, Arithmetic ckts. FILIP-FLOPs, Counters.	Digital Trainer kits, Logic probe, digital IC tester.	Draw the component layout of digital Trainer.	Density of solids, liquids & simple experimental determination center of

59 & 60	Micro-processor	Boolean algebra, Arithmetic ckts. FLIP- FLOPs, counters, MSI, LSI, VLSI, C MOS & Bipolar ICs  Introduction to Computer, Microprocessor, Micro-controllers and Memories. Introduction to Micro-processor 8085, Pin functions, architecture, Instruction set, writing assembly language programs, I/O, support chips, interfacing. EPROM programming. Introduction to computers, input output units, Hardware and Software.	Familiarization with 8085 microprocessor kit, Read/Write to memory and registers, execution of programs using single step, execution of data transfer, arithmetic and logic instructions, programs and debugging. Study of Microprocessor based applications using microprocessor trainers.	Trainer kit with Interfacing EPROM programmer.	Draw the component layout of microprocessor trainer.	gravity.  Simple experiment for its determination. Magnetic deflection theory Photoconductivity demodulation principle.
61 to 63	Anatomy and physiology.	(a)Introduction to regional anatomy : (b)Cell tissues and organs : (c )The blood (d)The Brain (e)Organs of the head and neck (f)The Heart (g)The alimentary canal and associated structures (h)The kidneys (i)The Lungs (j)The Skeleton (k)Muscle (l)Reproductive system (m)The nervous system (n)General disease processes (o)Biochemistry (p)Hematology (q)Pathology :	Instructor is to explain with models and students are to prepare the chart and learn medical terminology (which are commonly used in hospitals) of the organs. Identify organs, cell tissues, blood flow, muscle, nerves system etc. Charts showing different types of bio-chemical changes, types of enzymes, types of fluids produced in different organs etc.	Human body charts showing all the organs, nerves system, blood flow, muscles, cell tissues etc.  Charts related to blood, plasma. Charts showing chemical reactions takes-place in the body.	Free hand sketches of all organs i.e. full details of brain, eyes, ears, teeth, heart, lungs, liver, pancreas, kidneys, etc.  Shapes of red blood cells, white blood cells, platelets, etc.	Calculation of R.C. constant in A.G.C. ckt. Frequency calculation of R-C and L-C oscillator. Calculation of voltage in resistive net work using zener etc.
64	Introduction to health care systems.	(a)Evolution of Modern Health system. Definition of Bio-Medical Engineering. Role of Bio-Medical engineering in Hospital and Industry. Application of engineering	Organization chart of public health infrastructure. Hospital organization chart. (Different divisions in the hospital)	Visit to different health centers.	Draw the organization charts.	Calculation of current voltage, in voltage dividing net work using the

		<p>concepts and techniques to medical practice.</p> <p>(b)Health Care Delivery Sys. : Major health care trends and directions, system pressures.</p> <p>(c ) Public Health Infra-structure: Sub-centers, Primary Health Centers (PHCs), Community Health Centers, District Hospitals, Tertiary level health facilities including description of service roles.</p> <p>(d)Classification of Hospitals Public / voluntary corporate Hospitals, Nursing homes. Central Govt./State Govt./local bodies/ Autonomous bodies hospitals.</p> <p>(e)Hospital Organization &amp; Administration: Hospital as a system, organizational chart, place of engineering services in the hospital set up.</p>				<p>thermister V.DR., L.D.R. at different temp., voltage, light intensity etc.</p>
65 to 69	Physiological signals and biomedical transducers.	<p>Bio-Medical transducer-Transducers principles, bio electric signals, Recording electrodes, Physiological transducers (sensors), Respirators, sensors, flow transducers, LVDT, strain-gauge, piezo electric crystal, Thermocouple thermistor, photo cell, photo diode, photo voltaic cell, photo transistor. Amplifiers in biomedical applications.</p>	<p>Use of varies transducer and making measurements with them, correct usage and precautions to be taken while handling them. Maintenance practices for the sensors/transducers.</p>			<p>To calculate current indifferent resistive net work using Diode, Zener in F.B &amp; R.B.</p>
70 to 74	Clinical laboratory	<p>(a)Microscope: Principle of operation, parts of a microscope,</p>	<p>Study the Operation of the Microscope, alignment and</p>	Microscope	Draw the Microscope	<p>Determination of velocity</p>

	equipment.	<p>alignment and cleaning procedure, precautions for use in dry and humid climates, hazards in use.</p> <p>(b)Analytical Balance: categories of balances, mechanisms – mechanical and electromagnetic types, Installation, hazards, maintenance protocol, electronic balances.</p> <p>(c )Centrifuge: Basic principle, constructional part, types of centrifuges – preparative &amp; haemocrit, maintenance and repairs.</p> <p>(d)Water Bath: Function, Constructional details, temperature control and maintenance.</p> <p>(e)Hot Air Ovens &amp; Incubators: Purpose, constructional details, temperature ranges &amp; control, maintenance.</p> <p>(f)Analytical Equipment: Introduction to chromatography. Explain the working principle and block-diagrams of Conductivity Meter, Blood cell counter, Spectrophotometer, colorimeter, pH meters, Flame photometer, Blood Gas Analyzer, Automated Clinical Laboratory Equipment.</p>	<p>cleaning.</p> <p>Study the operation of the analytical Balance</p> <p>Study the operation, Temperature control, time and trace the circuit diagram of the Water Bath.</p> <p>Study the operation, Temperature control, time and trace the circuit diagram of the Hot air oven and Incubator.</p> <p>Study the panel controls and its functions, operation and trace the circuit diagram of the Conductivity meter, Blood cell counter, Spectrophotometer, Colorimeter. pH meter, Flame Photometer, Blood Gas Analyzer.</p>	<p>Analytical Balance</p> <p>Water Bath</p> <p>Hot Air Oven and Incubator</p> <p>Conductivity meter, Spectrophotometer, Colorimeter. pH meter, Flame Photometer, Blood Gas Analyzer.</p>	<p>Draw the analytical balance</p> <p>Draw the water bath</p> <p>Draw the Hot air oven and Incubator</p> <p>Draw the front panel and rear panel controls of Conductivity meter, Spectrophotometer, Blood cell counter, Colorimeter. pH meter, Flame hotometer, Blood Gas Analyzer.</p>	<p>ratio, mechanical advantage and efficiency.</p> <p>Determination of efficiency of simple machines- Wrench, Pulley blocks, wheels and compounds axles.</p>
75&76	Sterilization equipment.	<p>Sterilization equipment's- Microbe's central sterilization supplies departments, methods of dis-infection, methods of sterilization maintenance of</p>	<p>Types of sterilization equipments, and maintenance principles of each.</p>			<p>Problems of menstruation, Sq. hexagon, Prism Atmospheric</p>

		sterilizer.				pressure, pressure gauges, absolute pressure properties of matter.
77 to 79	Physio-therapy Equipment.	Introduction of physiotherapy equipment Principle and explanation of the block diagram and applications of Short-wave, Microwave, Ultrasonic diathermy, Tense stimulator, Wax bath, physiotherapy with IR and UV Radiation, Introduction to Radiation therapy.	Study the panel controls and its functions and study the operation and trace the circuit diagram of the Short-wave, Microwave and Ultrasonic diathermy, tense stimulator, , Wax bath, physiotherapy with IR and UV Radiation, Introduction to Radiation therapy.	Short-wave diathermy, Microwave diathermy and Ultrasonic diathermy.	Draw the panel controls of the short-wave, Microwave and Ultrasonic diathermy.	Effect of force on material in such application as extending, bending, twisting and shearing. Trigonometric tables, applied problems. Simple calculation of power output and ilasing.
80	Hospital structure.	Introduction to varies departments in a general hospital and applications of various equipment in respective departments. Constructional features-Trolleys, lifts, OT tables, beds. Layouts of distribution systems. Introduction to waste management, disposable of waste. Introduction to prosthetic devices.	Study the Hospital structure.	Visit to Hospital.	Draw the Hospital structure (wards, operation theatre, x-ray room, dark room, clinical laboratory etc.)	Logarithm use of log-tables for multiplication and division.
81 to 85	Patient care and	a)ECG: Block diagram of ECG Machine, Lead configurations	Study the panel controls and its functions and study the	ECG, Echo Cardiograph, Bedside Monitor,	Draw the front and rear panel controls of ECG,	Simple problems on



	monitoring systems:	<p>and Electrodes, ECG Waveform and its significance.</p> <p>(b)ECHO CARDIOGRAPH: Basic principle of Echo cardiograph, Block-diagram &amp; applications.</p> <p>(c )BEDSIDE MONITOR: Parameters to be mentioned in ICCU, Explanation of the block-diagram</p> <p>(d)PACEMAKERS: Types-external and Internal, Asynchronous &amp; synchronous Power supplies, Oscillators, lead wire and electrodes.</p> <p>(e)DEFIBRILLATOR: Types of defibrillators, capacitive discharge .</p> <p>(f)EMG: Introduction, block-diagram and electrodes.</p> <p>(g)EEG: Introduction, block-diagram, electrodes and their placement.</p> <p>(h) Principles of Apnea monitors, BP measurement with spygmo manometer and stethoscope, Blood flow phono cardiography, stress test, holter test, fetal monitor, Dialysis ventilators and Endoscopes.</p>	<p>operation and trace the circuit diagram of the ECG, Echo Cardiograph, Bedside Monitor, Pacemaker, Defibrillator, EMG, EEG.</p> <p>BP measurement with spygmo manometer and stethoscope.</p>	pacemaker, Defibrillator, EMG, EEG equipments.	Echo Cardiograph, Bedside Monitor, pacemaker, Defibrillator, EMG, EEG equipments.	<p>lifting devices. Solution of problems by vectors. Ex. On simple supported load . Calculation Of area vol. And weight of simple solids bodies-cubes, squares, hexagons, prism.</p>
86 to 89	Imaging systems	a)X–RAYS: Introduction of x – rays, properties of x – rays,	Study the panel controls and its functions and study the	Mobile x-ray and 300 mA x-ray equipment.	Draw the panel controls of the x-ray equipment.	Representation of forces by

90	Dental equipment	<p>Explain the principle of generation of x – rays. Explain the block diagram, and working principle of the x-rays, General features of x – ray tube, KV and mA setting, main supply, fixed anode and rotating anode, collimators, grids and their functions. Image intensifier ( fluoroscopy) Dark room Accessories and Procedures. Concept of radiation hazards &amp; safety.</p> <p>(b)ULTRASONICS: Principles of Ultrasound, Echo techniques, Functional block-diagram. Types of transducers , Applications.</p> <p>( c ) CAT, CT, MRI &amp; PET.</p> <p>(d) Introduction to LED, LCD, Plasma displays</p> <p>(a)Sub-systems of dental equipment – dental unit, dental chair, sterile water system &amp; operating lights.</p> <p>(b)Dental Unit – Mechanical, electrical / electronic and pneumatic parts and their description, water and air pressure adjustments</p> <p>(c )Dental Chair – Mechanical, electrical and electronic sub-system, various adjustments and controls, emergency stop switches, safety limits.</p> <p>(d)Dental X-rays Machine : Subsystems, X-ray tube, Transformer, timer, collimator, positioning aids.</p> <p>(e) Introduction to flow meters,</p>	<p>operation and trace the circuit diagram of the x-ray equipment</p> <p>Study the development of the film in Dark Room</p> <p>Study the panel controls and its functions and study the operation of the Ultrasonic Scanner</p> <p>Study the operation of the Dental equipment.(Dental unit, chair, water and air pressure adjustments, light system.) study the panel controls and operation of the Dental x-ray.</p>	<p>Dark Room Accessories.</p> <p>Ultrasonic Scanning equipment.(U/S scanner)</p> <p>Dental equipment (Dental Unit, dental chair, water system, Light and Dental x-ray.)</p>	<p>Draw the setup of the dark room.</p> <p>Draw the panel controls of the Ultra scanner.</p> <p>Draw the set up of the Dental equipment. Draw the Block diagram of the dental x-ray equipment.</p>	<p>vectors, simple problems on lifting tackles- Jig, wall cranes solution by vectors.</p> <p>General condition of equilibrium for series of forces on a body. Plotting of graph. Simple equation of graphs.</p>
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91 & 92	Operation theatre equipment.	pressure gauge, valves and rotary cylinders.  Introduction, principle and explanation of surgical diathermy, Suction apparatus, Pulse Oximeter, Endoscopy , Theatre lighting, Operating Microscope.	Visit to Hospital to study the operation theatre and its allied equipment. Study the panel controls and its Functions and study the working principle of the Surgical diathermy, Pulse Oximeter, endoscopy, Theatre lighting and operating Microscope.	Surgical diathermy, Pulse Oximeter.	Draw the structure of the operation theatre and positions of the various equipment. Draw the panel controls of Surgical diathermy, Pulse Oximeter.	problems of menstruation. General condition of equilibrium for series of forces on a body. Plotting of graph. Simple problems of graph.
93 to 96	Electrical Maintenance	Wiring of light & fan ckts. On rolling stock Installation Lightning arrestor/lightning conductor. Complete House wiring Layout. Circuit splitting load wire. I.E rules. Multistoried house wiring system. Earthing as per I.E. rules testing & Inspections of Installation as per I.E rule. And fault finding techniques. Electrical safety and leakage current in Medical Equipments, Electro magnetic interference (EMI) and electro static discharge (ESD)	Practice of wiring of lights and fans on rolling stock. Practice in wiring and in maintenance of Hospital building. Layout & repairing of electrical installation. Construction of earth pit and testing. Fault finding practice.	Multi meter. Earth leakage tester.	Layout of house wiring, connection diagram of lights, fans, sockets and switches. Draw the earth pit construction diagram.	Brief description and properties of silicon, Nichrome silver etc.
97 to 99	Cold Chain Refrigeration system.	Principles of air conditioning and refrigeration. Types of pumps and compressors and principle of operation.	Methods of leakage detection through pipes various types of regulator, fixing of the tap valves. Pressure gauges, methods of producing sketches, such as planning organizing, silver soldering	Air conditioners, Refrigerators.	Draw the circuit diagram of air conditioner and refrigerator.	Trigonometric function-Use of trigonometric tables. Applied problems.

			etc. Adding refrigerator to system through main old attachments. Tests on Thermostat calibration. Determination of refrigerant quantity within a system <u>Testing of compressors</u>			Calculation of areas of triangles, polygons etc.
100	Clinical safety and fault finding	Clinical safety and chemical safety	Fault finding.			
101	Industrial visit / Hospital Visit.					
102 to 104	Revision and NCVT Test.					

(For a batch of 20 trainees)

Sl. No.	Description	Quantity
1.	Combination Pliers 15 Cms insulated	20
2.	Long nose insulated pliers 15 Cms	20
3.	Side cutter 15 Cms	20
4.	End Cutting nipper insulated 15 Cms	20
5.	Tweezers 10 Cms	20
6.	Heat sink plier	10
7.	I.C. Tweezers/Puller	20
8.	Neon glow tester	20
9.	Knob Screw driver insulated 10cms	20
10.	Screw driver set of 6	10
11.	Watch maker screw	10
12.	Knife electrician	20
13.	Adjustable spanner/slide wrench (15-20cis)	10
14.	Wire stripper	10 sets
15.	Allen Key	1 set

#### WORK SHOP TOOLS & EQUIPMENT

16.	Fire extinguisher	1
17.	First aid kit	1
18.	Artificial Respiration Chart	2
19.	Work benches 120x400x75 cm	4
20.	Rubber mat – 180x45x2.5 cm	3
21.	Rubber gloves pair	1 set
22.	Steel ruler 30 cm	10
23.	Scriber 15 to 20 cm	4
24.	Center Punch 10 cm	4
25.	Hammer cross pane 110 cm with handle	4

26.	Hammer ball pane 220 cm with handle	4
27.	Spanners double ended (metric system) 6mm to 19mm by 1.6mm	4 sets
28.	Spanners single ended 6mm to 25mm by 1.0m	2 sets
29.	Box spanner set of (4-15) mm	1 set
30.	Mallet 8 oz	2
31.	Gimlet	2
32.	Saw tenon 25cm	2
33.	Chisel wood 15cm set of 6mm to 25mm	2 sets
34.	Chisel cold flat 10mm	2
35.	Bradawl	2
36.	Ratchet brace drill 10mm	2
37.	Electric drill 10mm	2
38.	Hacksaw 20-25cm (adjustable)	4
39.	Junior saw 20cm	2
40.	File flat 20cm 2 <sup>nd</sup> cut	4
41.	-do- 15cm bastard	4
42.	File half round 20cm bastard	4
43.	File round 20cm 2 <sup>nd</sup> cut	4
44.	Instrument files (needle) set of 12	2
45.	Vice bench 10cm jaw	2
46.	- do - 5cm jaw	2
47.	Taps set 3mm to 10mm (set of 9)	2
48.	Dies set 3mm to 10mm	2
49.	Grinder bench electric	1
50.	Soldering iron 25 Watt	20
51.	-do- 10 Watt	10
52.	-do- 65 Watt	20
53.	-do- 250 Watt	2
54.	Temperature controlled soldering station 15 Watt	2
55.	De-soldering pump & De-soldering wire	2
56.	Wire gauge set	2
57.	Feeler gauge	2

58.	Permanent bar magnet 15cm	2
59.	Solenoid with core	2
60.	Electric bells	4
61.	Battery eliminator	8
62.	Batter storage lead acid	2
63.	Hydrometer	2
64.	Rheostats asserted values and ratings	25
65.	Variable resistors/Potentiometer	25
66.	Fractional H.P. AC meters	2
67.	-do- DC meters	2
68.	Constant voltage transformer/Auto	4
69.	Auto Coil winding m/c. (manual)	1
70.	D.C./A.C. Ammeter 0-1mA	4
71.	-do- 0-5mA	4
72.	-do- 0-50mA	2
73.	-do- 0-100mA	2
74.	-do- 0-500mA	2
75.	Multi-meter small	20
76.	Multi-meter big	2
77.	Digital multi-meter	20
78.	Thermo-couple meter R.F. 0-100mA	1
79.	-do- 0-500mA	1
80.	D.C/A.C. Voltmeter 0-5V	4
81.	-do- 0-10V	4
82.	-do- 0-50V	4
83.	-do- 0-500V	2
84.	-do- 0-5KV	2
85.	Watt meter 5/250V	2
86.	Insulation Tester	2
87.	Service Oscillator	4
88.	Signal tracer	4
89.	A.F. Oscillator	4

90.	C.R.O ( 20 MHz)	5
91.	Digital storage oscilloscope (20MHz)	1
92.	Function Generator	5
93.	Power supply 0-30V/D.C.	2
94.	-do- 0-300V/D.C	2
95.	A.C. Bridge	1
96.	Transistor Tester	1
97.	I.C. Tester	1
98.	Signal Injector	2
99.	Strain gauge with load cell	2
100.	Linear IC trainer	5
101.	Micro Processor Trainer 8085 (with medical application card).	4
102.	Digital I.C. trainer	4
103.	Logic Probes	4
104.	Frequency counter	1
105.	A.F./R.F. Oscillator	2
106.	Inter Com. System for 12 lines.	1
107.	Steel Cabinet 120x60x45cm	4
108.	Steel lockers with 20 drawers	2
109.	Human body charts	2
110.	Microscope	2
111.	Analytical Balance	2
112.	Centrifuge	2
113.	Water Bath	1
114.	Hot air oven	2
115.	Incubator	2
116.	Spectrophotometer	1
117.	Colorimeter	1
118.	PH meter	2
119.	Flame Photometer	1
120.	Blood gas analyzer	1
121.	Short Wave Diathermy	2



122.	Micro Wave Diathermy	1
123.	Ultra sonic diathermy	1
124.	ECG Recorder	2
125.	Bed side monitor	2
126.	Defibrillator	1
127.	Pace maker	2
128.	60mA Mobile x-ray equipment	1
129.	Dental x-ray equipment	1
130.	Dental Chair	1
131.	Portable Ultra sonic scanner	1
132.	Surgical diathermy	1
133.	Pulse Oximeter	1
134.	Theatre lighting system	2
135.	Refrigerator	1
136.	Baby incubator	1
137.	Conductivity meter	2
138.	Ventilators	1
139.	Simple sterilization equipment	4
140.	U-V/ IR lamps	4 each
139.	B.P. Apparatus (Sphygmo manometer)	4
140.	Stethe scope	4
141.	Wax bath	2
142.	Muscle Stimulator	2
143.	Suction apparatus	1
144.	Fetal monitor	1
145.	Refrigeration and Air conditioning Tutor	1
146.	Air conditioners	2
147.	Earth leakage tester	1
148.	Blood cell counter	1
149.	<u>DARK ROOM ACCESSORIES:</u> 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
	<b><u>Consumables</u></b> (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