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

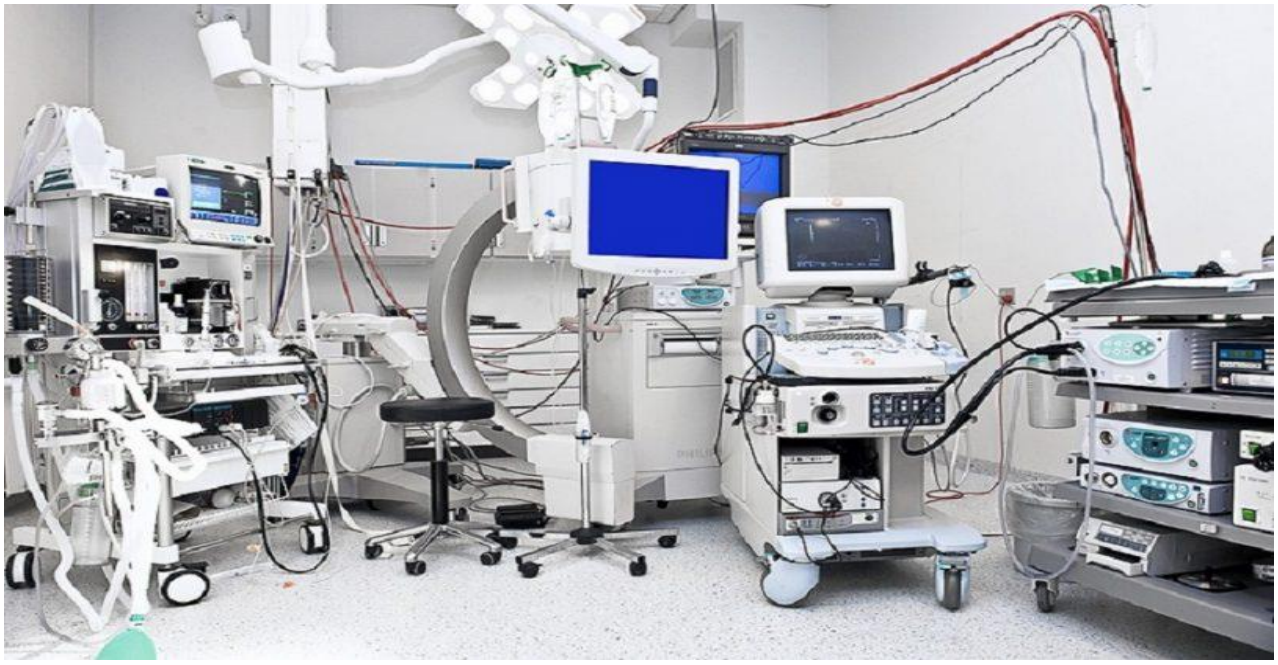
COMPETENCY BASED CURRICULUM

TECHNICIAN MEDICAL ELECTRONICS

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4



SECTOR – ELECTRONICS AND HARDWARE

Directorate General of Training

TECHNICIAN MEDICAL ELECTRONICS

(Engineering Trade)

(Revised in March 2023)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL – 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata – 700 091

www.cstaricalcutta.gov.in

CONTENTS

1. COURSE INFORMATION

During the two-year duration of Technician Medical Electronics trade a candidate is trained on professional skill, professional knowledge and Employability skill related to job role. 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 equipments 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 variantsand 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 (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.

Trainee needs to demonstrate broadly 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 repair & maintenance work.
- Check the job with circuit diagrams/components as per drawing for functioning, diagnose and rectify faults in the electronics components/module.
- Document the technical parameters in tabulation sheet related to the task undertaken.

2.2PROGRESSION 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: -

S 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**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150
5	Optional Courses (10th/ 12th class certificate along with ITI certification or add on short term courses)	240	240

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification or add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his 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.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 Controller of examinations, 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 the basis for setting question papers for final assessment. The examiner during final examination will also check the 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 percent for Trade Practical and Formative assessment is 60% &for all other subjects is 33%.

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 some of 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
- Computer based multiple choice question examination
- Practical Examination

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 for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate	• Demonstration of good skill in the use

should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	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.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• 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.
(c) Marks in the range of more than 90% to be allotted during assessment	
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

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, anaesthesia 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:

i) ELE/N0102
ii) ELE/N7812
iii) ELE/N7202
iv) ELE/N4610
v) ELE/N9447
vi) ELE/N9448
vii) ELE/N9449
viii) ELE/N9450
ix) ELE/N9472
x) ELE/N9475
xi) ELE/N9453
xii) ELE/N9454
xiii) ELE/N9455
xiv) ELE/N9456
xv) ELE/N9457
xvi) ELE/N9458
xvii) ELE/N9405
xviii) ELE/N9460
xix) ELE/N9409
xx) ELE/N9413
xxi) ELE/N9463
xxii) ELE/N9464
xxiii) ELE/N9465
xxiv) ELE/N9495
xxv) ELE/N9467
xxvi) ELE/N9468
xxvii) ELE/N9469
xxviii) PSS/N9401
xxix) PSS/N9402

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/N0102, ELE/N7812, ELE/N7202, ELE/N4610, ELE/N9447, ELE/N9448, ELE/N9449, ELE/N9450, ELE/N9472, ELE/N9475, ELE/N9453, ELE/N9454, ELE/N9455, ELE/N9456, ELE/N9457, ELE/N9458, ELE/N9405, ELE/N9460, ELE/N9409, ELE/N9413, ELE/N9463, ELE/N9464, ELE/N9465, ELE/N9495, ELE/N9467, ELE/N9468, ELE/N9469, PSS/N9401, PSS/N9402
NSQF Level	Level-4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector 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	
1. Technician Medical Electronics Trade	B.Voc/Degree in Electronics/ BME/ Medical Electronics Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. OR 03 years Diploma in Electronics/ BME/ Medical Electronics from AICTE recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. OR NTC/NAC passed in the Trade of "Technician Medical Electronics" With three years' experience in the relevant field. **<u>Essential Qualification</u>:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) 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. However both of them must possess NCIC in any of its variants.***

2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA or any of its variants under DGT
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (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.
5. 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.

5.1LEARNING OUTCOMES

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/N0102)
2. Plan, estimate, assemble, install and test wiring system in hospital & CSSD department. (NOS: ELE/N9447)
3. Identify, install, test and operate different photo therapy equipments in Biomedical Sector. (NOS: ELE/N9448)
4. Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances. (NOS: ELE/N9449)
5. Operate and test clinical equipment/ instruments used in hospital. (NOS: ELE/N9450)
6. Test and service different batteries used in electronics applications and record the data to estimate the repair cost. (NOS: ELE/N9472)
7. Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety norms using proper tools/setup. (NOS: ELE/N7812)
8. Assemble simple electronics power supply circuit and test for functioning. (NOS: ELE/N9475)
9. Execute testing; evaluate performance and maintenance of sphygmomanometers. (NOS: ELE/N9453)
10. Verify characteristics of electronics, power electronics and Special Semiconductors circuits. (NOS: ELE/N9454)
11. Test various Medical gas plant operation using suitable care and safety. (NOS: ELE/N9455)
12. Test and operate different types of Physiotherapy Equipment's technique and general care. (NOS: ELE/N9456)
13. Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N7202)
14. Construct, test and verify the input/output characteristics of various analog circuits. (NOS: ELE/N7202)
15. Demonstrate the significance of different parts in the organization in the human body (Basics of Human Anatomy and Physiology). (NOS: ELE/N9457)
16. Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments. (NOS: ELE/N9458)
17. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result. (NOS: ELE/N9405)
18. Identify the working principles, Operation, general care of Clinical Lab Equipments.(NOS: ELE/N9460)
19. Read and apply engineering drawing for different application in the field of works. (NOS: PSS/N9401)

20. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

SECOND YEAR

21. Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger.(NOS: ELE/N7202)
22. Prepare fibre optic setup and execute transmission and reception. (NOS: ELE/N9409)
23. Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital department. (NOS: ELE/N4610)
24. Identify, test, service & program 8085 Micro-processor. (NOS: ELE/N9413)
25. Demonstrate ICU Department functions, equipments etc., calibration and basic human rating chart.(NOS: ELE/N9463)
26. Interpret the factors, tools and techniques affecting the medical terminology image quality.(NOS: ELE/N9464)
27. Demonstrate the functions of bio-medical Department. (NOS: ELE/N9465)
28. Identify, test, service and program Micro controller 8051. (NOS: ELE/N9495)
29. Demonstrate various operations and functions of Dental Chair & Dental X-Ray. (NOS: ELE/N9467)
30. Execute the operation of different of Imaging Equipments used in hospitals. (NOS: ELE/N9468)
31. Recognize development of a Bio-medical Department in a hospital. (NOS: ELE/N9469)
32. Read and apply engineering drawing for different application in the field of works. (NOS: PSS/N9401)
33. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

6. 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/N0102)	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. 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.
5. Operate and test clinical equipment/ instruments used in hospital. (NOS: ELE/N9450)	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.
6. Test and service different batteries used 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. Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety norms using proper tools/setup. (NOS: ELE/N7812)	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 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.
	Identify, solder and desolder the PGA components.
8. 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 rectifier 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.
9. 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.

10. 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.
11. 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.
12. 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.
13. Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N7202)	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.
14. Construct, test and verify the input/output characteristics of various analog circuits. (NOS: ELE/N7202)	Ascertainandselecttools andinstrumentsforcarryingoutthe 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.
15. 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.
16. Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments. (NOS: ELE/N9458)	Ascertain and select tools, material for the job and make this 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.
17. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	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.

(NOS: ELE/N9405)	Construct and test different configurations of 555 IC e.g. astable, monostable, bi-astable and VCO circuits.
18. 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.
19. Read and apply engineering drawing for different application in the field of work. (NOS:PSS/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.
20. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:PSS/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
21. Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger. (NOS: ELE/N7202)	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.
22. 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.
23. Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital department. (NOS: ELE/N4610)	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.
24. Identify, test, service & program 8085 Micro-processor. (NOS: ELE/N9413)	Interpret the procedure as per manual of Micro-processor 8085.
	Identity various ICs & their functions on the given Micro-processor 8085 Kit.
	Identify the address range of RAM & ROM.
	Write data into RAM & observe its volatility.
	Identify the port pins of the controller & configure the ports for Input & Output operation.
	Demonstrate entering of simple programs, execute & monitor the results.

25. 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.
26. 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.
27. 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.
28. Identify, test, service & program Micro controller 8051. (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.
	Check input / output ports and their configuration.
	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.
29. 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.
30. 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.
31. 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).
32. Read and apply engineering drawing for different application in the field of work. (NOS:PSS/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.
33. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:PSS/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS - TECHNICIAN MEDICAL ELECTRONICS			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	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.	EM Trade and its applicability in industries. Expectations of the Industry from trainees after the completion of the Trade. The skills to be acquired to become part of industry. Intro to Safety and measures to be taken to maintain the standards of safety of personnel working and the equipment. Different First aid mechanisms to rescue the effected by electric shocks or any physical injuries. Classification of cables according to gauge, core size, insulation strength, flexibility etc.
		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 type of soldering guns, relate temperature with wattage's, types of tips. Solder materials and their grading. Use of wax and other materials. Selection of a soldering gun for specific requirement. Soldering and De-soldering stations and their specifications.

		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 energy meter board.	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	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. 21. Test and check rating of different type of switches, sockets, 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 principle of PMMC type ammeter. Conversion of ammeter into voltmeter. Working principles and study of Block diagrams / Schematic diagrams of Analog Multimeter. Working principles and study of Block diagrams / Schematic diagrams of Digital Multimeter.
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify, install, test and operate different photo therapy equipments in Biomedical Sector.	22. Install electrical line 110 V. 23. Install and test using light fitting with reflector for direct and indirect lighting. 24. Test and identify different groups wattage of lamps in series for specified voltage.	Different type of electrical cables and their specifications. Different types of Cables used in the electronic industries. Different types of Cables used in the electronic industries. Ohm's law and its variables.

		25. Practice installation of various lamps e.g. fluorescent tube, Tub light/CFL etc. 26. Identify different types of analog & digital multimeters parts, its function and operation. 27. Practice on various analog and digital measuring instruments. 28. Practice on measuring instruments in single and three phase circuits.	Different types of UVB, Halogen, Tube lights, UV, Lights, IR lights, CFL Photo Therapy Working principles and study of Block diagrams / Schematic diagrams of Digital LCR meter.
Professional Skill 50 Hrs; Professional Knowledge 15 Hrs	Plan, carry out installation, fault detection and repairing of Hospital Electrical appliances.	29. Wire up the consumers main board with ICDP switch and distribution house box. 30. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. 31. Practice wiring of hospital building as per IE rules. 32. Practice on wiring of UPS and inverter diagram, test/fault detection of domestic and industrial wiring installation and repair.	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
		33. Wire up the OPD, general ward and ICU main board with ICDP switch and distribution fuse box. 34. Estimate the cost/bill of material for wiring of OPD, general ward and ICU. 35. Practice wiring diagram of OPD as per IE rules. 36. Practice wiring diagram of general ward as per IE rules. 37. Practice wiring diagram of	contactor contact currents, protection to contactor s and high current applications

		ICU as per IE rules. 38. Practice wiring diagram of minor OT as per IE rules. 39. Install various light fitting with reflectors for direct and indirect lighting of OT. 40. Practice test/fault detection of minor OT and OT wiring installation and repair.	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Test and service different batteries used in electronics applications and record the data to estimate the repair cost.	41. Identify the rated various types of cells output voltage and Ah capacity of given battery. 42. Practice on grouping of cells for specified voltage and current under different conditions and care. 43. Measure the specific gravity of the electrolyte using hydrometer. 44. Practice on routine, care/maintenance and testing of batteries. 45. Measure the resister value by colour code and verify the same by measuring with multimeter. 46. Identify the different type of passive components with colour code SMD and DIP package. 47. Identify the different type of active components of SMD and DIP package. 48. Identify different types of transformers and test. 49. Verify terminals, identify HT and LT side and calculate transformation ratio of single phase transformers.	**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 (07 hrs)

		50. Determine voltage regulation of single phase transformer at different loads. 51. Identify different types of auto transformers and test.	
Professional Skill 100 Hrs; Professional Knowledge 15 Hrs	Operate and test clinical equipment/ instruments used in hospital.	52. Dismantle and assemble electrical/electronic parts of various electronic appliances e.g. Iron box, Radiant warmer, Auto cutoff multi coil, nebulizer, AC & DC motor. 53. Service and repair of electrical/electronic irons. 54. Prepare and test of silicon pipe sealer. 55. Measure and test of clinical sterilizer. 56. Practice testing/fault detection of autoclave (with & without auto cutoff multi coil). 57. Plan and prepare of incubator. 58. Service and repair of radiant warmer. 59. Prepare and mount for setup baby clinical incubator. 60. Prepare and mount the proper nebulizer. 61. Identify different terminals and parts of electrical wiring diagram for water pump with auto controller. 62. Identify parts and terminals of different types of single phase AC motors. 63. Install, connect and determine performance of	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 Specifications, conventional speed control methods and applications. Types of DC motors and their applications.

		single phase AC motors. 64. Identify parts and terminals of different types of single phase DC motors. 65. Install, connect and determine performance of single phase DC motors. 66. Connect, set proper direction of rotation and run. 67. Identify and test permanent magnet DC motor. 68. Identify and test brush less DC motor. 69. Service and repair of mixer and fan. 70. Install, connect and determine performance of centrifuge.	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Identify, place, solder, desolder and test different SMD discrete components and IC packages with due care and following safety norms using proper tools/setup.	71. Practice soldering on different electronics components, IC bases and PCB's. 72. Practice desoldering using pump and wick. 73. Join the broken PCB track and test. 74. Identification of 2,3,4 terminal SMD components. 75. Desolder the SMD components from the given PCB. 76. Solder the SMD components in the same PCB. 77. Check for cold continuity of PCB. 78. Identify various connections and setup required for SMD soldering	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

		station. 79. Identify different types of Si &Ge diodes and their specifications. 80. Measure the voltage and current through a diode in a circuit and verify its forward characteristics. 81. Measure the voltage and current through a Zener diode in a circuit and verify its forward characteristics.	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Assemble simple electronics power supply circuit and test for functioning.	82. Operate different controls on the CRO front panel and observe the function of each control. 83. Measure DC voltage, AC voltage, time period using CRO sine wave parameters. 84. Construct and test a half wave, full wave and bridge rectifier circuit with and without filter 85. Construct and test voltage doubler's, tripler's and quadruple's. 86. Test different regulated power supply and measure output voltage with load. 87. 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 07 Hrs	Execute testing; evaluate performance and maintenance of sphygmomanometers.	88. Identify terminals verify the rubber cuff which is apply to the arms. 89. Construct and test sphygmomanometer for measuring blood	**Sphygmomanometer:** Names, Types (manual and digital), Operation, significance

		pressure. 90. Execute planning setup for blood pressure monitor examination. 91. Determine the thermal effect of electric current. 92. Measure and test of stethoscope. 93. Construct and test of BP operator/ Sphygmomanometers.	
Professional Skill 75 Hrs; Professional Knowledge 15 Hrs	Verify characteristics of electronics, power electronics and Special Semiconductors circuits.	94. Identify different types of transistors and their specification. 95. Measure the voltage and current of different types of transistors in a circuit and verify its characteristics and measure Alpha, Beta and Gama. 96. Construct and test fixed bias, ammeter bias and voltage divider bias of a transistor amplifier circuit. 97. Identify different types of photo diodes, tunnel diodes, variactor diodes and lascer diodes and their specifications. 98. Measure the voltage and current through a photo diode in a circuit and verify its characteristics. 99. Construct a circuit to switch a lamp load using photo diode. 100. Measure the voltage and current through a tunnel diode in a circuit and verify its characteristics. 101. Measure the voltage and	Transistor biasing circuits and stabilization techniques. 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

		current through a variactor diode in a circuit and verify its characteristics. 102. Measure the voltage and current through a LASCR diode in a circuit and verify its characteristics. 103. Identify different types of DIAC, TRIAC, SCR, SCS, SBS & SUS and their specification. 104. Measure the voltage and current through DIAC & TRIAC in different circuits and verify its characteristics. 105. Measure the voltage and current through SCR & SCS in different circuit and verify its characteristics. 106. Measure the voltage and current through SBS & SUS in different circuits and verify its characteristics. 107. Identify Different types of UJT, PUT, FET, IGBT, GTO and MOSFET. 108. Measure the voltage and current through UJT & PUT in different circuits and verify its characteristics. 109. Measure the voltage and current through FET & IGBT in different circuits and verify its characteristics. 110. Measure the voltage and current through GTO & MOSFET in different	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, 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 (15 hrs)

		circuits and verify its characteristics.	
Professional Skill 25 Hrs; Professional Knowledge 03 Hrs	Test various Medical gas plant operation using suitable care and safety.	111. Identify the different gas plant safety precaution while working. 112. Measure & Test of Hospital Oxygen o_2 gas plant. 113. Construct & Test of Hospital nitrous (n_2o) plant.	Introduction to safety precaution for different gas plants, Hospital Oxygen o_2 gas plant, Hospital nitrous (n_2o) plant. Hospital Gas Plant Layout
Professional Skill 25 Hrs; Professional Knowledge 04 Hrs	Test and operate different types of Physiotherapy Equipment's technique and general care.	114. Identify different types of diathermy and their system. 115. Operate & Test of shot wave diathermy. 116. 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 25Hrs; Professional Knowledge 07 Hrs	Assemble, test and troubleshoot various digital circuits.	117. Familiarize digital IC's. 118. Identify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them. 119. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. 120. Construct and verify the truth table of all the gates using NAND and NOR gates. 121. Use digital IC tester to test the various digital ICs (TTL and CMOS). 122. Verify the switching circuits of all logic circuit with the help of Boolean equation. 123. Verify the Truth table for	Difference between analog and digital signals, Iogic levels of TTL and CMOS Introduction to Digital Electronics, Number systems and codes Digital code: binary, octal, Excess 3 code, grey code, BCD code, ASCII code and code conversions, Logic Gates and their truth tables, 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

		De-Morgans first law and second law and from the result draw the logic gates.	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 07 Hrs	Construct, test and verify the input/output characteristics of various analog circuits.	124. Construct & Test RC coupled Amplifier by using single stage. 125. Construct & Test RC coupled Amplifier using double stage. 126. Construct & Test of transformer Coupled Amplifier. 127. Construct & Test of class B Push pull Amplifier. 128. Construct & Test Audio Amplifier. 129. Construct & Test FET Common-source Low frequency amplifier. 130. 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 30 Hrs; Professional Knowledge 07 Hrs	Demonstrate the significance of different parts in the organization in the human body (Basics of Human Anatomy and Physiology).	131. Identify Different parts of the human Body. 132. Identify the role of the main components and features of the human body cell. 133. Outline the structure of the main tissues of the human body. 134. Identify the functions of all the main organs of human body.	The human body cell is comprised of several organelles. Each has a specific role in the life 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 65 Hrs; Professional Knowledge 07 Hrs	Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments.	135. Test biomedical sensors. 136. Measure temperature of a lit fire using a Thermometer and record the readings referring to data chart. 137. Identify different types of Electrodes. 138. Identify the electrodes used in medical devices.	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. Biomedical Sensors, Types, classification, construction details, measurement output, signals of biomedical sensors.
Professional Skill 120 Hrs; Professional Knowledge 15 Hrs	Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	139. Construct & Test by using IC 741 op-amp. 140. Construct & Test Mono stable Multi-vibrator by using IC 555. 141. Construct & Test Bi stable Multi-vibrator	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

		using IC 555. 142. Construct & Test of VCO (V to F converter) using IC 555. 143. Construct and test Schmitt trigger using IC 555. 144. Construct and test Ramp generator using IC 555. 145. Construct and test time delay relay using IC 555. 146. Construct and test water level controller using IC 555. 147. Construct and test 555 timers as pulse width modulator.	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.
		148. Pin Identification of OP-Amp LM741, TLC274C, LF356, LM324. 149. Construct & Test of Inverting Amplifier using Op –Amp. 150. Construction & Testing of Non-Inverting Amplifier using Op –Amp. 151. Construct & Test of Summing Amplifier using Op –Amp. 152. Construction & Testing of Differential Amplifier using Op –Amp. 153. Construct & Test of Logarithmic Amplifier using Op –Amp. 154. Construct & Test of Low - Pass Filter using Op – Amp. 155. Construct & Test of High - Pass Filter using Op – Amp. 156. Construct & Test of Band - Pass Filter using Op –	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, Comparater 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,

		Amp. 157. Construction & Testing of RC Phase-shift Oscillator using Op-Amp. 158. Construct & Test of Wien Bridge Oscillator using Op-Amp. 159. Construct & Test of voltage to current converter using Op-Amp. 160. Construct & Test current to voltage converter using Op-Am. 161. Construct & Test Peak Detector using Op-Amp. 162. Construct & Test Precision Rectifier using Op-Amp. 163. Construct & Test Bio-medical Instrumentation Amplifier using Op –Amp. 164. Construct & Test Basic Triangular & Square Wave Generator using Op-Amp.	Triangular & Square Wave Generator using Op-Amp (08 hrs)
Professional Skill 100 Hrs; Professional Knowledge 13 Hrs	Identify the working principles, Operation, general care of Clinical Lab Equipments.	165. Identify various ABD kits peripherals and connect it to the system of Blood Group using. 166. Perform and execute PH Meter. 167. Understand how to prepare and measure calorimeter digital / analog. 168. Practically understand how to use Spectrophotometer. 169. Practice and perform sugar testing using Quick check (TECO). 170. 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, Densitometry, Ph meters, Semi auto analyzers, Blood, cell counter, Blood gas analyzer.

		and handling Semi Auto Analyzer. 171. Perform how to calculate Blood Cell counter. 172. Practically understand how to measure uro meter. 173. Select and perform the appropriate syringe Destroyer & syringe Pump. 174. Prepare the room apparatus and instrument for electro surgical Unit (surgical cut and coagulation).	
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge ED-40 Hrs.	Read and apply engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instrument – (02 Hrs.) • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Free hand drawing of–(06 Hrs.) • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools. Drawing of Geometrical figures: (04 Hrs.) • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke Symbolic representation– (04 Hrs.) • Different Electronic symbols used in the related trades Reading of Electronic Circuit Diagram. (14 Hrs.) Reading of Electronic Layout drawing. (10 Hrs.)	
WORKSHOP CALCULATION & SCIENCE: (36 Hrs)			
Professional Knowledge ED-40 Hrs. WCS-36 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and	**Unit, Fractions (04 Hrs.)** 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, substraction, multiplication & division. Decimal fractions - Addition, subtraction, multiplication & division.	

	explain basic science in the field of study.	Solving problems by using calculator. **Square root, Ratio and Proportions, Percentage (06 Hrs.)** 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. **Material Science (04 Hrs.)** Types metals, types of ferrous and non ferrous metals Introduction of iron and cast iron **Mass, Weight, Volume and Density (02 Hrs.)** Specific gravity **Heat & Temperature and Pressure (04 Hrs.)** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals. Scales of temperature, Celsius, Fahrenheit, Kelvin and conversion between scales of temperature. **Basic Electricity (12 Hrs.)** Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC,DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel. Ohm's law, relation between V.I.R & related problems. Electrical power, energy and their units, calculation with assignments. Magnetic induction, self and mutual inductance and EMF generation Electrical power, HP, energy and units of electrical energy **Trigonometry (04 Hrs.)** 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)**	**Professional Knowledge (Trade Theory)**
Professional Skill 40 Hrs; Professional Knowledge 10 Hrs	Detect the faults and troubleshoot SMPS, UPS and Inverter and Battery charger.	175. Identify various input and output sockets/connectors /indicators on the given UPS. 176. Make individual connections between batteries of battery stack and test for healthiness of batteries on stack. 177. Connect battery stack to the UPS. 178. Make load test to measure backup time. 179. Identify isolator transformer, inverting transformer and control transformers. 180. Adjust charging current according to number of batteries. 181. Identify various circuit boards and monitor voltages at vital test points. 182. Identify the charging section and set the charging current according to backup. Perform a load test to UPS. 183. Identify the semiconductor power modules and measure voltages. 184. Maintain, Service and troubleshoot Battery charger and UPS.	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, alarm circuits,

			Indicator circuits.
Professional Skill 50 Hrs; Professional Knowledge 10 Hrs	Prepare fibre optic setup and execute transmission and reception.	185. Cutting, cleaning and preparing of fibre cable for splicing. 186. Splicing of OFC using splicing machine. Testing of OFC using OTDR. 187. Measure propagation, return and bending losses etc. 188. Measure optical signal power using optical power meter. 189. Test the optical fibre cable using Visual Fault locator. 190. Make optical fibre setup to transmit and receive analog.	Intro to optical fiber as a transmission media, its advantages over other media. Working principle of transmitter and receiver in fiber optic communication. Application and advantages of fiber optic communication properties of optic 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 10 Hrs	Install, test and maintain a CCTV system and configure the system for surveillance function in Hospital department.	191. Identify different CCTV components. 192. Draw, trace or follow the CCTV setup of any commercial installation. 193. Identify the strategic locations for the installation of camera. 194. Identify various indicators, cables, connectors and ports on the computer cabinet. 195. Demonstrate various parts of the system unit and motherboard components. 196. Identify various computer peripherals and connect it to the system. 197. Install a Printer driver software and test for	Introduction of CCTV, computer hardware, software's installation, multiple frame split in digital TV, restore old memories, format new & old hard disk.

		print outs 198. Install antivirus software, scan the system and explore the options in the antivirus software. 199. Install MS office software. 200. Connect network connectivity for backup recovery. 201. Prepare multiple frame split. 202. Identify LCD Display module and its decoder/driver ICs	
Professional Skill 100 Hrs; Professional Knowledge 15 Hrs	Identify, test, service &program 8085 Micro-processor.	203. Identify various ICs & their functions on the given Microprocessor Kit. 204. Measure the wave forms on different ICs and IC pins of the processor. 205. Monitor the clock frequency. 206. Write down the address range of different memory ICs and peripheral ICs on the kit. 207. Enter data to different memory locations in RAM. 208. Enter simple programs and execute using assembly language. 209. Use assembler to assemble the programs and load them for execution by the processor. 210. Use assembler to load them for execution by the processor. 211. Program to Blink an LED using port pins of 8255.	Draw schematic diagrams for Microprocessor, Draw schematic diagrams for Micro-controller based circuits., Intro to 8085 Microprocessor, Architecture, pin details and Bus System of the processor Function of different ICs such as decoders Function of different ICs such as buffers, latches etc used with 8085 processor Interfacing to memory ICs RAM, PROM / EEPROM Interfacing different peripheral ICs such as 8255. Instruction set covering data transfer, logical, Instruction set covering data transfer, Arithmetic. Instruction set covering data transfer, serial communication etc.

		212. Program to Control a relay using the port pins of 8255. 213. Program to read the data from memory to sequentially ON the LEDs.	
Professional Skill 50 Hrs; Professional Knowledge 15 Hrs	Demonstrate ICU Department functions, equipments etc., calibration and basic human rating chart.	214. Plan and prepare of Kidney chart, eye chart, ear chart, Brain chart. 215. Identify the internal procedure of heart chart, blood circulatory system. 216. Practice and perform the skeletal system chart, respiratory system chart, nerve system chart, digestive system chart. 217. 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 Instrumentation system.
Professional Skill 75 Hrs; Professional Knowledge 26 Hrs	Interpret the factors, tools and techniques affecting the medical terminology image quality.	218. Perform how to calculate Pulse Oximeter. 219. Perform how to prepare an EMG. 220. Practice and perform the method of patient care and handling ECG. 221. Plan patient setup for EEG & ERG. 222. Perform techniques of applications of Multi-Para monitor. 223. Plan and perform the care of Ultrasound Doppler equipments. 224. Plan patient setup for Fetal Monitor, Infusion Pump & Syringe Pump. 225. 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	Demonstrate the	273. Identify & test of Pulse	Elements of Intensive-Care

Skill 100 Hrs; Professional Knowledge 26 Hrs	functions of bio-medical Department.	Oximeter, EMG, ECG different controls of the related equipments. 274. Identify calibration 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.	Monitoring, Patient monitoring displays, Defibrillators, Pacemakers, EMG, EEG, Monitors: Video 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, Respirators, Humidifiers, Aspirators, Surgical diathermy.
Professional Skill 75 Hrs; Professional Knowledge 20 Hrs	Identify, test, service & program Micro controller 8051.	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.	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

		285. Use 8051 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 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.	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 compilers for 8051 Micro-controllers. 8052 and its difference with 8051. (20 hrs)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	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	Different components of Dental X-ray machine. Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits

		disassembling of chair & compressor. 296. Assembling and disassembling of X-Ray	
Professional Skill 150 Hrs; Professional Knowledge 55 Hrs	Execute the operation of different of 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 & 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.	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, Screens, Darkroom system & Procedure, Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits, Dental X-ray machine. CT Scanner, MRI, mammography, Bronchoscope

		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 partsGeneral fault finding of Bronchoscope.	
Professional Skill 75 Hrs; Professional Knowledge 26 Hrs	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 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.	Role of Biomedical Engineer, record maintenance of Department, NBEA license (National Biomedical Engineers Association. MCEBTI. Bangalore, Biomedical engineers should have NTC 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), 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).
ENGINEERING DRAWING: (40 Hrs.)			
Professional Knowledge ED-40 Hrs.	Read and apply engineering drawing for different application in the field of work.	• Reading of Electronics Sign and Symbols.(04 Hrs.) • Sketches of Electronics components. (06 Hrs.) • Reading of Electronics wiring diagram and Layout diagram. (06 Hrs.) • Drawing of Electronics circuit diagram. (12 Hrs.) Drawing of Block diagram of Instruments & equipment of trades. (12 Hrs.)	
WORKSHOP CALCULATION & SCIENCE: (20 Hrs)			
Professional Knowledge WCS-20 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Algebra, (08 Hrs.)** Addition, Subtraction, Multiplication & Divisions. Algebra– Theory of indices, Algebraic formula, related problems. **Estimation and Costing (12 Hrs.)** Simple estimation of the requirement of material etc., as applicable to the trade. Problems on estimation and costing.	
Project Work/ Industrial Visit **Broad areas:** a. Draw and identify & test of pulse oxymeter, EMG, ECG different controls of related equipments. b. Identify various ICs and their functions on the given microcontroller kit. c. Write a programme to use on board ADC and converter the analog voltage signal into digital value and store it memory. d. List the defect and symptom in the faulty SMPS. e. Connect battery and load to UPS and test to measure backup time of battery.			

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

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately inwww.bharatskills.gov.in/ dgt.gov.in

ANNEXURE-I

LIST OF TOOLS & EQUIPMENT			
TECHNICIAN MEDICAL ELECTRONICS(For batch of 24 Candidates)			
S 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	25 nos.
2.	Neon tester	500 V.	25 nos.
3.	Screw driver set	set of 5	25 nos.
4.	Insulated combination pliers	150 mm	25 nos.
5.	Insulated side cutting pliers	150 mm	25 nos.
6.	Long nose pliers	150 mm	25 nos.
7.	Soldering iron	25 W. 240 V.	25 nos.
8.	Electrician knife		25 nos.
9.	Tweezers	100mm	25 nos.
10.	Digital Multimeter		25 nos.
11.	Soldering Iron Changeable bits	15 W	25 nos.
12.	De- soldering pump		25 nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
13.	Fire extinguisher	Operate and test clinical equipment/ instruments used in hospital.	1 no.
14.	First aid kit		1 no.
15.	Artificial Respiration Chart		2nos.
16.	Rubber mat -	180x45x2.5 cm	3nos.
17.	Rubber gloves pair		1 set
18.	Steel ruler	30 cm	12 nos.
19.	Scriber	15 to 20 cm	4nos.
20.	Center Punch	10 cm	4 nos.
21.	Hammer cross pane	110 cm with handle	4 nos.
22.	Hammer ball pane	220 cm with handle	4 nos.
23.	Spanners double ended (metric system)	6mm to 19mm by 1.6mm	4 sets
24.	Spanners single ended	6mm to 25mm by 1.0m	2 sets
25.	Box spanner set of	(4-15) mm	1 set
26.	Mallet	8 oz	2 nos.
27.	Saw tenon	25 cm	2 nos.
28.	Chisel wood	15cm set of 6mmto 25mm	2 sets

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

69.	Thermo-couple meter R.F.	0-500mA	1no.
70.	D.C/A.C. Voltmeter	0-5V	4nos.
71.	D.C/A.C. Voltmeter	0-10V	4nos.
72.	D.C/A.C. Voltmeter	0-50V	4 nos.
73.	D.C/A.C. Voltmeter	0-500V	2 nos.
74.	D.C/A.C. Voltmeter	0-5KV	2 nos.
75.	Watt meter	5/250V	2 nos.
76.	Insulation Tester		2 nos.
77.	Service Oscillator		4 nos.
78.	Signal tracer		4 nos.
79.	A.F. Oscillator		4 nos.
80.	Micro Wave Diatherrmy		1no.
81.	Ultra sonic diathermy		1 no.
82.	ECG Recorder		2 nos.
83.	Bed side monitor		2 nos.
84.	Defibrillator		1 no.
85.	Pace maker		2 nos.
86.	60mA Mobile x-ray equipment		1 no.
87.	Dental x-ray equipment		1 no.
88.	Dental Chair		1 no.
89.	Portable Ultra sonic scanner	(MOU) any hospital / Industries	1 no.
90.	Surgical diathermy		1 no.
91.	Pulse Oximeter		1 no.
92.	Operation Theater lighting system		2 nos.
93.	Refrigerator		1 no.
94.	Baby incubator		1 no.
95.	Conductivity meter		2 nos.
96.	Ventilators		1 no.
97.	Simple sterilization equipment		4 nos.
98.	U-V/ IR lamps		4 each
99.	C.R.O (20 MHz)		5 nos.
100.	Digital storage oscilloscope (20MHz)		1 no.
101.	Function Generator		5 nos.
102.	Power supply 0-30V/D.C.		2 nos.
103.	Power supply 0-300V/D.C		2 nos.
104.	Strain gauge with load cell		2 nos.
105.	Allen Key set		2 nos.
106.	SWG		2 nos.
107.	Linear IC trainer		5 nos.
108.	Personnel computer with latest configuration	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi	4 nos.

		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.	
109.	Laser Printer		1 no.
110.	Micro Processor Trainer 8085 (with medical application card).		4 nos.
111.	Microcontroller Trainer Kit		2 nos.
112.	Digital I.C. trainer		4 nos.
113.	Needle destroyer		1 no.
114.	Infusion pump		1 no.
115.	Syringe Pump		1 no.
116.	Ultrasound Doppler		1 no.
117.	X-Ray	(MOU) any hospital / Industries	1 no.
118.	CT Scan	(MOU) any hospital / Industries	1 no.
119.	MRI	(MOU) any hospital / Industries	1 no.
120.	Dialysis	(MOU) any hospital / Industries	1 no.
121.	Oxygen concentration		1 no.
122.	CPAP		1 no.
123.	BIPAP		1 no.
124.	Nebulizer		1 no.
125.	Flow meter		1 no.
126.	Photo Therapy		1 no.
127.	Radiant warmer		1 no.
128.	Biolyes Operator		1 no.
129.	OT Table	Hydraulic	1 no.
130.	ICU cot		1 no.
131.	Phone cardiogram		1 no.
132.	Traction machine		1 no.
133.	Short wave Diathermy		1 no.
134.	EMG		1 no.
135.	TMT		1 no.
136.	Logic Probes		4 nos.
137.	Frequency counter		1 no.

138.	A.F./R.F. Oscillator		2 nos.
139.	Human body charts		2 nos.
140.	Microscope		2 nos.
141.	Analytical Balance		2 nos.
142.	Centrifuge		2 nos.
143.	Water Bath		1 no.
144.	Hot air oven		2 nos.
145.	Incubator		2 nos.
146.	Spectrophotometer		1 no.
147.	Colorimeter		1 no.
148.	PH meter		2 nos.
149.	Flame Photometer		1 no.
150.	Blood gas analyzer	(MOU) any hospital / Industries	1 no.
151.	Short Wave Diathermy		2 nos.
152.	B.P. Apparatus (Sphygmo manometer)		4 no.
153.	Stethoscope		4 nos.
154.	Wax bath		2 nos.
155.	Muscle Stimulator		2 nos.
156.	Suction apparatus		1 no.
157.	Fetal monitor		1 no.
158.	Refrigeration and Air conditioning Tutor		1 no. Each
159.	Air conditioners		As Required
160.	Earth leakage tester		1 no.
161.	Blood cell counter		1 no.
162.	DARK ROOM ACCESSORIES: a) Film viewer b) Cassettes c) Safe light d) Set of tanks for 18 liters capacity Stainless Steel (Master tank, Developer tank, separator tank and Fixer tank.) e) Hangers f) Stainless steel clips g) Lead Apron h) Lead protection screen	 (18" x 15") (12" x 15", 10" x 12"and 10" x 8") (12' x 15", 10" x 12" and 10" x 8") 4' x 6' with lead glass window	 1 no. 1 each 1 no. 1 set 1 each 1 Dozen 1 no. 1 no.
163.	Consumables a. Electricalfuses - Assorted/ different types b. Thermal paper roll for ECG recorder. c. Conductivitygel for ECG isposable skin surface electrodes. d. Chemicals for pathology lab		As required

	e. Medicated cotton.		

Note: -

1. Internet facility is desired to be provided in the class room.
2. *All the tools and equipment are to be procured as per BIS specification.*

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.

List of Expert Members participated/ contributed for finalizing the course curriculum of Technician Medical Electronics held at MCEBTI-ITI Bangalore from on 09th & 10th February' 2018			
S No.	**Name & Designation Sh/Mr./Ms.**	**Organization**	**Remarks**
Industry Expert			
1.	B. V. S. Sesha Chari, Director	CSTARI, Kolkata	Chairman
2.	Prasad Kumar, PA	Acee Tubes Pvt. Ltd., Chennai	Member
3.	Ramesh Nanduri, Executive	Golden Placock Hospital Biomedical Services, Vijayawada, A.P.	Member
4.	T. Madan, Executive	Accurex Biomedical	Member
5.	T. Kumar, Executive	V Care biomedical, J.C. Nagar, Bangalore-069	Member
6.	Laxmikant Kulkarni, Executive	Micrologics, Nagarbhavi, Bangalore	Member
7.	Hemanth. CR	Akash hospital, Bangalore	Member
8.	Satish. A	Colombia Asia Hospital, Yeshwanthpur	Member
9.	Dr. M. Nagaraju, Chairman	Suwaena-Nagaraju Educational Trust, Bangalore	Member
10.	H. Vishnu Parasarh, Proprieror	Total Water Solution (RO Plants)	Member
DGT & Training Institute			
11.	L. K. Mukherjee, DDT	CSTARI, Kolkata	Member
12.	Sridhar. P, Director	MCEBTI-ITI, Bangalore	Member
13.	S. Srinivasu, ADT	ATI-EPI, Hyderabad	Member
14.	N. Raghavendra, Principal	Sri Raghavendra I.T.C., Basaveshwarnagar, Bangalore-560079	Member
15.	Srikanth. P, TO	MCEBTI-ITI, Bangalore	Member
16.	Rohini. B.A.	-do-	Member
17.	Sahithya. R	-do-	Member
18.	R. Parameswarappa, Chairman	MCEBTI (R), Basaveshwara Nagar, Bangalore	Member
19.	Shankaramma, Trainer	-do-	Member
20.	Anitha. S, junior Tech. Officer	-do-	Member
21.	P.K. Bairagi, TO	CSTARI, Kolkata	Member

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