GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

TECHNICIAN MEDICAL ELECTRONICS

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL: 4



SECTOR – ELECTRONICS AND HARDWARE

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
Kolkata-700091

TECHNICIAN MEDICAL ELECTRONICS

(Engineering Trade)

(Revised in August 2025)

Version: 3.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL: 4

Developed By

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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1. COURSE INFORMATION

During the two-year duration of Technician Medical Electronics trade a candidate is trained on professional skill, professional Knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill related to job roles. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered under Professional Skill subject are as below: -

FIRST YEAR: In this year, the trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He gets the idea of trade tools & its standardization, Familiarize with basics of electricity. Plan, estimate, assemble, install and test wiring system in hospital & CSSD department, Identify, install, test and operate different photo therapy equipment's in Biomedical Sector. Skilling to test and service different batteries used in electronics applications and record the data to estimate the repair cost. Identify and test various electronics components using proper measuring instruments, verify characteristics and compare the data using standard parameter. Demonstrate soldering and de-soldering of various types of electrical components, Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances. Execute testing; evaluate performance and maintenance of sphygmomanometers. Test and operate different types of Physiotherapy Equipment's technique and general care. Test various Medical gas plant operation using suitable care and safety. The candidate will be able to Construct, test and verify the input/output characteristics of various analog circuits. Assemble, test and troubleshoot various digital circuits. Demonstrate the significance of different parts in the organization in the human body (Basics of Human Anatomy and Physiology). Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result. Identify the working principles, Operation, general care of Clinical Lab Equipments.

SECOND YEAR: In this year, the trainee will be able to detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger. They will also be skilled with various modulation techniques to acquaint with fibre optic communication techniques transmission and reception. Trainees will be able to Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital department. Identify various functional blocks, I/O ports of a 8085 micro processor system and run the basic program. Trainees will be able to demonstrate the ICU department functions, equipments, calibration and basic human rating chart. They will also interpret the factors, tools and techniques affecting the medical terminology image quality. The trainee will demonstrate function of bio-medical department. Familiarize with the instruction set of 8051 micro controller kit and run the application. The trainees will demonstrate the operation and function of dental chair & dental x-ray. They will also be able operate different imaging equipments used in hospitals. The trainee will develop a bio-medical department in a hospital for supporting role of bio-medical engineer.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of Labour market. The vocational training programmes are running under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programmes under DGT for propagating vocational training.

Technician Medical Electronics trade under CTS is one of the popular newly designed courses. The earlier course was Technician Medical Electronics. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and Knowledge, while Core area (Workshop Calculation science, Engineering Drawing and Employability Skills) imparts requisite core skill & Knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional Knowledge, core skills & employability skills while performing the job and machining work.
- Check the job/components as per drawing for functioning, identify and rectify errors in job/components.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can take admission in diploma course in Notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

Sl. No.	Course Element	Notional Training Hours	
		1st Year	2nd Year

1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
Total		**1200**	**1200**
On the Job Training (OJT)/ Group Project *		150	150
Optional Courses**		240	240
Grand Total		**1590**	**1590**

** The trainee has to undergo 150 hours of mandatory OJT (On the Job Training) at nearby industry or wherever industry Not available then group project has to be done with the supervision of the trade instructor for every year.*

*** Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for obtaining 10th/ 12th class certificate from NIOS along with ITI certification, or, short term courses for extra skills/Knowledge.*

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his/her skill, Knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as Notified by the DGT from time to time.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment** Method by testing for assessment criteria listed against learning outcomes. The training institute has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.cstaricalcutta.gov.in or www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by DGT as per the guidelines. The pattern and marking structure is being Notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percentage for Trade Practical and Formative assessment are 60% & for all other subjects is 33%. There will be No Grace marks.

2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be No artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The

sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking pattern to be adopted while assessing:

Marks Allotted during Assessment	Performance Level	Evidence
Marks between 60% to 75%	For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	● Demonstration of good skill in the use of hand tools, machine tools and workshop equipment ● 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. ● A fairly good level of neatness and consistency in the finish ● Occasional support in completing the project/job.
Marks above 75% to 90%	For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	● Good skill levels in the use of hand tools, machine tools and workshop equipment ● 70-80% accuracy achieved while undertaking different work with those demanded by the component/job. ● A good level of neatness and consistency in the finish ● Little support in completing the project/job
Marks Above 90%	For performance in this grade, the candidate, with minimal or No support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	● High skill levels in the use of hand tools, machine tools and workshop equipment ● Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. ● A high level of neatness and consistency in the finish. ● Minimal or No support in completing the project.

3. JOB ROLE

Brief Description of Job Roles:

Bio-Medical Equipment Technician; Electronics Technician; Biomedical Engineering Technician repairs, calibrates, and maintains medical equipment and instrumentation used in health-care delivery field: Inspects and installs medical and related technical equipment in medical and research facilities for use by physicians, nurses, scientists, or engineers involved in researching, monitoring, diagnosing, and treating physical ailments or dysfunctions. Services various equipment and apparatus, such as patient monitors, electrocardiographs, blood-gas analysers, x-ray units, defibrillators, electrosurgical units, an aesthesia apparatus, pacemakers, blood- pressure transducers, spirometers, sterilisers, diathermy equipment, in-house television systems, patient-care computers, and other related technical paraphernalia. Repairs, calibrates, and maintains equipment, using hand tools, power tools, measuring devices, and Knowledge of manufacturers' manuals, troubleshooting techniques, and preventive-maintenance schedules. Safety-tests medical equipment and health-care facility's structural environment to ensure patient and staff safety from electrical or mechanical hazards. Consults with medical or research staff to ascertain that equipment functions properly and safely, utilizing Knowledge of electronics, medical terminology, human anatomy and physiology, chemistry, and physics.

Medical Equipment Technician; in the Healthcare Industry is also known as a Biomedical Equipment Technician (BMET), Service Technician, Biomedical Electronics Technician, and Biomedical Engineering Technician (BMET). Medical Equipment Technicians install, maintain and repair patient care equipment. They perform inspection, installation, and preventative maintenance of general clinical equipment, including appropriate documentation for all service activities and training the hospital staff.

Medical Laboratory Technician; (MLT) is also referred to as Clinical Laboratory Science professionals, Medical Technologists and Medical Laboratory Scientists. The Medical Laboratory Technician performs complex tests for diagnosis, treatment, and prevention of disease. These professionals are responsible for supporting and assisting doctors and scientists in their day-today healthcare work in a variety of roles. They function as the main support to biomedical scientists in pathology laboratories. They are also sometimes responsible for imparting training and supervision to the staff.

Medical Electronics General; fits, assembles and repairs various kinds of Medical electronic equipment in Hospital or company at place of use. Hospital construction and maintains of bio-medical departments should Examines drawings and wiring diagrams centralize gas plant; checks parts for accuracy of fit and minor adjustments; assembles parts or mounts them on chassis or panels with aid of hand tools; installs and connects wiring, soldering joints equipment, diagnoses faults with aid of electrical and electronic testing equipment; dismantles equipment if required and replaces faulty parts or wiring.

Medical Electronics Fitter, other; include all other workers engaged in fitting, assembling, repairing and manufacture and service medical electronic equipment, machinery, appliances, etc.

Medical Electronics Mechanic; Medical Electronic Equipment Mechanic repairs medical

equipment, such as all medical equipment example Radiology equipment's, ICU equipment's, control systems following blueprints and manufacturer's specifications and using hand tools and test instruments. Tests faulty equipment and applies Knowledge of functional operation of medical electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using instruments, adjusts mechanical parts, using hand tools and soldering iron. Aligns, adjusts and calibrates testing instruments. Maintains records of repairs, calibrations and test.

ECG Technician (ECG operation); tests programmer ECG lead selector switch with testing equipment to ensure that assembly in ECG leads, frequency, performance, etc. are in accordance with prescribed Standards Places assembled ECG leads in position and visually examines it to ensure that position of equipment, connections, Switches on and operates different knobs to check calibration, audibility and general performance of set by varying its tone and listening to various stations and frequencies. Tightens loose leads locates faults, replaces defective components and conducts necessary changes. Approves correctly assembled sets for further processing and rejects defective ones for rectification. May tests sets at different stages of assembly. May service, repair and overhaul ECG leads.

Patient Monitoring system, pulmonary Function Analyses, Blood gas analyzers, Cardiac Defibrillators Installs, X-ray machine technician Ultrasonic Imaging Systems Functioning. If the problem identified is in the Printed Circuit Board (PCB), the technician identifies the specific fault in the PCB and corrects it. Replaces the dysfunctional PCB with a new one, if the damage identified requires fixing at the service Centre.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO-2015:

(i) 3211.0200 – Bio-Medical Equipment Technician
(ii) 3211.0501 – Medical Equipment Technician
(iii) 3212.0701 – Medical Laboratory Technician

Reference NOS: -

a) ELE/N9516
b) ELE/N9447
c) ELE/N9448
d) ELE/N9531
e) ELE/N9449
f) ELE/N9472
g) ELE/N9517
h) ELE/N9521
i) ELE/N9475
j) ELE/N9453
k) ELE/N9454
l) ELE/N9455
m) ELE/N9456
n) ELE/N9518
o) ELE/N9404
p) ELE/N9457
q) ELE/N9458
r) ELE/N9405
s) ELE/N9460
t) CSC/N9401
u) CSC/N9402
v) ELE/N9533
w) ELE/N9525
x) ELE/N9409
y) ELE/N9532
z) ELE/N9463
aa) ELE/N9464
bb) ELE/N9465
cc) ELE/N9495
dd) ELE/N9467
ee) ELE/N9468
ff) ELE/N9469

4. GENERAL INFORMATION

Name of the Trade	**TECHNICIAN MEDICAL ELECTRONICS**
Trade Code	DGT/1070
NCO – 2015	3211.0200, 3211.0501, 3212.0701
NOS Covered	ELE/N9516, ELE/N9447, ELE/N9448, ELE/N9531, ELE/N9449, ELE/N9472, ELE/N9517, ELE/N9521, ELE/N9475, ELE/N9453, ELE/N9454, ELE/N9455, ELE/N9456, ELE/N9518, ELE/N9404, ELE/N9457, ELE/N9458, ELE/N9405, ELE/N9460, CSC/N9401, CSC/N9402, ELE/N9533, ELE/N9525, ELE/N9409, ELE/N9532, ELE/N9463, ELE/N9464, ELE/N9465, ELE/N9495, ELE/N9467, ELE/N9468, ELE/N9469
NSQF Level	4
Duration of the Trade	Two Years
Entry Qualification	Passed 10th class examination with Science and Mathematics or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. Of Student)	24 (There is No separate provision of supernumerary seats)
Space Norms	120 Sq. mtr (inclusive 10 sq. m dark room area)
Power Norms	2 KW
Instructors Qualification for	
(i) Technician Medical Electronics Trade	B.Voc/Degree in Electronics/ BME/ Medical Electronics Engineering from AICTE/UGC recognized Engineering College/ university with one year of teaching or industry experience in the Technician Medical Electronics field. OR 03 years Diploma in Electronics/ BME/ Medical Electronics from AICTE recognized board of technical education with two years of teaching or industry experience in the Technician Medical Electronics field. OR NTC/NAC passed in the Trade of "Technician Medical Electronics" with three years of teaching or industry experience in the Technician Medical Electronics field. **Essential Qualification:** Regular/RPL variants National Craft Instructor Certificate (NCIC) in Technician Medical Electronics trade under DGT. ***NOTE: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one year teaching or industry. OR 03 years Diploma in Engineering from AICTE recognized board of technical education with two years of teaching or industry experience.

	OR NTC/ NAC in any one of the engineering trades with three years of teaching or industry experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in any one of the engineering trade or RoDA.
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one year of teaching or industry experience. OR 03 years Diploma in Engineering from AICTE recognized board of technical education with two years of teaching or industry experience. OR NTC/ NAC in any one of the Electrical, Electronics & IT Trade group (Gr- II) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years of teaching or industry experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in any one of the engineering trades or RoDA.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years of teaching or industry experience with short term ToT Course in Employability Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills conducted by DGT institutes.
Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

Sl. No.	NOS CODE	Learning Outcome	Duration		
			Practical	Theory	Total
First Year					
1.	ELE/N9516	Plan and execute soldering and de soldering of various electrical components like Lug's, tag's, clips, Eyelets & Plugs for electronic circuits following safety precautions	50	10	60
2.	ELE/N9447	Plan, estimate, assemble, install and test wiring system in hospital & CSSD department	75	15	90
3.	ELE/N9448	Identify, install, test and operate different photo therapy equipments in Biomedical Sector	50	10	60
4.	ELE/N9531	Perform measurements selecting proper analog/digital instruments	25	5	30
5.	ELE/N9449	Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances	75	15	90
6.	ELE/N9472	Test and service different batteries used in electronics applications and record the data to estimate the repair cost	25	5	30
7.	ELE/N9517	Test various electronics components using proper measuring instruments and compare the data using standard parameter	25	5	30
8.	ELE/N9521	Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety Norms using proper tools/setup.	25	5	30
9.	ELE/N9475	Assemble simple electronics power supply circuit and test for functioning.	25	5	30
10.	ELE/N9453	Execute testing; evaluate performance and maintenance of sphygmomanometers	25	5	30
11.	ELE/N9454	Verify characteristics of electronics, power electronics and Special Semiconductors circuits.	65	10	75
12.	ELE/N9455	Test various Medical gas plant operation using suitable care and safety.	10	5	15
13.	ELE/N9456	Test and operate different types of	10	5	15

		Physiotherapy Equipment's technique and general care.			
14.	ELE/N9518	Assemble, test and troubleshoot various digital circuits.	112	23	135
15.	ELE/N9404	Construct, test and verify the input/output characteristics of various analog circuits.	25	5	30
16.	ELE/N9457	Demonstrate the significance of different parts in the organization in the human body (Basics of Human Anatomy and Physiology).	25	5	30
17.	ELE/N9458	Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments.	35	10	45
18.	ELE/N9405	Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	113	22	135
19.	ELE/N9460	Identify the working principles, Operation, general care of Clinical Lab Equipments.	45	15	60
20.	CSC/N9401	Read and apply engineering drawing for different application in the field of work.	-	30	30
21.	CSC/N9402	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	-	30	30
		Employability Skills		**120**	**120**
		Total	**840**	**360**	**1200**
		Second Year			
22.	ELE/N9533	Solder and desolder Pin Grid Array (PGA) packages with due care and safety.	50	10	60
23.	ELE/N9525	Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger.	50	10	60
24.	ELE/N9409	Prepare fibre optic setup and execute transmission and reception.	50	10	60
25.	ELE/N9532	Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital department.	50	10	60
26.	ELE/N9463	Demonstrate ICU Department functions, equipments etc., calibration and basic human rating chart.	50	10	60
27.	ELE/N9464	Interpret the factors, tools and techniques affecting the medical terminology image quality.	90	30	120
28.	ELE/N9465	Demonstrate the functions of bio-medical Department.	90	30	120
29.	ELE/N9495	Identify, test, service and program Micro controller 8051, STM32 and ESP32.	90	30	120
30.	ELE/N9467	Demonstrate various operations and functions of Dental Chair & Dental X-Ray.	80	25	105

31.	ELE/N9468	Execute the operation of different of Imaging Equipments used in hospitals.	150	45	195
32.	ELE/N9469	Recognize development of a Bio-medical Department in a hospital.	90	30	120
33.	CSC/N9401	Read and apply engineering drawing for different application in the field of work.	-	30	30
34.	CSC/N9402	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	-	30	30
		Employability Skills		**60**	**60**
		Total	**840**	**360**	**1200**
		Grand Total	**1680**	**720**	**2400**

ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Plan and execute soldering and de soldering of various electrical components like Lug's, tag's, clips, Eyelets & Plugs for electronic circuits following safety precautions. (NOS: ELE/N9516)	• Plan work in compliance with standard safety Norms. • Identify different types of Electrical components and test. • Identify various types of lug's and test the polarity. • Identify different types of tag's, clips, Eyelets & plug and test the polarity. • Solder the given components. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
2. Plan, estimate, assemble, install and test wiring system in hospital & CSSD department. (NOS: ELE/N9447)	• Comply with safety & IE rules when performing the wiring. • Prepare and mount the energy meter board. • Draw and wire up the consumers main board with ICDP switch and distribution fuse box. • Draw and wire diagram of all CSSD equipment's • Identify the types of fuses their ratings and applications. • Identify the parts of a relay, MCB & ELCB and check its operation. • Estimate the cost of material for wiring in PVC channel for an office room having 2 lamps, 1 Fan, one 6A socket outlet and wire up. • Estimate the requirement for conduit wiring (3 phase) and wire up. • Estimate the materials and wire up the lighting circuit for a godown. • Estimate the materials and wire up a lighting circuit for a corridor in conduit. • Test, locate the fault and repair Hospital wiring installation.
3. Identify, install, test and operate different photo therapy equipments in Biomedical Sector. (NOS: ELE/N9448)	• Install light fitting with reflectors for direct and indirect lighting. • Assemble and connect single & twin tube fluorescent light. • Connect, install and test the HPMV & HPSV lamp with accessories. • Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher. • Install light fitting for show case window lighting. • Plan work in compliance with standard safety Norms related with electrical illumination system.
4. Perform measurements selecting proper analog/digital instruments. (NOS: ELE/N9531)	• Identify the type of electrical instruments. • Extend the range of MC voltmeter and ammeter. • Measure the frequency by frequency meter. • Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.

	• Measure the value of resistance, voltage and current using digital multimeter. • Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.
5. Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances. (NOS: ELE/N9449)	• Plan work in compliance with standard safety Norms related with domestic appliances. • Service and Repair of calling bell/ buzzer/ Alarm. • Service and repair an automatic iron. • Repair and service of oven having multi-range heat control. • Replace the heating element in a kettle and test. • Service and repair an induction heater. • Service and repair a geyser. • Service and repair a mixer. • Service and repair of washing machine. • Install a Suction machine. • Service and repair of table fan. • Service, repair and install a ceiling fan.
6. Test and service different batteries use in electronics applications and record the data to estimate the repair cost. (NOS: ELE/N9472)	• Identify Tools and instruments for testing of batteries. • Observe safety procedure during testing of batteries and work as per standard Norms and company guidelines. • Identify the primary and secondary cells. • Measure and test the voltages of the given cells/ battery using analog / digital multimeter. • Charging and discharging the battery. • Maintain and estimate the repair cost of secondary battery. • Use a hydro meter to measure the specific gravity of the secondary battery.
7. Test various electronics components using proper measuring instruments and compare the data using standard parameter. (NOS: ELE/N9517)	• Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety Norms. • Identify the different types of resistors. • Measure the resistor values using colour • code and verify the reading by measuring in multi meter. • Identify the power rating using size. • Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. • Identify different inductors and measure the values using LCR meter. • Identify the different capacitors and measure capacitance of various capacitors using LCR meter. • Ascertain and select tools and materials for the job and make this available for use in.
8. Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety	• Identify the various crimping tools for various IC packages. • Identify different types of soldering guns and choose the suitable tip for the application. • Demonstrate the soldering and de-soldering the different active and passive components, IC base on GPCBs using

Norms using proper tools/setup. (NOS: ELE/N9521)	solder, flux, pump and wick. • Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety Norms. • Identify SMD components, de-solder and solder the SMD components on the PCB. • Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects. • Avoid waste, ascertain unused materials and components for safe disposal.
9. Assemble simple electronics power supply circuit and test for functioning. (NOS: ELE/N9475)	• Practice soldering on components, lug and board with safety. • Identify the passive /active components by visual appearance, • Code number and test for their condition. • Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period. • Construct and test a half & full wave rectifiers with and without filter circuits. • Construct and test a bridge rectifier with and without filter circuits. • Construct and test a Zener based voltage regulator circuit.
10. Execute testing; evaluate performance and maintenance of sphygmomanometers. (NOS: ELE/N9453)	• Plan work in compliance with standard safety Norms related with sphygmomanometers. • Identify the types of sphygmomanometer and their specifications. • Identify terminals, verify the rubber cuff which is apply to the arms. • Connect and test an instrument for measuring blood pressure. • Identify the operation and blood pressure monitor. • Connect to a column of mercury next to a graduate scale. • Determine of systolic and diastolic blood pressure by increase and gradually reduce the pressure in the cuff. • Perform and operate the BP machine/ sphygmomanometers. • Construct and test of stethoscope.
11. Verify characteristics of electronics, power electronics and Special Semiconductors circuits. (NOS: ELE/N9454)	• Plan work in compliance with standard safety Norms. • Construct and test the transistor based switching circuits. • Construct and test CB, CE & CC amplifier circuit. • Ascertain the performance of different oscillator circuits. • Measure the resistance, voltage, current through electronic circuit using multimeter. • Construct and test of JFET amplifiers, oscillators and multi vibrators. • Construct and test a UJT as relaxation Oscillator. • Construct and test lamp dimmer using TRIAC/DIAC. • Construct and MOSFET, IGBT test circuit and apply for suitable operation with proper safety. • Construct and test a circuit using photo diode and verify its characteristics.

12. Test various medical gas plant operation using suitable care and safety. (NOS: ELE/N9455)	• Check Mechanical Ventilation, Refrigeration, Air conditioning. • Test Air curtains, Laminar Flow Systems. • Apply safety and care of Refrigeration systems and Air conditioning systems. • Maintain Medical Gas pipe lines, Gas generators etc.
13. Test and operate different types of Physiotherapy Equipment's technique and general care. (NOS: ELE/N9456)	• Identify short wave Diathermy Principles. • Check Micro Wave Diathermy Principles. • Identify different types of Electrodes used in Physiotherapy Equipments. • Check Preparation Equipments, Patient Positioning and Application Techniques. • Take General Care of Transducers / Sensors and Equipments.
14. Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N9518)	• Illustrate to practice the digital trainer kit with safety. • Identify various digital ICs, test IC using digital IC tester and verify the truth table. • Construct and verify the truth table of all gates using NOR and NAND gates. • Construct an adder cum subtractor circuits and verify the truth table. • Construct a decoder and encoder, multiplexer and de-multiplexer circuits and verify the truth table. • Construct a multiplexer and de-multiplexer and verify the truth table. • Construct and verify the truth table of various flip flop, counter and shift register circuits.
15. Construct, test and verify the input/output characteristics of various analog circuits. (NOS: ELE/N9404)	• Ascertain and select tools and instruments for carrying out the jobs. • Plan and work in compliance with standard safety Norms. • Practice on soldering components on lug board with safety. • Identify the passive /active components by visual appearance, code number and test for their condition. • Construct and test the transistor based switching circuit. • Construct and test CB, CE & CC amplifier circuit. • Ascertain the performance of different oscillator circuits. • Construct and test clipper, clamper and Schmitt trigger circuit.
16. Demonstrate the significance of different parts in the organization in the human body (Basics of Human Anatomy and Physiology). (NOS: ELE/N9457)	• Explain the roles of the main components and features of a cell to the cell's functions. • Analyze the benefits of cells combining together to form tissues with specifications. • Description the roles of organ and the interrelationships between body system.
17. Execute the operation of	• Ascertain and select tools, material for the job and make this

different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments. (NOS: ELE/N9458)	available for use in the timely manner. • Plan work in compliance with safety Norms. • Demonstrate possible solution and agree task within the team. • Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT by their appearance. • Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. • Measure temperature of a lit fire using RTD and record the readings referring to data chart. • Measure the DC voltage of Sensor & Transducers • Detect different objectives using capacitive, inductive and photoelectric proximity sensors.
18. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result. (NOS: ELE/N9405)	• Demonstrate analog trainer kit with safety precautions. • Identify various ICs, differentiate by code No. and test for their condition. • Construct and test various OPAMP circuits. • Construct and test R-2R ladder type digital to analog converter circuit. • Construct and test different configurations of 555 IC e.g. astable, monostable, bi-astable and VCO circuits.
19. Identify the working principles, Operation, general care of Clinical Lab Equipments. (NOS: ELE/N9460)	• Identify Cell Counters Principles. • Check Spectrophotometer Principles. • Identify Colorimeter Principles. • Identify transducers in Analytical Instruments. • Illustrate operation of Instruments. • Take general Care of equipments.
20. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	• Read & interpret the information on drawings and apply in executing practical work. • Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. • Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
21. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	• Solve different mathematical problems • Explain concept of basic science related to the field of study
SECOND YEAR	
22. Solder and desolder Pin Grid	• Identify the various crimping tools for various PGA packages.

Array (PGA) packages with due care and safety. (NOS: ELE/N9533)	• Make de-solder various PGA's of different packages by following the safety Norms. • Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects. • Avoid waste, ascertain unused materials and components for safe disposal. • Identify, solder and desolder the PGA components.
23. Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger. (NOS: ELE/N9525)	• Identify the tools and equipments to perform the job with due care and safety. • Dismantle the given stabilizer and find major sections/ ICs components. • Identify various input and output sockets / connectors of the given SMPS. • Identify major sections/ ICs/components of SMPS. • Identify and replace the faulty components and construct and test IC Based DC-DC converter for different voltages. • Identify front panel control & indicators of UPS. • Identify various circuit boards in UPS and monitor voltages at various test points. • Test UPS under Fault condition & rectify fault. • Identify the parts, trace the connection and test the DC regulated power supply with safety. • Troubleshoot and service a DC regulated power supply • Test battery charger for its operation.
24. Prepare fibre optic setup and execute transmission and reception. (NOS: ELE/N9409)	• Plan and select appropriate tools to complete the job safely. • Identify the resources and their need on the given fiber optic trainer kit. • Make optical fibre setup to transmit and receive analog and digital data. • Demonstrate and apply FM modulation and demodulation using • OFC trainer kit using audio signal and voice link. • Demonstrate PWM modulation and demodulation using OFC trainer kit using audio signal. • Demonstrate PPM modulation and demodulation using OFC trainer kit using audio.
25. Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital department. (NOS: ELE/N9532)	• Identify & use different tools and equipment used for installation of CCTV, handle the tools with due care and safety. • Identify the different CCTV components, Trace or follow the CCTV setup for any commercial installation. • Identify the strategic locations for the installation of cameras. • Plan and setup the procedure for switching the cameras to have different views. • Identify the connectors and sockets used on DVRs, connect CCTV Cameras to DVR, Record and Replay. • Dismantle DVR and identify major functional blocks and test

	for the healthiness. • Make tools, machine tools, taste measure equipment and technical equipment ready for operational use, check and maintain such tools and equipment and initiate measures for the rectify of errors. • Monitor, evaluate and check own work.
26. Demonstrate ICU Department functions, equipments etc., calibration and basic human rating chart. (NOS: ELE/N9463)	• Prepare of kidney chart and eye chart. • Execute planning setup for ear chart and brain chart. • Calculate and analyze the internal heart chart rate. • Sketch blood circulating system. • Select and perform the techniques of skeletal system chart, respiratory system chart, nerve system chart and digestive system chart. • Plan and prepare reproductive system chart. • Illustrate the bio medical engineering instrument calibration.
27. Interpret the factors, tools and techniques affecting the medical terminology image quality. (NOS: ELE/N9464)	• Interpret medical terminology quality, resolution, Noise and speed. • Differentiate between the geometric factors affecting medical terminology quality. • Analyse the subject factors affecting medical terminology quality. • Analyse the tools and technique available to create high quality film. • Identify different types of equipments calibration procedure and error measuring as per manual. • Conduct systematic troubleshooting.
28. Demonstrate the functions of bio-medical Department. (NOS: ELE/N9465)	• Recognize various principles of air conditioning and Refrigeration, types of pumps and compressors, Principles of operation. • Identify various elements of Intensive-Care Monitoring, Patient monitoring displays. • Identify different Defibrillators, Pacemakers, EMG, EEG. • Check various monitors: Video monitors etc., Recorders: Strip chart recorders, Galvanometric recorders, Ultraviolet recorders and other recorders. • Operate ventilator identifying the physiology of respiratory system. • Identify instrumentation for the mechanics of breathing, Inhalators, Ventilators, Respirators, Humidifiers, Aspirators, Electro Surgical diathermy.
29. Identify, test, service & program Micro controller 8051 STM32 and ESP32. (NOS: ELE/N9495)	• Differentiate Microprocessor and Micro controller. • Identify architecture of 8051 family of Micro controllers, pin diagram and various on chip resources. • Check various types of memory with 8051 such as On-chip, external code memory, External RAM. • Prepare register Banks and use Memory mapping of the bit addressable registers (bit memories).

	• Plan and prepare Instruction set and apply various types of instructions. • Identify and select special function registers (SFRs) and their configuration for various applications. • Identify architecture of STM32 and ESP32. • Implement various Timer and counting functions, aspects of serial communication. • Utilize on-chip resources such as ADC etc. • Identify and select assembly software and compilers for 8051 • Micro-controllers, 8052 and differentiate with 8051.
30. Demonstrate various operations and functions of Dental Chair & Dental X-Ray. (NOS: ELE/N9467)	• Identify different components of Dental X-ray machine. • Identify and check Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits.
31. Execute the operation of different of Imaging Equipments used in hospitals. (NOS: ELE/N9468)	• Identify, plan & prepare basic physics applications. • Prepare block diagram of Ultrasound scanner. • Apply transducer theory & various types. different modes i.e. A, B, M- mode etc. Colour Doppler Ultrasound scanners • Analyze the basic physics subject factors affecting X-Ray. • Identify different components of X-ray machine, • Plan and prepare block diagram of X-ray machine, H.T. Generator etc. • Identify X-ray tubes, scattered radiation and Secondary radiation controls. • Identify and check digital X-ray concepts, X-ray films, Screens, Darkroom system & Procedure, Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits.
32. Recognize development of a Bio-medical Department in a hospital. (NOS: ELE/N9469)	• Identify role of Biomedical Engineer • Record maintenance of Bio-Medical Department • Get acquainted with NBEA license (National Biomedical Engineers Association. MCEBTI. Bangalore, Biomedical engineers should have NTC in Trade Medical Electronics under MIS NCVT). • Get accustomed with different types of License required for Hospitals, NABH (National accreditation Board for Hospitals and Healthcare), AERB (Atomic Energy Regulatory Board), ARRT (American Registry Radiologic Technologists), Drug License, RMDC (Registered Diagnostic Medical Sonographers), PC – PNDT (Pre Conception and Pre-Natal Diagnostic Techniques).
33. Read and apply engineering drawing for different application in the field of work. (NOS: CSC/N9401)	• Read & interpret the information on drawings and apply in executing practical work. • Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. • Encounter drawings with missing/unspecified key information and make own calculations to fill in missing

	dimension/parameters to carry out the work.
34. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: CSC/N9402)	• Solve different mathematical problems • Explain concept of basic science related to the field of study

SYLLABUS - TECHNICIAN MEDICAL ELECTRONICS			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	1. Plan and execute soldering and de soldering of various electrical components like Lug's, tag's, clips, Eyelets & Plugs for electronic circuits following safety precautions.	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. 2. Identify safety signs for danger, warning, caution & personal safety message. 3. Use of personal protective equipment (PPE). 4. Practice elementary first aid. 5. Preventive measures for electrical accidents & steps to be taken in such accidents 6. Practice elementary on Artificial Respiration. 7. Use of Fire extinguishers. 8. Practice soldering on different electronics components Lug's, Tag's, Clips, Eyelets and Plugs. 9. Practice De soldering using pump and wick. 10. Identify and use Lug's, Tag's, Clips, Eyelets and Plugs used in electronics industries. 11. Identify different types of Passive electronic components. 12. Practice soldering on combinational circuits in different values of resistance. 13. Identify resistors by their appearance and check physical defects. 14. Practice De soldering the same circuit using pump and wick. 15. Wire up the consumers main board with ICDP switch and distribution fuse box. 16. Prepare and mount the	Medical Electronics 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. Classification of cables according to gauge, core size, insulation strength, flexibility etc. Different type of soldering guns, relate temperature with wattage's, types of tips. Solder materials and their grading. Use of wax and other materials. Basics of electronic components. Selection of a soldering gun for specific requirement. Soldering and De-soldering stations and their specifications.

		energy meter board.	
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	2. a. Plan, estimate, assemble, install and test wiring system in hospital & CSSD department.	17. Practice fixing of screws of different sizes on wooden board. 18. Identify various conduits and different electrical accessories. 19. Practice cutting, threading of different sizes and laying installations. 20. Prepare test boards/extension boards and mount accessories like lamp holders, various switches indicator, sockets, fuse, MCB's etc. 23. Test and check rating of different type of switches, sockets, ELCB, fuse and MCB's.	**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. Insulators, conductors and semiconductor properties, Single phase and Three phase power, Terms like Line and Phase voltage/ currents. Working principles and study of Block diagrams / Schematic diagrams of Digital Multimeter.
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	3. a. Identify, install, test and operate different photo therapy equipments in Biomedical Sector.	22. Install electrical line 110 V. 24. Install and test using light fitting with reflector for direct and indirect lighting. 25. Test and identify different groups wattage of lamps in series for specified voltage. 26. Practice installation of various lamps e.g. fluorescent tube, Tub light/CFL etc. 27. Identify different types of analog & digital multimeters parts, its function and operation. 28. Practice on various analog and digital measuring instruments. 35. Practice on measuring instruments in single and three phase circuits.	Different type of electrical cables and their specifications. Different types of Cables used in the electronic industries. Ohm's law and its variables. Different types of UVB, XENON BULB, Halogen, LED LIGHTS, Tube lights, UV, Lights, IR lights, CFL Photo Therapy Working principles and study of Block diagrams / Schematic diagrams of Digital LCR meter.
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	4. Perform measurements selecting proper analog/digital instruments.	29. Identify the phase, neutral & earth on power socket, use a tester to monitor AC power. 30. Construct a test lamp and use it to check mains healthiness. 31. Measure the voltage between phase and ground and rectify earthing.	Types and Properties of magnets and their materials, preparation of artificial magnets, Significance of Electromagnetism, types of cores. Electromagnetic Relays, types, construction, specifications.

		32. Refer table and find current carrying capacity of wires. 33. Measure voltage and current using clamp meter. 34. Dismantle and identify the different parts of a relay. 36. Connect a timer relay in a circuit and test for its working. 37. Connect a contactor in a circuit and test for its working.	
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs.	2. b. Plan, estimate, assemble, install and test wiring system in hospital & CSSD department.	38. Practice on electrical wiring diagram for 3 phase connection. 38. Wire up the consumers main board with ICDP switch and distribution house box. 39. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. 40. Practice wiring of hostel and residential building as per IE rules. 41. Practice on wiring of UPS and inverter diagram, test/fault detection of domestic and industrial wiring installation and Repair AS PER PRIORITY. 42. Wire up the OPD, general ward and ICU main board with ICDP switch and distribution fuse box. 43. Estimate the cost/bill of material for wiring of OPD, general ward and ICU. 44. Practice wiring diagram of OPD as per IE rules. 45. Practice wiring diagram of general ward as per IE rules. 46. Practice wiring diagram of ICU as per IE rules. 47. Practice wiring diagram of minor OT as per IE rules. 48. Install various light fitting with reflectors for direct and indirect lighting of OT. 49. Practice test/fault detection of minor OT and OT wiring	Overload Relay, Fuse ratings, types of Fuses, Fuse bases, single/three phase MCB's, single phase ELCB' s. Phase angle, phase relations, active and reactive power, power factor and its importance in the industry. Three phase Transformers and their Types of Contractors, contactor coils and working voltages. Contactor contact currents, protection to contactors and high current applications Resistor - definition, types of resistors, KVL & KCL with applications their construction & specific use, color-coding, power rating. Types of inductors, Construction, specifications and applications (energy storage concept). Equivalent Resistance of series parallel circuits. V & I in series parallel circuits. Principles of induction, inductive Reactance, Self and Mutual induction. Behaviors of inductor at low and high frequencies. series and parallel combination, Q factor.

		installation and repair.	
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	3. b. Identify, install, test and operate different photo therapy equipments in Biomedical Sector.	50. Group different wattage of ultra violet lamp in series for specified voltage. 51. Connect a contactor in ultra violet lamp and test for its working. 52. Install light fitting for a spot lighting. 53. Install light fitting for photo therapy. 54. Practice testing/fault detection of UV lamp, spot lamp and photo therapy installation and repair.	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.
Professional Skill 75 Hrs; Professional Knowledge 15 Hrs	5. Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances.	55. Dismantle and assemble electrical/electronic parts of various electronic appliances e.g. Iron box, Radiant warmer, Auto cutoff multi coil, nebulizer, AC & DC motor. 56. Service and repair of electrical/electronic irons. 57. Prepare and test of silicon pipe sealer. 58. Measure and test of clinical sterilizer. 59. Practice testing/fault detection of autoclave (with & without auto cut off multi coil). 60. Plan and prepare of REPAIR OF incubator. 61. Service and repair of radiant warmer. 62. Prepare mount setup baby clinical incubator. 63. Prepare mount for the proper nebulizer. 64. Identify different terminals and parts of electrical wiring diagram for water pump with auto controller. 65. Identify parts and terminals of different types of single phase AC motors. 66. Install, connect and determine performance of single phase AC motors. 67. Identify parts and terminals	Concept of Time constant of a RC circuit. Concept of Resonance and its application in RC, RL & RLC series and parallel circuit. Wheatstone bridge circuits, Introduction, Balances, Hot plate and Magnetic Stirrer Centrifuges, Hot air oven, Incubator, Water bath, Nebulizer Construction & Testing of Baby / clinical Incubator, Radiant warmer Construction & Testing of Baby / clinical Incubator, Construction & Testing of Radiant warmer **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 phases AC motors. DC Motor construction, sub assemblies, carbon brushes interpretation of name plate

		of different types of single phase DC motors. 68. Install, connect and determine performance of single phase DC motors. 69. Connect, set proper direction of rotation and run. 70. Identify and test permanent magnet DC motor. 71. Identify and test brush less DC motor. 72. Service and repair of mixer and fan. 73. Install, connect and determine performance of centrifuge.	Specifications, conventional speed control methods and applications. Types of DC motors and their applications.
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	6. Test and service different batteries used in electronics applications and record the data to estimate the repair cost.	74. Identify the rated various types of cells output voltage and Ah capacity of given battery. 75. Practice on grouping of cells for specified voltage and current under different conditions and care. 76. Measure the specific gravity of the electrolyte using hydrometer. 77. Practice on routine, care/maintenance and testing of batteries. 78. Measure the resister value by colour code and verify the same by measuring with multimeter. 79. Identify the different type of passive components with colour code SMD and DIP package. 80. Identify the different type of active components of SMD and DIP package. 81. Identify different types of transformers and test. 82. Verify terminals, identify HT and LT side and calculate transformation ratio of single phase transformers. 83. Determine voltage regulation of single phase transformer at different	**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. Propagation delay, power dissipation and Noise immunity

		loads. 84. Identify different types of auto transformers and test.	
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	7. Test various electronics components using proper measuring instruments and compare the data using standard parameter.	85. Identify resistors by their appearance and check physical defects. 86. Identify the power rating of carbon resisters by their size. 87. Practice on measurement of parameters in combinational circuit by applying Ohm's Law for different resistor values and voltage sources. 88. Measurement of current and voltage in circuits to verify Kirchhoff's law. 89. Verify Laws of series and parallel circuits with voltage source in different combinations. 90. Measure unknown resistance using Wheatstone bridge circuits. 91. Identify and measure VI characteristics of VDR, LDR and Thermistor.	Working principle of a Transformer, Transformer construction, Types of cores used Specifications of a transformer. Step-up, Step down and isolation transformers with applications. Different type of losses in Transformers.
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	8. Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety Norms using proper tools/setup.	92. Practice soldering on different electronics components, IC bases and PCB's. 93. Practice DE soldering using pump and wick. 94. Join the broken PCB track and test. 95. Identification of 2, 3, 4 terminal SMD components. 96. Desolder the SMD components from the given PCB. 97. Solder the SMD components in the same PCB. 98. Check for cold continuity of PCB. 99. Identify various connections and setup required for SMD soldering station. 100. Identify different types of Si & Ge diodes and their specifications. 101. Measure the voltage and	PCB design making, Identification of 2/3/4 terminal SMD components. Soldering / de soldering of above components. Interpretation of diode specifications Forward current and Reverse voltage, Packing styles of diodes. Semiconductor component number coding for different electronic components such as Diodes, Zeners, Transistors, FETs, MOSFETs, IGBTs. PN Junction, Forward and Reverse biasing of diodes. Different layers of PCBs.

		current through a diode in a circuit and verify its forward characteristics. 102. Measure the voltage and current through a Zener diode in a circuit and verify its forward characteristics.	
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	9. Assemble simple electronics power supply circuit and test for functioning.	103. Identify the different controls on the CRO/DSO front panel and observe the function of each control. 104. Measure DC voltage, AC voltage, time period using CRO sine wave parameters. 105. Construct and test a half wave, full wave and bridge rectifier circuit with and without filter. 106. Construct and test voltage doubler's, tripler's and quadruple's. 107. Construct and test a dual power supply. 108. Construct and test different regulated power supply and measure output voltage with load. 109. Measure ripple voltage, ripple frequency and ripple factor of rectifiers for different load and filter capacitors.	Diode Bridge Modules. Rectifier configurations, their efficiency, Filter components and their role in reducing ripple +ve Voltage Regulator, -ve Voltage Regulator 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. 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.
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	10. Execute testing; evaluate performance and maintenance of sphygmomanometers.	110. Identify terminals verify the rubber cuff which is apply to the arms. 111. Construct and test sphygmomanometer for measuring blood pressure. 112. Execute planning setup for blood pressure monitor examination. 113. Determine the thermal effect of electric current. 114. Measure and test of stethoscope. 115. Construct and test of BP operator/Sphygmomanometers.	**Sphygmomanometer:** Names, Types (manual and digital), Operation, significance
Professional Skill 65 Hrs;	11. Verify characteristics of	116. Identify different types of transistors and their	Transistor biasing circuits and stabilization techniques.

Professional Knowledge 10 Hrs	electronics, power electronics and Special Semiconductors circuits.	specification. 117. Measure the voltage and current of different types of transistors in a circuit and verify its characteristics and measure Alpha, Beta and Gama. 118. Construct and test fixed bias, ammeter bias and voltage divider bias of a transistor amplifier circuit. 119. Identify different types of photo diodes, tunnel diodes, variactor diodes and lascer diodes and their specifications. 120. Measure the voltage and current through a photo diode in a circuit and verify its characteristics. 121. Construct a circuit to switch a lamp load using photo diode. 122. Measure the voltage and current through a tunnel diode in a circuit and verify its characteristics. 123. Measure the voltage and current through a variactor diode in a circuit and verify its characteristics. 124. Measure the voltage and current through a LASCR diode in a circuit and verify its characteristics. 125. Identify different types of DIAC, TRIAC, SCR, SCS, SBS & SUS and their specification. 126. Measure the voltage and current through DIAC & TRIAC in different circuits and verify its characteristics. 127. Measure the voltage and current through SCR & SCS in different circuit and verify its characteristics. 128. Measure the voltage and current through SBS & SUS	Voltage amplifiers- voltage gain, loading effect. Configuration of common emitter configuration of common base their definition characteristics and application Configuration of common collector transistor their definition characteristics and application, 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. Methods of coupling. CE, CB, CC amplifier circuit and their characteristics Alpha, beta, voltage gain Construction of FET, differentiate it with BJT. Purpose of Gate Drain and source terminals and voltage/current relations between them. Amplification factor of FET. 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, Impedance 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 junction capacitance, Frequency of operation,

		in different circuits and verify its characteristics. 129. Identify Different types of UJT, PUT, FET, IGBT, GTO and MOSFET. 130. Measure the voltage and current through UJT & PUT in different circuits and verify its characteristics. 131. Measure the voltage and current through FET & IGBT in different circuits and verify its characteristics. 132. Measure the voltage and current through GTO & MOSFET in different circuits and verify its characteristics.	Discuss a Transistor application as a switch. Discuss a Transistor application as an amplifier, Define input impedance and output impedance amplifier. configuration of common collector transistor their definition characteristics and application Classification of amplifiers according to frequency, mode of operation, Distinguish between voltage and power amplifier Types and effect of negative feedback in amplifiers Working of emitter follower circuit and its advantages different packages styles of transistors, in-circuit testing of transistor
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	12. Test various medical gas plant operation using suitable care and safety.	133. Identify the different gas plant safety precaution while working. 134. Measure & Test of Hospital Oxygen o2 gas plant. 135. Construct & Test of Hospital nitrous (n2o) plant.	Introduction to safety precaution for different gas plants, Hospital Oxygen o2 gas plant, Hospital nitrous (n2o) plant. Hospital Gas Plant Layout
	13. Test and operate different types of Physiotherapy Equipment's technique and general care.	136. Identify different types of diathermy and their system. 137. Operate & Test of shot wave diathermy. 138. Operate & Test of micro wave diathermy.	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
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	14. Assemble, test and troubleshoot various digital circuits.	139. Familiarize digital IC's. 140. Identify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them. 141. Verify the truth tables of all Logic Gate ICs by	Difference between analog and digital signals, logic levels of TTL and CMOS Introduction to Digital Electronics, Number systems and codes Digital code: binary, octal, Excess 3 code, grey code,

		connecting switches and LEDs. 142. Construct and verify the truth table of all the gates using NAND and NOR gates. 143. Use digital IC tester to test the various digital ICs (TTL and CMOS). 144. Verify the switching circuits of all logic circuit with the help of Boolean equation. 145. Verify the Truth table for De-Morgans first law and second law and from the result draw the logic gates.	BCD code, ASCII code and code conversions, Logic Gates and their truth tables, Study of a Digital IC Tester: Specifications & Block diagram, Operation and circuit description of a Digital IC Tester, 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 Logic s Universal property of NAND and NOR gates. Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders. IC 7482 as 2-bit and four bit full adders. Magnitude compactors. Half adder, full adder ICs and their applications for implementing arithmetic operations
Professional Skill 25 Hrs; Professional Knowledge 05 Hrs	15. Construct, test and verify the input/output characteristics of various analog circuits.	146. Construct & Test RC coupled Amplifier by using single stage. 147. Construct & Test RC coupled Amplifier using double stage. 148. Construct & Test of transformer Coupled Amplifier. 149. Construct & Test of class B Push pull Amplifier. 150. Construct & Test Audio Amplifier. 151. Construct & Test FET Common-source Low frequency amplifier. 152. Construct & Test FET Common-Drain Low frequency amplifier.	RC coupled Amplifier (single & double stage), transformer Coupled Amplifier, B Push pull Amplifier, Audio Amplifier, FET Common-source Low frequency amplifier, FET Common-Drain Low frequency amplifier Diode shunt and series clipper circuits and clamping/limiting circuits and their applications. R C based Differentiator Transistor power ratings & packaging styles, Use of different heat sinks.
Professional Skill 25 Hrs; Professional Knowledge	16. Demonstrate the significance of different parts in the organization	153. Identify Different parts of the human Body. 154. Identify the role of the main components and	The human body cell is comprised of several organelles. Each has a specific role in the life

05 Hrs	in the human body (Basics of Human Anatomy and Physiology).	features of the human body cell. 155. Outline the structure of the main tissues of the human body. 156. Identify the functions of all the main organs of human body.	process of the cell. Some of these processes include respiration, protein synthesis and excretion. The human body comprises of four main tissues. Firstly, the epithelial tissue has tightly packed cells. These form continuous sheets and act as linings for different parts of the body. These linings also help to protect and separate the organs. Epithelial tissue functions on both the inside and outside of the body. The role in which this specific tissue plays is that it acts as a barrier from the outside world's contaminants. These tissues have many layers which provide better protection, meaning if one layer is lost, the Underlying layer is still protected. Explain the functions of all the main organs found within the body
Professional Skill 35 Hrs; Professional Knowledge 10 Hrs	17. Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments.	157. Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT PT 100 (platinum resistance sensor), water level sensor, thermostat float switch, float valve by their appearance. 158. Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. 159. Measure temperature of a lit fire using RTD and record the readings referring to data chart.	Bio potential Electrodes, Bio chemical electrodes & Other electrodes. Cells and their Structure, Bio-electric potentials, Sources of Bio-electric, potentials, Resting & Action potentials Study different IC Packages IR LEDS, Photo diode for photo transistor, its characteristics and application, optical sensor, opto-couplers, circuits with opto isolation, characteristics of LASER diodes.

		160. Measure the DC voltage of a LVDT. 161. Identify different types of Electrodes. 162. Identify the electrodes used in medical devices.	
Professional Skill 38 Hrs; Professional Knowledge 07 Hrs	18. a. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	163. Construct & Test a stable Multi-vibrator by using IC 555. 164. Construct & Test Mono stable Multi-vibrator by using IC 555. 165. Construct & Test Bi stable Multi-vibrator using IC 555. 166. Construct & Test of VCO (V to F converter) using IC 555. 167. Construct and test Schmitt trigger using IC 555. 168. Construct and test Ramp generator using IC 555. 169. Construct and test time delay relay using IC 555. 170. Construct and test water level controller using IC 555. 171. Construct and test 555 timers as pulse width modulator.	Types of multi-vibrators and study of circuit diagrams Time constants of RC & RL circuits., Block diagram of 555, functional description w.r.t. different configurations of 555 monostable block diagram of 555, functional description w.r.t. different configurations of 555 monostable functional description wrt different configurations of 555 monostable functional description wrt different configurations of 555 astable functional description wrt different configurations of 555 VCO operations for various application, introduction to positive feedback and requisites of an oscillator
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	14. b. Assemble, test and troubleshoot various digital circuits.	172. Construct Half Adder circuit using ICs and verify the truth table. 173. Construct Full adder with two Half adder circuit using ICs and verify the truth table. 174. Construct the adder cum subtractor circuit and verify the result. 175. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse. 176. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. 177. Verify Binary to Gray code converter. 178. Verify Gray to Binary code	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 IC74151 AS Data selector/Multiplexer. 1 to 4 line De-multiplexing. IC 74154 as a De-multiplexer. S-R Latch, Gated S-R Latch, D- Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop Clocked Flip Flop, Master-Slave flip flops and Timing diagrams Basic flip flop

		converter. 179. Identify and test common anode and common cathode seven segment LED display using multimeter. 180. Interface 7 Segment display with IC 7447/7448 decoder. 181. Display the two digit count value on seven segment display using decoder/ drivers.	applications like data storage, data transfer and frequency division. Specifications and block diagram, Operation of a Analog IC Tester and it Circuit description, Basics of Counters. Two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams. 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
Professional Skill 75 Hrs; Professional Knowledge 15 Hrs	18. b. Construct and test different circuits using IC 741 operational amplifiers & IC 555 linear integrated circuits and execute the result.	182. Pin Identification of OP-Amp LM741, TLC274C, LF356, LM324. 183. Construct & Test of Inverting Amplifier using Op –Amp. 184. Construction & Testing of Non inverting Amplifier using Op –Amp. 185. Construct & Test of Summing Amplifier using Op –Amp. 186. Construction & Testing of Differential Amplifier using Op –Amp. 187. Construct & Test of Logarithmic Amplifier using Op –Amp. 188. Construct & Test of Low - Pass Filter using Op – Amp. 189. Construct & Test of High - Pass Filter using Op – Amp. Construct & Test of Band Pass and band Reject Filter using Op – Amp. 190. Construction & Testing of RC Phase-shift Oscillator using Op-Amp.	Study of a Linear IC Tester Integrator circuits, 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, Bio- medical Instrumentation Amplifier using Op -Amp, RC Phase-shift Oscillator using, Wien Bridge Oscillator using Op-Amp, voltage to current converter using Op-Amp, current to voltage converter using Op-Amp, Peak Detector using Op-Amp, Precision Rectifier using Op-Amp, Triangular &

		191. Construct & Test of Wien Bridge Oscillator using Op-Amp. 192. Construct & Test of voltage to current converter using Op-Amp. 193. Construct & Test current to voltage converter using Op-Am. 194. Construct & Test Peak Detector using Op-Amp. 195. Construct & Test Precision Rectifier using Op-Amp. 196. Construct & Test Bio-medical Instrumentation Amplifier using Op –Amp. 197. Construct & Test Basic Triangular & Square Wave Generator using Op-Amp.	Square Wave Generator using Op-Amp
Professional Skill 37 Hrs; Professional Knowledge 08 Hrs	14. c. Assemble, test and troubleshoot various digital circuits.	198. Construct and Test a 4 to 1 Multiplexer. 199. Construct and Test a 1 to 4 De Multiplexer. 200. Construct and Test 4bit SISO shift Register. 201. Construct and Test 4bit SIPO shift Register. 202. Construct and Test 4bit PISO shift Register. 203. Construct and Test 4bit PIPO shift Register. 204. Construct and test up - down counter with timing diagram.	Shift Register functions, Serial to parallel and vice verse, 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.
Professional Skill 45 Hrs; Professional Knowledge 15 Hrs.	19. Identify the working principles, Operation, general care of Clinical Lab Equipments.	205. Identify various ABD kits peripherals and connect it to the system of Blood Group using. 206. Perform and execute PH Meter. 207. Understand how to prepare and measure calorimeter digital / analog. 208. Practically understand how to use Spectrophotometer. 209. Practice and perform sugar testing using Quick check (TECO). 210. Practice and perform the method of patient care	Microscope, Colorimeter and Spectrophotometer (Both VIS & UV), Laboratory tests based on Colorimeter and Photometry, Flame photometry, Electrophoresis, Ph meters, Semi auto analyzers, Blood, cell counter, Blood gas analyzer.

		and handling Semi Auto Analyzer and fully auto analyzer. 211. Perform how to calculate Blood Cell counter. 212. Practically understand how to measure uro meter. 213. Select and perform the appropriate syringe Destroyer & syringe Pump. 214. Prepare the room apparatus and instrument for electro surgical Unit (surgical cut and coagulation).	
Engineering Drawing			
Professional Knowledge ED- 30 Hrs.	20. Read and apply engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Lines- Types and applications in drawing Free hand drawing of • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing offhand tools and measuring tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, square, Parallelogram. • Lettering & Numbering- Single Stroke. Dimensioning • Types of arrow head • Leader line with text • Position of dimensioning (Unidirectional, Aligned) Symbolic representation– • Different symbol used in the related trades. Concept and reading of Drawing in • Concept of axes plane and quadrant • Concept of Orthographic and ISO metric projections • Method of first angle and third angle projections (definition and difference) • Reading of Job drawing of related trades.	
Workshop Calculation & Science			
Professional Knowledge WCS- 30 Hrs.	21. Demonstrate basic mathematical concept and principles to perform practical	**Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division	

	operations. Understand and explain basic science in the field of study.	Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, electric current AC, DC their comparison, voltage, resistance and their units **Mensuration** Area and perimeter of square, rectangle and parallelogram Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels **Levers and Simple machines** Simple machines - Effort and load, mechanical advantage, velocity ratio, efficiency of machine, relationship between efficiency, velocity ratio and mechanical advantage **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables

Project work/Industrial visit

Broad areas:

a) Construct and test of four bit synchronous binary counter using IC 74163.
b) Construct and test bidirectional shift resistor.
c) Construct and test instrumentation amplifier.
d) Construct and test R-2R ladder type digital to analog converters circuit.
e) Construct and test a class B complementary push pull amplifier.

SYLLABUS - TECHNICIAN MEDICAL ELECTRONICS			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	22. Solder and desolder Pin Grid Array (PGA) packages with due care and safety.	216. Identify PGA packages. 217. De-solder the PGA components. 218. Solder the PGA components. 219. Identify lose /dry solders, broken tracks on printed wiring assemblies.	Identification of PGA packages, Soldering / De soldering of above PGA components, Cold/Continuity check of PCBs, Identification of lose /dry solders, broken tracks on printed wiring assemblies.
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	23. Detect the faults and troubleshoot SMPS, UPS and Inverter and Battery charger.	220. Identify various input and output sockets/ connectors/ indicators on the given UPS. 221. Make individual connections between batteries of battery stack and test for healthiness of batteries on stack. 222. Connect battery stack to the UPS. 223. Make load test to measure backup time. 224. Identify isolator transformer 1:1, inverting: transformer and control transformers. 225. Adjust charging current according to number of batteries. 226. Identify various circuit Boards and monitor voltages at vital test points. 227. Identify the charging section and set the charging current according to backup. Perform a load test to UPS. 228. Identify the semiconductor power modules and measure voltages. 229. Maintain, Service and	Electrical wiring for Single phase and Three phase systems, Earthing and earth resistance measurement. Calculation of load power and power factor of a power source. Review on Batteries – various types, their selection, grouping of cells and batteries, charging of batteries. Various Battery charging circuits used in Inverters and UPS, Maintenance of Batteries Inverter – their principle & operation, power rating, change over period Installation of Inverters, Protection circuits used in inverters– battery level, over load, over charging etc. Various faults and its rectification. 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,

		troubleshoot Battery charger and UPS.	alarm circuits, Indicator circuits.
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	24. Prepare fibre optic setup and execute transmission and reception.	230. Cutting, cleaning and preparing of fibre cable for splicing. 231. Splicing of OFC using splicing machine. Testing of OFC using OTDR. 232. Measure propagation, return and bending losses etc. 233. Measure optical signal power using optical power meter. 234. Test the optical fibre cable using Visual Fault locator. 235. Make optical fibre setup to transmit and receive analog.	Intro to optical fiber as a transmission media, its advantages over other media. Identify different optical cables and understand IEEE Standards. Working principle of transmitter and receiver in fiber optic communication. Application and advantages of fiber optic communication properties of moptic fiber, testing, losses, types of fiber optic cables and specifications, Fiber optic Encoding of light, Fiber optic joints, splicing, testing and the related equipment s /measuring tools, precautions to be taken, laying of cables, safety aspects while handling optical cables.
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	25. Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital Department.	236. Identify different CCTV components. 237. Draw, trace or follow the CCTV setup of any commercial installation. 238. Identify the strategic locations for the installation of camera. 239. Identify various indicators, cables, connectors and ports on the computer cabinet. 240. Demonstrate & practice assembly and disassembly of a desktop and identify various parts of the system unit and motherboard components. 241. Identify various computer peripherals and connect it to the system. 242. Install a Printer driver software and test for print outs 243. Install antivirus software, scan the system and explore the options in the antivirus software.	Introduction of CCTV, computer hardware, software's and types of networking installation, multiple frame split in digital TV, restore old memories, format new & old hard disk.

		244. Install MS office software. 245. Connect network connectivity for backup recovery. 246. Prepare multiple frame split. 249. Identify LCD Display module and its decoder/ driver ICs.	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	26. Demonstrate ICU Department functions, equipments etc., calibration and basic human rating chart.	261. Plan and prepare of Kidney chart, eye chart, ear chart, Brain chart. 262. Identify the internal procedure of heart chart, blood circulatory system. 263. Practice and perform the skeletal system chart, respiratory system chart, nerve system chart, digestive system chart. 264. Prepare reproductive system chart.	kidney chart, eye chart, ear chart, Brain chart, working of heart chart, blood circulatory system, skeletal system chart, respiratory system chart, nerve system chart, digestive system chart, reproductive system chart, History of Bio-medical Engineering Instrumentation, Man Machine System, NABH, NABL
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	27. Interpret the factors, tools and techniques affecting the medical terminology image quality.	265. Perform how to calculate Pulse Oximeter. 266. Perform how to prepare an EMG. 267. Practice and perform the method of patient care and handling ECG. 268. Plan patient setup for EEG & ERG. 269. Perform techniques of applications of Multi-Para monitor including ETCO2. 270. Plan and perform the care of Ultrasound Doppler equipments. 271. Plan patient setup for Fetal Monitor, Infusion Pump & Syringe Pump. 272. Practice and perform the method of patient care and handling Endo scope & Colonoscopy.	Physiological system of the Body, Medical Terminology. Various departments in Hospital Classification of Hospitals, Introduction to anatomy, Human Physiology, Electro-physiology, Multi-Para monitor, Ultrasound Doppler, fetal Monitor Pulse Oximeter.
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	28. Demonstrate the functions of bio-medical Department.	273. Identify & test of Pulse Oximeter, EMG, ECG different controls of the related equipments. 274. Identify calibration	Elements of Intensive-Care Monitoring, Patient monitoring displays, Defibrillators, Pacemakers, EMG, EEG, Monitors: Video

		procedure or measuring and monitoring instruments. 275. Demonstrate care of applicators used infusion pump & syringe pump. 276. Prepare the room, apparatus and instrument for Endoscope & Colonoscopy. 277. Troubleshooting & Maintenance aspects. 278. Check the effect on image due to variation in focal object distance, object field distance, exposer angle. 279. Identify the technical aspect of quality assurance. 280. Check the quality assurance of the related equipments and its benefits with respect to visual assessment.	monitors, Recorders: Strip chart recorders, Galvanometric recorders, Ultraviolet recorders, and other recorders Ventilator: The physiology of respiratory system, Instrumentation for the mechanics of breathing, Inhalators, Ventilators, Air compressors, Respirators, CPAP, BIPAP Humidifiers, Aspirators, Surgical diathermy.
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	29. Identify, test, service & program Advanced Micro controller	281. Identify various ICs & their functions on the given Microcontroller Kit. 282. Identify the address range of RAM & ROM. 283. Measure the crystal frequency, connect it to the controller. 284. Identify the port pins of the controller & configure the ports for Input & Output operation. 285. Use 8051/ 8056 microcontroller, connect 8 LED to the port, blink the LED with a switch. 286. Perform the initialization, load & turn on a LED with delay using Timer. 287. Perform the use of a Timer as an Event counter to count external events. 288. Demonstrate entering of	Differentiate Microprocessor and Micro controller, Architecture of 8051 family of Micro controllers, pin diagram and various on chip resources. Types of memory with 8051 such as On-chip, external code memory, External RAM Register Banks and their use Memory mapping of the bit addressable registers (bit memories). Instruction set and various types of instructions 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

		simple programs, execute & monitor the results. 289. Perform with 8051 microcontroller assembling language program, check the reading of an input port and sending the received bytes to the output port of the microcontroller, used switches and LCD for the input and output. 290. Write a program to use on board ADC and convert the analog voltage signal into digital value and store it memory.	compilers for 8051 Micro-controllers. 8052 and its difference with 8051. Understanding the concept of Advanced microcontroller and Its Programming.
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	30. Demonstrate various operations and functions of Dental Chair & Dental X-Ray.	291. Operating & maintenance of Dental chair with suction & air compressor. 292. Dental x-ray clarification Intra oral Dental x-Ray & Extra oral Dental x-ray. 293. Identification Dentist handling tools. 294. Basic level of Dental X ray calibration. 295. Assembling and disassembling of chair & compressor. 296. Assembling and disassembling of X-Ray	Introduction to digital image processing techniques. Different components of Dental X-ray machine. Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits, AERB, OPG
Professional Skill 150 Hrs; Professional Knowledge 54 Hrs	31. Execute the operation of different Imaging Equipments used in hospitals.	297. Identification of control Panel of Ultrasound scanners. 298. Identification of Types Probe of Ultrasound scanners. 299. Identification of Modes imaging of Ultrasound scanners. 300. Operating Process of Ultrasound scanners. 301. Identification of control Panel of X-ray. 302. Identification & difference In CR & DR. 303. Identification & difference In Manual process of x-Ray expose	Ultrasound scanners: Basic physics, Block diagram of Ultrasound scanner, Transducer theory & types, Ultrasound scanner, transducer theory & types, Different modes i.e. A, B, M-mode etc. Colour Doppler Ultrasound scanners 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, Digital X-ray concepts, X-ray films,

		& film Development. 304. Calibration of X-ray Beam and tube head. 305. Digital X-ray imaging process. 306. Identify General fault finding of X-ray Equipment's. 307. Calibration of table alignment. 308. Identification of CT scanner parts. 309. Identification of CT scanner control panel parts. 310. Digital Image conversion of Ct scanner. 311. General fault finding of CT scanner. 312. Calibration of table alignment. 313. Identification of MRI parts. 314. Identification of MRI control panel parts. 315. Digital Image conversion of MRI. 316. General fault finding of MRI. 317. Calibration of table alignment. 318. Identification of mammography parts. 319. Identification of mammography control panel parts. 320. Digital Image conversion of mammography. 321. General fault finding of mammography. 322. Identification of Bronchoscope parts General fault finding of Bronchoscope.	Screens, Darkroom system & Procedure, Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits, Dental X-ray machine. CT Scanner, MRI, mammography, Bronchoscope, PNDT Regulations as per DMHO
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	32. Recognize development of a Bio-medical Department in a hospital.	323. Identify the main role of Biomedical Engineer. 324. Identify SOPs of Biomedical Departments. 325. Demonstrate preventive steps care for NABH. 326. Check the Insurance	Role of Biomedical Engineer, record maintenance of Department, NBEA license (National Biomedical Engineers Association. MCEBTI. Bangalore, Biomedical engineers should have NTC

		applied for related Biomedical Instruments. 327. Check the certification for radiations. 328. Check the certification for registration. 329. Check the certification for related licensee for biomedical equipment's.	in Trade Medical Electronics under MIS NCVT) Introduction of different types of License required for Hospitals, NABH (National accreditation Board for Hospitals and Health care), and NABL, AERB (Atomic Energy Regulatory Board), ARRT (American Registry Radiologic Technologists), Drug License, RMDC (Registered Diagnostic Medical Sonographers), PC - PNDT (Pre Conception and Pre-Natal Diagnostic Techniques) (PNDT ACT 1994).
Engineering Drawing:			
Professional Knowledge ED- 30 Hrs.	33. Read and apply engineering drawing for different application in the field of work.	• Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. • Reading of foundation drawing • Reading of Rivets and rivetted joints, welded joints, welded joints • Reading of drawing of pipe and pipe joints Reading of Job Drawing, Sectional View & Assembly view.	
Workshop Calculation & Science:			
Professional Knowledge WCS- 30 Hrs.	34. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Centre of Gravity** Centre of gravity - Centre of gravity and its practical application **Area of cut out regular surfaces and area of irregular surfaces** Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress **Heat Treatment** Heat treatment and advantages Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalizing and case hardening **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of	

		material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing
Project Work/ Industrial Visit		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. for 1st year + 60 Hrs. for 2nd year)

Learning outcomes, assessment criteria, syllabus and Tool List of Employability Skills is provided separately in www.cstaricalcutta.gov.in / www.bharatskills.gov.in / www.dgt.gov.in

ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
TECHNICIAN MEDICAL ELECTRONICS (For batch of 24 Candidates)			
Sl. No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Connecting screwdriver	100 mm	10 Nos.
2.	Neon tester	500 V.	10 Nos.
3.	Screw driver set	set of 5	10 Nos.
4.	Insulated combination pliers	150 mm	10 Nos.
5.	Insulated side cutting pliers	150 mm	10 Nos.
6.	Long Nose pliers	150 mm	10 Nos.
7.	Soldering iron	25 W. 240 V.	10 Nos.
8.	Electrician knife		10 Nos.
9.	Tweezers	100mm	10 Nos.
10.	Digital Multimeter	As required	05 Nos.
11.	Soldering Iron Change able bits	15 W	10 Nos.
12.	Magnifying glass		02 Nos.
13.	De- soldering pump		10 Nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units No additional items are required			
14.	Fire extinguisher		01 No.
15.	First aid kit		1 No.
16.	Artificial Respiration Chart		2 Nos.
17.	Rubber mat -	180x45x2.5 cm	2 Nos.
18.	Rubber gloves pair		1 set
19.	Spanners double ended (metric system)	6mm to 19mm by 1.6mm	4 sets
20.	Box spanner set of	(4-15) mm	1 set
21.	Mallet	8 oz	2 Nos.
22.	Electric drill	10mm	2 Nos.
23.	Junior saw	20cm	2 Nos.
24.	File flat	20cm 2nd cut	4 Nos.
25.	File flat	15 cm bastard	4 Nos.
26.	File half round	20cm bastard	4 Nos.
27.	File round	20cm 2nd cut	4 Nos.
28.	Instrument files (needle)	set of 12	2 Nos.
29.	Vice bench	5cm jaw	2 Nos.
	Taps set	3mm to 10mm (set of 9)	2 Nos.
30.	Dies set	3mm to 10mm	2 Nos.
31.	Grinder bench electric		1 No.
32.	Temperature controlled soldering station SMD	AS REQUIRED	4 Nos.
33.	De-soldering pump		2 Nos.
34.	Permanent bar magnet	15 cm	2 Nos.
35.	Electric bells		4 Nos.
36.	Battery eliminator		4 Nos.
37.	Battery storage lead acid		2 Nos.
38.	Hydrometer		2 Nos.
39.	Rheostats asserted values and ratings		12 Nos.

40.	Variable resistors/Potentiometer		12 Nos.
41.	Constant voltage transformer/Auto		4 Nos.
42.	Auto Coil winding m/c. (manual)		1 Nos.
43.	Thermo-couple meter R.F.	0-100mA	1 No.
44.	Thermo-couple meter R.F.	0-500mA	1 No.
45.	Watt meter	5/250V	2 Nos.
46.	Insulation Tester		2 Nos.
47.	Signal tracer		4 Nos.
48.	Micro Wave Diatherrmy		1 No.
49.	Ultra sonic diathermy		1 No.
50.	ECG Recorder		2 Nos.
51.	Bed side monitor		2 Nos.
52.	Defibrillator		1 No.
53.	Pace maker		2 Nos.
54.	60mA Mobile x-ray equipment	(MOU) any hospital / Industries repeted	1 No.
55.	Dental x-ray equipment		1 No.
56.	Dental Chair		1 No.
57.	Portable Ultra sonic scanner	(MOU) any hospital / Industries	1 No.
58.	Surgical diathermy		1 No.
59.	Pulse Oximeter		1 No.
60.	Operation Theater lighting system		2 Nos.
61.	Refrigerator		1 No.
62.	Baby incubator		1 No.
63.	Conductivity meter		2 Nos.
64.	Ventilators		1 No.
65.	Simple sterilization equipment		4 Nos.
66.	U-V/ IR lamps		4 each
67.	C.R.O (20 MHz)/ DSO	2 Channel, DSO of 20MHZ Bandwidth	5 Nos.
68.	Digital storage oscilloscope (20MHz)		4 Nos.
69.	Digital Function Generator	3 MHz Function generator	5 Nos.
70.	Power supply 0-30V/D.C.	As req	2 Nos.
71.	Power supply 0-300V/D.C		2 Nos.
72.	Strain gauge with load cell		2 Nos.
73.	Allen Key set		2 Nos.
74.	SWG		2 Nos.
75.	Linear IC trainer	Latest as required	01 No.
76.	Personnel computer with latest configuration	CPU: 64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:- 4 GB DDR-III or Higher, Wi- Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch.) Licensed Operating System and Antivirus compatible with trade related software or Latest	4 Nos.

77.	Laser / Multifunctional Printer		1 No.
78.	Microcontroller Trainer Kit	Latest as required	2 Nos.
79.	Digital I.C. trainer	Latest as required	4 Nos.
80.	Needle destroyer		1 No.
81.	Infusion pump		1 No.
82.	Syringe Pump		1 No.
83.	Ultrasound Doppler	(MOU) any hospital / Industries	1 No.
84.	X-Ray	(MOU) any hospital / Industries	1 No.
85.	CT Scan	(MOU) any hospital / Industries	1 No.
86.	MRI	(MOU) any hospital / Industries	1 No.
87.	Dialysis	(MOU) any hospital /Industries	1 No.
88.	Oxygen concentrator		1 No.
89.	CPAP		1 No.
90.	BIPAP		1 No.
91.	Nebulizer		1 No.
92.	Flow meter		1 No.
93.	Photo Therapy		1 No.
94.	Radiant warmer		1 No.
95.	Biolyes Operator		1 No.
96.	OT Table	Hydraulic	1 No.
97.	ICU cot		1 No.
98.	Phone cardiogram		1 No.
99.	Traction machine		1 No.
100.	EMG		1 No.
101.	TMT		1 No.
102.	Logic Probes		4 Nos.
103.	Frequency counter		1 No.
104.	A.F./R.F. Oscillator		2 Nos.
105.	Human body charts		2 Nos.
106.	Microscope		2 Nos.
107.	Analytical Balance		2 Nos.
108.	Centrifuge		2 Nos.
109.	Water Bath		1 No.
110.	Hot air oven		2 Nos.
111.	Incubator		2 Nos.
112.	Spectrophotometer		1 No.
113.	Colorimeter		1 No.
114.	PH meter		2 Nos.
115.	Flame Photometer		1 No.
116.	Blood gas analyzer	(MOU) any hospital / Industries	1 No.
117.	Short Wave Diathermy		2 Nos.
118.	B.P. Apparatus (Sphygmo maNometer)		4 No.
119.	Stethoscope		4 Nos.

120.	Wax bath		2 Nos.
121.	Muscle Stimulator		2 Nos.
122.	Suction apparatus		1 No.
123.	Fetal monitor		1 No.
124.	Refrigeration and Air conditioning Tutor		1 No.
125.	Air conditioners		As Required
126.	Earth leakage tester		1 No.
127.	Blood cell counter		1 No.
128.	Consumables a. Electrical fuses - Assorted/ different types b. Thermal paper roll for ECG recorder. c. Conductivity gel for ECG disposable skin surface electrodes. d. Chemicals for pathology lab e. Medicated cotton. f. No clean flux g. Solder wire different gauges h. 75% IP solution i. Desoldering wick j. Cat 6 cable k. Rj45 Connector & Boot Caps l. BNC & DC connector m. Heat shrink sleeves set n. Zip ties o. Velcro tapes p. Electrical Tape q. SVG Connector r. Various Connectors		As required
129.	SMD Kit - Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety Norms using proper tools/setup.	SMD component identification board with SMD Components Resistors, Capacitors, Inductors, Diodes, Transistors & IC's packages. Proto boards with ready made solder ads for various SMD Components. SMD Soldering Jig.	1 No.
130.	Electronics servicing/Maintenance work station Test various electronics	Latest as required	1 No.
131.	Optical Fiber Communication Trainer kit	Latest as required	1 No.
132.	Advanced Microcontroller Trainer kit	Latest as required	1 No.
133.			
C. Shop Floor Furniture and Materials - For 2 (1+1) units No additional items are required			

134.	Instructor's table		1 No
135.	Instructor's chair		2 Nos
136.	Metal Rack		4 Nos
137.	Lockers with 16 drawers	standard size	2 Nos
138.	Steel Almirah		2 Nos
139.	Smart Panel		1 Nos

ANNEXURE - II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

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ANNEXURE-III

ABBREVIATIONS	
CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्