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

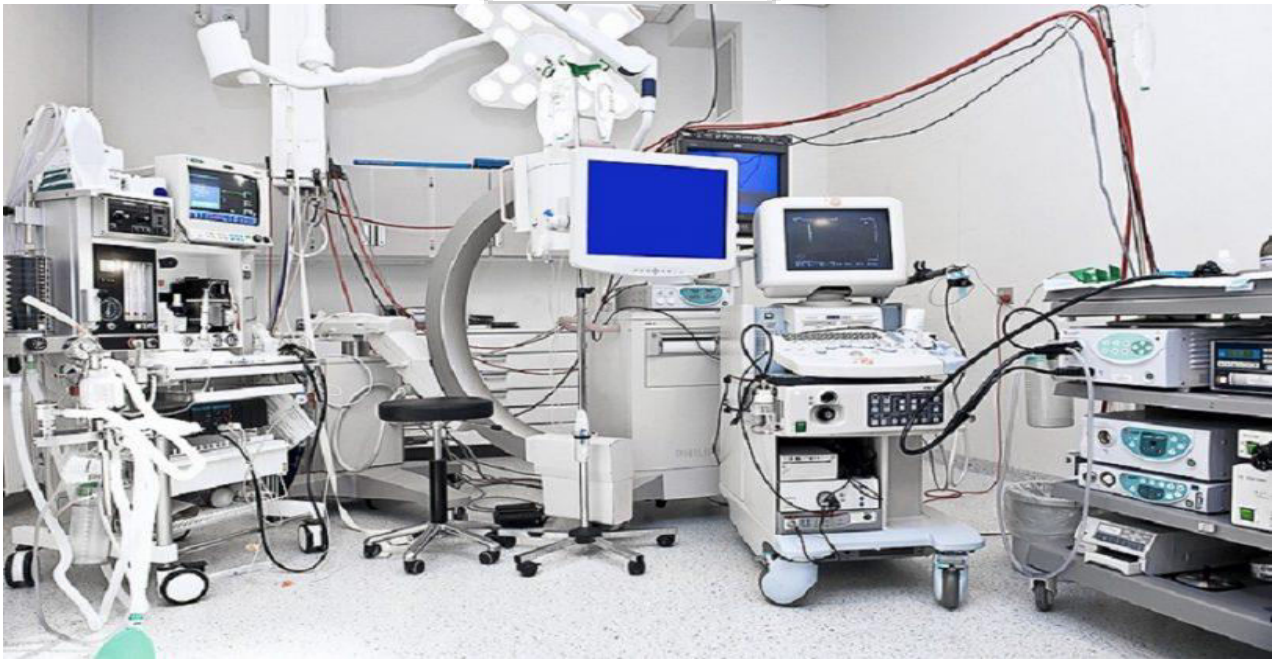
COMPETENCY BASED CURRICULUM

TECHNICIAN MEDICAL ELECTRONICS

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR – ELECTRONICS AND HARDWARE

Industrial Training Institute

Directorate General of Training

Skill India
कौशल भारत - कुशल भारत

TECHNICIAN MEDICAL ELECTRONICS

(Engineering Trade)

(Revised in 2018)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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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			
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CONTENTS

1. COURSE INFORMATION

During the two-year duration of Technician Medical Electronics trade a candidate is trained on professional skill, professional knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered related to the trade are categorized in four semester of six months duration each. The semester wise course coverage is categorized as below:-

Semester-I

In this semester 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. Estimate, assemble, install and test wiring system in hospital &CSSD department, Identify and test photo therapy equipments in biomedical devices. Skilling practice on 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. Practice soldering and de-soldering of various types of electrical components, fault detection and repairing of hospital electrical appliances . Plan, prepare, testing evaluate performance and maintenance of sphygmomanometers. Identify different types of Physiotherapy Equipments. Technique, test and operating system and general care of various medical gas plant operation using and their safety.

Semester-II

In this semester the candidate will able to construct, test and verify the input/output characteristics of various analog circuits. Assemble, test, verify the truth tables and trouble shoot various digital circuit. Understand the significance of different parts in the organization in the human body. The trainee will identify various operations of different Bio-medical sensors, 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. Understand the working principles, operation, general care of clinical lab equipments.

Semester – III

In this semester trainee will be able to detect the faults and troubleshoot SMPS, UPS, inverter and battery charger. They will also skilled with various modulation techniques to acquaint with fibre optic communication techniques transmission and reception. Trainees will be able to install a CCTV system and configure the system for surveillance function in hospital departments. Identify various functional blocks I/O ports of a 8085 micro processor system and run the basic program. Measurement voltage, frequency using CRO, operating storage oscilloscope. Trainees will be able to understand 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.

Semester – IV

In this semester the trainee will understand function of bio-medical department. Familiarize with the instruction set of 8051 micro controller kit and run the application. The trainees will be understood the operation and function of dental chair & dental x-ray. They will also operate different imaging equipments used in hospitals. The trainee will develop a bio-medical department in a hospital for main 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 National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes under NCVT 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 (04 semester) duration. It mainly consists of trade (skills and knowledge) and Core area (Workshop Calculation and science, Engineering Drawing and Employability Skills). After passing out the training programme, the trainee is being awarded National Trade Certificate (NTC) by NCVT having worldwide recognition.

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.

2.2 CAREER PROGRESSION PATHWAYS:

- 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.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two-years (04 semesters): -

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2266
2	Professional Knowledge (Trade Theory)	528
3	Workshop Calculation & Science	176
4	Engineering Drawing	264
5	Employability Skills	110
6	Library & Extracurricular activities	176
7	Project work	400
8	Revision & Examination	240
	Total	**4160**

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of the course and at the end of the training program as notified by the Government of India (GoI) from time to time. The employability skills will be tested in the first two semesters itself.

a) The **Internal Assessment** 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 template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NTC will be conducted by NCVT at the end of each semester as per the guideline of Government of India. The pattern and marking structure is being notified by Govt. of India 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

The minimum pass percentage for practical is 60% & minimum pass percentage of theory subjects is 40%. For the purposes of determining the overall result, 25% weightage is applied to the result of each semester examination.

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence based comprising the following:

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

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

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • Below 70% tolerance dimension 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) Weightage 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	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in

practices	the finish. • Little support in completing the project/job.
(c) Weightage 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% tolerance dimension 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

4. GENERAL INFORMATION

Name of the Trade	**TECHNCIAN MEDICAL ELECTRONICS**
NCO – 2015	3211.0200,3211.0501,3212.0701
NSQF Level	Level-5
Duration of Craftsmen Training	Two Years (4 Semesters having duration of six months each)
Entry Qualification	Passed 10th class examination under 10+2 system of education with Science & Mathematics
Unit Strength (No. Of Student)	20 (Max. supernumeraries seats: 6)
Space Norms	120 Sq. mtr (inclusive 10 sq. m dark room area)
Power Norms	2 KW
Instructors Qualification for	
1. Technician Medical Electronics Trade	Degree in Electronics / BME / Medical Electronics Engineering from recognized Engineering College/ university with one year post qualification experience in the relevant field. OR Diploma in Electronics/ BME/ Medical Electronics from recognized board of technical education with two years post qualification experience in the relevant field. OR NTC/NAC passed in the Trade With three years post qualification experience in the relevant field. **Desirable: -** Preference will be given to a candidate who completed Diploma/ B.Sc (MPC/E) and with one year HNTC in Medical Electronics. ***Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.***
2. Workshop Calculation & Science	Degree in Engineering with one year experience. **OR** Diploma in Engineering with two years experience. **Desirable:** ***Craft Instructor Certificate under NCVT.***
3. Engineering Drawing	***Degree in Engineering with one year experience.*** ***OR*** ***Diploma in Engineering with two years experience.*** ***OR*** ***NTC / NAC in the Draughtsman (Mechanical / Civil) with three years experience.***
4. Employability Skill	MBA OR BBA with two years experience OR Graduate in Sociology/

	Social Welfare/ Economics with Two years experience OR Graduate/ Diploma with Two years experience and trained in Employability Skills from DGT institutes. **AND** Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above. **OR** **Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes**
List of Tools and Equipment	As per Annexure – I

Distribution of training on Hourly basis: (Indicative only)

Total hours /week	Trade practical	Trade theory	Work shop Cal. &Sc.	Engg. Drawing	Employability skills	Extra-curricular activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

5. NSQF LEVEL COMPLIANCE

NSQF level for **Technician Medical Electronics** trade under CTS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

a. Process
b. professional knowledge
c. professional skill
d. core skill
e. Responsibility

The Broad Learning outcome of **Technician Medical Electronics** trade under CTS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study	A range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and Learning and some responsibility for other's works and learning.

6. LEARNING/ ASSESSABLE OUTCOME

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

6.1 GENERIC LEARNING OUTCOME

1. Apply safe working practices.
2. Comply environment regulation and housekeeping.
3. Interpret & use company and technical communication
4. Demonstrate basic mathematical concept and principles to perform practical operations.
5. Understand and explain basic science in the field of study including simple machine.
6. Read and apply engineering drawing for different application in the field of work.
7. Understand and apply the concept in productivity, quality tools, and labour welfare legislation in day to day work to improve productivity & quality.
8. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
9. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
10. Utilize basic computer applications and internet to take benefit of IT developments in the industry.

6.2 SPECIFIC LEARNING OUTCOME

Semester- I

11. Plan and execute soldering and de soldering of various electrical components like Lug's, tag's, clips, Eyelets & Plugs for electronics circuits.
12. Estimate, assemble, install and test wiring system in hospital& CSSD department
13. Photo therapy Equipment's in Biomedical Sector's
14. Select and perform measurements using analog/digital instrument.
15. Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances.
16. Test and service different batteries used in electronics applications and record the data to estimate the repair cost.
17. Test various electronics components using proper measuring instruments and compare the data using standard parameter.
18. Identify, place, solder and de solder and test different SMD discrete components and IC's package with due care and following safety norms using proper tools/setup.
19. Assemble simple electronics power supply circuit and test for functioning.

20. Execute testing; evaluate performance and maintenance of sphygmomanometers.
21. Verify characteristics of electronics, power electronics and Special Semiconductors circuits.
22. Test various Medical gas plant operation using suitable care and safety.
23. Test and operating different types of Physiotherapy Equipment's technique , and general care.

Semester- II

24. Assemble, test and troubleshoot various digital circuit
25. Construct, test and verify the input/output characteristics of various analog circuits.
26. Understand the significance of different parts in the organization in the human body (Basics of Human Anatomy and Physiology).
27. Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments.
28. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.
29. Understand the working principles , Operation , general care of Clinical Lab Equipments

Semester- III

30. Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger.
31. Prepare fibre optic setup and execute transmission and reception.
32. Understand and Maintain a CCTV system and configure the system for surveillance function in Hospital departments.
33. Identify Test , service & programs of Micro-processor 8085.
34. Understand the ICU Department functions, equipments etc calibration and basic human rating chart.
35. Interpret the factors, tools and techniques affecting the medical terminology image quality.

Semester- IV

36. Understand the functions of bio-medical Department.
37. Identify Test , service & programs of Micro controller 8051.
38. Understand the operation and functions of Dental Chair & Dental X-Ray.
39. Execute the operation of different of Imaging Equipment's used in hospitals.
40. Development of a Bio-medical Department in a hospital.

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING/ ASSESSABLE OUTCOME	
LEARNING / ASSESSABLE OUTCOME	**ASSESSMENT CRITERIA**
1. Apply safe working practices	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose off dangerous goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
2. Comply environment regulation and housekeeping ***in Hospitals***	2.1 Identify environmental pollution & contribute to the avoidance of instances of environmental pollution.
	2.2 Deploy environmental protection legislation & regulations
	2.3 Take opportunities to use energy and materials in an environmentally friendly manner
	2.4 Avoid waste and dispose waste as per procedure
	2.5 Recognize different components of 5S and apply the same in the working environment.
3. Interpret & use company and technical communication.	3.1 Obtain sources of information and recognize information.
	3.2 Use and draw up technical drawings and documents.
	3.3 Use documents and technical regulations and occupationally related provisions.
	3.4 Conduct appropriate and target oriented discussions with higher authority and within the team.

	3.5 Present facts and circumstances, possible solutions &use English special terminology.
	3.6 Resolve disputes within the team
	3.7 Conduct written communication.
4. Demonstrate basic mathematical concept and principles to perform practical operations.	4.1 Semester examination to test basic skills on arithmetic, algebra, trigonometry and statistics.
	4.2 Applications will be assessed during execution of assessable outcome and will also be tested during theory and practical examination.
5. Understand and explain basic science in the field of study including simple machine.	6.1 Semester examination to test basic skills on science in the field of study including friction, heat, temperature and simple machine.
	6.2 Applications will be assessed during execution of assessable outcome and will also be tested during theory and practical examination.
6. Read and apply engineering drawing for different application in the field of work.	6.3 Semester examination to test basic skills on engineering drawing.
	6.4 Applications will be assessed during execution of assessable outcome and will also be tested during theory and practical examination.
7. Understand and apply the concept in productivity, quality tools, and labour welfare legislation in day to day work to improve productivity & quality.	7.1 Semester examination to test the concept in productivity, quality tools and labour welfare legislation.
	7.2 Applications will be assessed during execution of assessable outcome.
8. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	8.1 Semester examination to test knowledge on energy conservation, global warming and pollution.
	8.2 Their applications will be assessed during execution of assessable outcome.
9. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal &	9.1 Semester examination to test knowledge on personnel finance, entrepreneurship.
	9.2 Their applications will be assessed during execution of assessable outcome.

societal growth.	
10. Utilize basic computer applications and internet to take benefit of IT developments in the industry.	10.1 Semester examination to test knowledge on basic computer working, basic operating system and uses internet services.
	10.2 Their applications will be assessed during execution of assessable outcome.

SPECIFIC LEARNING / ASSESSABLE OUTCOMES	
LEARNING/ ASSESSABLE OUTCOME	**ASSESSMENT CRITERIA**
SEMESTER-I	
11. Plan and execute soldering and de soldering of various electrical components like Lug's, tag's, clips, Eyelets & Plugs for electronic circuits.	11.1 Plan work in compliance with standard safety norms.
	11.2 Identify different types of Electrical components and test.
	11.3 Identify various types of lug's and test the polarity.
	11.4 Identify different types of tag's, clips, Eyelets & plug and test the polarity.
	11.5 Solder the given components
	11.6 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
12. Estimate, Assemble, install and test wiring system in Hospital & CSSD department	12. 1 Comply with safety & IE rules when performing the wiring.
	12. 2 Prepare and mount the energy meter board.
	12. 3 Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	12. 4 Draw and wire diagram of all CSSD equipment's
	12. 5 Identify the types of fuses their ratings and applications.
	12. 6 Identify the parts of a relay, MCB & ELCB and check its operation.
	12. 7 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.
	12. 8 Estimate the requirement for conduit wiring (3 phase) and wire up.
	12. 9 Estimate the materials and wire up the lighting circuit for a godown.
	12. 10 Estimate the materials and wire up a lighting circuit for a corridor in conduit.
	12. 11 Test, locate the fault and repair Hospital wiring installation.
13. Photo therapy equipment's in Biomedical sectors.	13. 1 Install light fitting with reflectors for direct and indirect lighting.
	13. 2 Assemble and connect single & twin tube fluorescent

		ligh
	13. 3	Connect, install and test the HPMV & HPSV lamp with accessories.
	13. 4	Prepare and test a decorative serial lamp set for 240 V using 6V bulb and flasher.
	13. 5	Install light fitting for show case window lighting.
	13. 6	Plan work in compliance with standard safety norms related with electrical illumination system.
14. Select and perform measurements using analog / digital instruments.	14. 1	Identify the type of electrical instruments.
	14. 2	Extend the range of MC voltmeter and ammeter.
	14. 3	Measure the frequency by frequency meter.
	14. 4	Measure the power and energy in a single & three phase circuit using wattmeter and energy meter with CT and PT.
	14. 5	Measure the value of resistance, voltage and current using digital multimeter.
	14. 6	Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.
15. Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances.	15.1	Plan work in compliance with standard safety norms related with domestic appliances.
	15.2	Service and Repair of calling bell/ buzzer/ Alarm.
	15.3	Service and repair an automatic iron.
	15.4	Repair and service of oven having multi-range heat control.
	15.5	Replace the heating element in a kettle and test.
	15.6	Service and repair an induction heater.
	15.7	Service and repair a geyser.
	15.8	Service and repair a mixer.
	15.9	Service and repair of washing machine.
	15.10	Install a Suction machine .
	15.11	Service and repair of table fan.
	15.12	Service, repair and install a ceiling fan.
16. Test and service different batteries used in electronics applications and record the data to estimate the repair cost.	16.1	Identify Tools and instruments for testing of batteries.
	16.2	Observe safety procedure during testing of batteries and work as per standard norms and company guidelines
	16.3	Identify the primary and secondary cells.
	16.4	Measure and test the voltages of the given cells/

		battery using analog / digital multimeter.
	16.5	Charging and discharging the battery.
	16.6	Maintain and estimate the repair cost of secondary battery.
	16.7	Use a hydro meter to measure the specific gravity of the secondary battery.
17. Test various electronics components using proper measuring instruments and compare the data using standard parameter.	17.1	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	17.2	Plan work in compliance with standard safety norms.
	17.3	Identify the different types of resistors.
	17.4	Measure the resistor values using colour code and verify the reading by measuring in multi meter.
	17.5	Identify the power rating using size.
	17.6	Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter.
	17.7	Identify different inductors and measure the values using LCR meter.
	17.8	Identify the different capacitors and measure capacitance of various capacitors using LCR meter.
	17.9	Ascertain and select tools and materials for the job and make this available for use in.
18. Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup.	18.1	Identify the various crimping tools for various IC packages.
	18.2	Identify different types of soldering guns and choose the suitable tip for the application.
	18.3	Practice the soldering and de-soldering the different active and passive components, IC base on GPCBs using solder, flux, pump and wick.
	18.4	Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety norms.
	18.5	Identify SMD components, de-solder and solder the SMD components on the PCB.
	18.6	Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects.
	18.7	Avoid waste, ascertain unused materials and components for safe disposal.
19. Assemble simple electronic	19.1	Practice soldering on components, lug and board with

	power supply circuit and test for functioning.	safety.
		19.2 Identify the passive /active components by visual appearance, Code number and test for their condition.
		19.3 Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
		19.4 Construct and test a half & full wave rectifiers with and without filter circuits.
		19.5 Construct and test a bridge rectifier with and without filter circuits.
		19.6 Construct and test a Zener based voltage regulator circuit.
20.	Execute testing, evaluate performance and maintenance of sphygmomanometers.	20. 1 Plan work in compliance with standard safety norms related with sphygmomanometers.
		20. 2 Identify the types of sphygmomanometer and their specifications.
		20. 3 Identify terminals, verify the rubber cuff which is apply to the arms.
		20. 4 Connect and test an instrument for measuring blood pressure.
		20. 5 Identify the operation and blood pressure monitor.
		20. 6 Connect to a column of mercury next to a graduate scale.
		20. 7 Determine of systolic and diastolic blood pressure by increase and gradually reduce the pressure in the cuff.
		20. 8 Perform and operate the BP machine/ sphygmomanometers.
		20. 9 Construct and test of stethoscope.
21.	Verify characteristics of electronics, power electronics and special semiconductor circuits.	21. 1 Plan work in compliance with standard safety norms.
		21. 2 Construct and test the transistor based switching circuits
		21. 3 Construct and test CB, CE & CC amplifier circuit.
		21. 4 Ascertain the performance of different oscillator circuits.
		21. 5 Measure the resistance, voltage, current through electronic circuit using multimeter.
		21. 6 Construct and test of JFET amplifiers, oscillators and multi vibrators.
		21. 7 Construct and test a UJT as relaxation Oscillator.

	21. 8 Construct and test lamp dimmer using TRIAC/DIAC.
	21. 9 Construct and MOSFET, IGBT test circuit and apply for suitable operation with proper safety.
	21. 10 Construct and test a circuit using photo diode and verify its characteristics.
22. *Test various gas plant operation using suitable care and safety.*	22. 1 *Mechanical Ventilation, Refrigeration, Air conditioning.*
	22. 2 *Air curtains, Laminar Flow Systems.*
	22. 3 *Safety and care of Refrigeration systems.*
	22. 4 *Safety and care of Air conditioning systems.*
	22. 5 *Maintenance of Medical Gas pipe lines , Gas generators etc.*
23. *Test and operate different types of Physiotherapy Equipment's, techniques and general care.*	23. 1 *Short wave Diathermy Principles.*
	23. 2 *Micro Wave Diathermy Principles.*
	23. 3 *Types of Electrodes used in Physiotherapy Equipment's.*
	23. 4 *Preparation Equipment's , Patient Positioning and Application Techniques.*
	23. 5 *General Care of Transducers / Sensors and Equipment's.*
SEMESTER-II	
24. Assemble, test and troubleshoot various digital circuits.	24. 1 Illustrate to practice the digital trainer kit with safety.
	24. 2 Identify various digital ICs, test IC using digital IC tester and verify the truth table.
	24. 3 Construct and verify the truth table of all gates using NOR and NAND gates.
	24. 4 Construct an adder cum substractor circuits and verify the truth table.
	24. 5 Construct a decoder and encoder, multiplexer and de-multiplexer circuits and verify the truth table.
	24. 6 Construct a multiplexer and de-multiplexer and verify the truth table.
	24. 7 Construct and verify the truth table of various flip flop, counter and shift register circuits.
25. Construct, test and verify the input/ output characteristics of various analog circuits.	25. 1 Ascertain and select tools and instruments for carrying out the jobs.
	25. 2 Plan and work in compliance with standard safety norms.

	25. 3	Practice on soldering components on lug board with safety.
	25. 4	Identify the passive /active components by visual appearance, code number and test for their condition.
	25. 5	Construct and test the transistor based switching circuit
	25. 6	Construct and test CB, CE & CC amplifier circuit
	25. 7	Ascertain the performance of different oscillator circuits.
	25. 8	Construct and test clipper, clamper and Schmitt trigger circuit.
26. Understand the significance of different parts in the organization in the human body (Basic human anatomy and physiology).	26. 1	Explain the roles of the main components and features of a cell to the cell's functions.
	26. 2	Analyze the benefits of cells combining together to form tissues with specifications.
	26. 3	Description the roles of organ and the interrelationships between body system
27. Execute the operation of different Bio Medical sensors, identify, wire & test various sensors by selecting appropriate test instruments.	27. 1	Ascertain and select tools, material for the job and make this available for use in the timely manner.
	27. 2	Plan work in compliance with safety norms.
	27. 3	Demonstrate possible solution and agree task within the team.
	27. 4	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.
	27. 5	Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart.
	27. 6	Measure temperature of a lit fire using RTD and record the readings referring to data chart.
	27. 7	Measure the DC voltage of Sensor & Transducers
	27. 8	Detect different objectives using capacitive, inductive and photoelectric proximity sensors.
28. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	28. 1	Demonstrate analog trainer kit with safety precautions.
	28. 2	Identify various ICs, differentiate by code No. and test for their condition.
	28. 3	Construct and test various OPAMP circuits.
	28. 4	Construct and test R-2R ladder type digital to analog converter circuit.
	28. 5	Construct and test different configurations of 555 IC

	e.g. astable, monostable, bi-astable and VCO circuits.
29. *Understand the working principles, operation, general care of clinical lab equipment.*	29.1 *Cell Counters Principles*
	29.2 *Spectrophotometer Principles*
	29.3 *Colorimeter Principles*
	29.4 *Transducers in Analytical Instruments*
	29.5 *Operation of Instruments*
	29.6 *General Care of Equipments*
SEMESTER-III	
30. Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger.	30.1 Identify the tools and equipments to perform the job with due care and safety.
	30.2 Dismantle the given stabilizer and find major sections/ ICs components.
	30.3 Identify various input and output sockets / connectors of the given SMPS.
	30.4 Identify major sections/ ICs/components of SMPS.
	30.5 Identify and replace the faulty components and construct and test IC Based DC-DC converter for different voltages.
	30.6 Identify front panel control & indicators of UPS.
	30.7 Identify various circuit boards in UPS and monitor voltages at various test points.
	30.8 Test UPS under Fault condition & rectify fault.
	30.9 Identify the parts, trace the connection and test the DC regulated power supply with safety.
	30.10 Troubleshoot and service a DC regulated power supply
	30.11 Test battery charger for its operation.
31. Prepare fibre optic setup and execute transmission and reception	31.1 Plan and select appropriate tools to complete the job safely.
	31.2 Identify the resources and their need on the given fiber optic trainer kit.
	31.3 Make optical fibre setup to transmit and receive analog and digital data.
	31.4 Demonstrate and apply FM modulation and demodulation using OFC trainer kit using audio signal and voice link
	31.5 Demonstrate PWM modulation and demodulation using OFC trainer kit using audio signal
	31.6 Demonstrate PPM modulation and demodulation using OFC trainer kit using audio

32. Understand and maintain a CCTV system and configure the system for surveillance function in *Hospital department.*	32.1 Identify & use different tools and equipment used for installation of CCTV, handle the tools with due care and safety.
	32.2 Identify the different CCTV components, Trace or follow the CCTV setup for any commercial installation.
	32.3 Identify the strategic locations for the installation of cameras.
	32.4 Plan and setup the procedure for switching the cameras to have different views.
	32.5 Identify the connectors and sockets used on DVRs, connect CCTV Cameras to DVR, Record and Replay.
	32.6 Dismantle DVR and identify major functional blocks and test for the healthiness.
	32.7 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.
	32.8 Monitor, evaluate and check own work.
33. Identifiy Test , service & programs of Micro-processor 8085.	33.1 Understand and interpret the procedure as per manual of Micro-processor 8085.
	33.2 Identity various ICs & their functions on the given Micro-processor 8085 Kit.
	33.3 Identify the address range of RAM & ROM.
	33.4 Write data into RAM & observe its volatility.
	33.5 Identify the port pins of the controller & configure the ports for Input & Output operation.
	33.6 Demonstrate entering of simple programs, execute & monitor the results.
34. Understand the ICU department functions, equipment, etc. calibration and basic human rating chart.	34. 1 Understand and prepare of kidney chart and eye chart.
	34. 2 Execute planning setup for ear chart and brain chart.
	34. 3 Calculate and analyze the internal heart chart rate.
	34. 4 Understand and sketch blood circulating system.
	34. 5 Select and perform the techniques of skeletal system chart, respiratory system chart, nerve system chart and digestive system chart.
	34. 6 Plan and prepare reproductive system chart.
	34. 7 Illustrate the bio medical engineering instrument calibration.

35. Interpret the factors, tools and techniques affecting the medical terminology image quality.	35. 1 Understand medical terminology quality, resolution, noise and speed.
	35. 2 Differentiate between the geometric factors affecting medical terminology quality.
	35. 3 Analyse the subject factors affecting medical terminology quality.
	35. 4 Analyse the tools and technique available to create high quality film.
	35. 5 Understand different types of equipments calibration procedure and error measuring as per manual.
	35. 6 Conduct systematic troubleshooting.
SEMESTER- IV	
36. Understand the function of bio-medical Department.	36.1 Principles of air conditioning and, Refrigeration. Types of pumps and compressors, Principle of operation
	36.2 Elements of Intensive-Care Monitoring,
	36.3 Patient monitoring displays,
	36.4 Defibrillators, Pacemakers, EMG, EEG,
	36.5 Monitors: Video monitors, Recorders: Strip chart recorders, Galvanometric recorders, Ultraviolet recorders, and other recorders.
	36.6 Ventilator: The physiology of respiratory system, Instrumentation for the mechanics of breathing, Inhalators, Ventilators, Respirators, Humidifiers , Aspirators, Electro Surgical diathermy
37. Identifiy Test , service & programs of Microcontroller 8051	37.1 Differentiate Microprocessor and Micro controller.
	37.2 Architecture of 8051 family of Micro controllers, pin diagram and various on chip resources.
	37.3 Types of memory with 8051 such as On-chip, external code memory, External RAM
	37.4 Register Banks and their use Memory mapping of the bit addressable registers (bit memories)
	37.5 Instruction set and various types of instructions
	37.6 Special function registers (SFRs) and their configuration for various applications.
	37.7 Input / output ports and their configuration
	37.8 Implementation of various Timer and counting functions, aspects of serial communication,
	37.9 Utilization of on-chip resources such as ADC etc.
	37.10 Assembly software and compilers for 8051 Micro-controllers. 8052 and its difference with 8051.

38. Understand the operation and function of Dental Chair & Dental X-Ray	38.1	Different components of Dental X-ray machine.
	38.2	Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits
39. Execute the operation of different of Imaging Equipment's used in hospitals	39.1	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.
	39.2	X-Ray: Basic physics.
	39.3	Different components of X-ray machine, Block diagram of X-ray machine, H.T. Generator,
	39.4	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.
40. Development of an Bio-medical Department in a hospital.	40.1	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)
	40.2	Introduction of 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).

SYLLABUS FOR TECHNICIAN MEDICAL ELECTRONICS TRADE			
FIRST SEMESTER- 6 MONTHS			
Week No.	**Ref. Learning Outcome**	**Professional Skills (Trade Practical) with Indicative Hours**	**Professional Knowledge (Trade Theory)**
1	Apply safe working practices	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. (5 hrs) 2. Identify safety signs for danger, warning, caution & personal safety message. (3 hrs.) 3. Use of personal protective equipment (PPE). (5 hrs) 4. Practice elementary first aid. (5 hrs) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs) 6. Practice elementary on Artificial Respiration 7. Use of Fire extinguishers. (5 hrs)	Introduction to NCVT and its certification mechanism Semester system and its flexibility for the Trainee and to the Institute. EM Trade and its applicability in industries. Expectations of the Industry from trainees after the completion of the Trade. The skills to be acquired to become part of industry. Intro to Safety and measures to be taken to maintain the standards of safety of personnel working and the equipment Different First aid mechanisms to rescue the effected by electric shocks or any physical injuries. Classification of cables according to gauge, core size, insulation strength, flexibility etc
2	Plan and execute soldering and de soldering of various electrical components like Lug's, tag's, clips, Eyelets & Plugs for electronics circuits.	8. Practice soldering on different electronics components Lug's, Tag's, Clips, Eyelets and Plugs. (3 hrs) 9. Practice De soldering using pump and wick. (2 hrs) 10. Identify and use Lug's, Tag's, Clips, Eyelets and Plugs used 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

		electronics industries. (4 hrs) 11. Identify different types of passive electronic components. (2 hrs) 12. Practice soldering on combinational circuits in different values of resistance. (2 hrs). 13. Identify resistors by their appearance and check physical defects. (3 hrs) 14. Practice De soldering the same circuit using pump and wick. (3 hrs) 15. Wire up the consumers main board with ICDP switch and distribution fuse box. (3 hrs) 16. Prepare and mount the energy meter board. (3 hrs)	and De-soldering stations and their specifications.
3	Estimate, assemble, install and test wiring system *in hospital* & CSSD department	17. Practice fixing of screws of different sizes on wooden board. (2 hrs) 18. Identify various conduits and different electrical accessories. (2 hrs) 19. Practice cutting, threading of different sizes and laying installations. (5 hrs) 20. Prepare test boards/extension boards and mount accessories like lamp holders, various switches indicator, sockets, fuse, MCB's etc. (9 hrs) 21. Test and check rating of different type of switches, sockets, fuse and MCB's. (7 hrs)	**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.
4	Photo therapy Equipment's in Biomedical Sector's	22. Install electrical line 110 V. (2 hrs) 23. Install and test using light fitting with reflector for direct and indirect lighting. (6 hrs)	Different type of electrical cables and their specifications. Different types of Cables used in the electronic industries.

		24. Test and identify different groups wattage of lamps in series for specified voltage. (4 hrs) 25. Practice installation of various lamps e.g. fluorescent tube, Tub light/CFL etc. (5 hrs) 26. Identify different types of analog & digital multimeters parts, its function and operation. (4 hrs) 27. Practice on various analog and digital measuring instruments. (2 hrs) 28. Practice on measuring instruments in single and three phase circuits. (2 hrs)	Different types of Cables used in the electronic industries. Ohm's law and its variables. 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.
5	Select and perform measurements using analog/digital instrument.	29. Identify the phase, neutral & earth on power socket, use a tester to monitor AC power. (3 hrs) 30. Construct a test lamp and use it to check mains healthiness. (2 hrs) 31. Measure the voltage between phase and ground and rectify earthing. (2 hrs) 32. Refer table and find current carrying capacity of wires. (2 hrs) 33. Measure voltage and current using clamp meter. (1 hr) 34. Dismantle and identify the different parts of a relay. (3 hrs) 35. Connect a timer relay in a circuit and test for its working. (4 hrs) 36. Connect a contractor in a circuit and test for its working. (4 hrs) 37. Practice on electrical wiring diagram for 3 phase connection. (4 hrs)	Types and Properties of magnets and their materials, preparation of artificial magnets, Significance of Electromagnetism, types of cores. Electromagnetic Relays, types, construction, specifications.
6	Estimate, assemble, install and test wiring system *in hospital*& CSSD department	38. Wire up the consumers main board with ICDP switch and distribution house box. (6 hrs) 39. Estimate the cost/bill of material for wiring of hostel/ residential building and	Overload Relay, Fuse ratings, types of Fuses, Fuse bases, single/three phase MCB's, single phase ELCB' s. Phase angle, phase relations,

		workshop. (7 hrs) 40. Practice wiring of hostel and residential building as per IE rules. (5 hrs) 41. Practice on wiring of UPS and inverter diagram, test/fault detection of domestic and industrial wiring installation and repair. (7 hrs)	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,
7-8	-do-	42. Wire up the OPD, general ward and ICU main board with ICDP switch and distribution fuse box. (7 hrs) 43. Estimate the cost/bill of material for wiring of OPD, general ward and ICU. (6 hrs) 44. Practice wiring diagram of OPD as per IE rules. (7 hrs) 45. Practice wiring diagram of general ward as per IE rules. (6 hrs) 46. Practice wiring diagram of ICU as per IE rules.(6hrs) 47. Practice wiring diagram of minor OT as per IE rules(6hrs). 48. Install various light fitting with reflectors for direct and indirect lighting of OT.(7hrs) 49. Practice test/fault detection of minor OT and OT wiring installation and repair.(5hrs)	contactor contact currents, protection to contactor s and high current applications Resistor -definition, types of resistors, KVL & KCL with applications. their construction & specific use, color-coding, power rating. Types of inductors , Construction, specifications and applications (energy storage concept). Equivalent Resistance of series parallel ckts. V & I in series parallel ckts. Principles of induction, inductive Reactance, Self and Mutual induction. Behaviors of inductor at low and high frequencies. series and parallel combination, Q factor.
9	Photo therapy Equipment's in Biomedical Sector's	50. Group different wattage of ultra violet lamp in series for specified voltage.(6hrs) 51. Connect a contactor in ultra violet lamp and test for its working.(5hrs) 52. Install light fitting for a spot lighting.(4hrs) 53. Install light fitting for photo therapy(5hrs). 54. Practice testing/fault detection of UV lamp, spot lamp and photo therapy installation and repair.(5hrs)	Construction & its application Capacitance and Capacitive Reactance, Impedance Types of capacitors, construction, Specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behavior with AC and DC.

10-14	Plan and carry out installation, fault detection and repairing of Hospital Electrical appliances.	55. Dismantle and assemble electrical/electronic parts of various electronic appliances e.g. Iron box, Radiant warmer, Auto cutoff multi coil, nebulizer, AC & DC motor. (7 hrs) 56. Service and repair of electrical/electronic irons. (6 hrs) 57. Prepare and test of silicon pipe sealer. (5 hrs) 58. Measure and test of clinical sterilizer. (6 hrs) 59. Practice testing/fault detection of autoclave (with & without auto cutoff multi coil). (9 hrs) 60. Plan and prepare of incubator. (6 hrs) 61. Service and repair of radiant warmer. (7 hrs) 62. Prepare and mount for setup baby clinical incubator. (8 hrs) 63. Prepare and mount the proper nebulizer. (6 hrs) 64. Identify different terminals and parts of electrical wiring diagram for water pump with auto controller. (10 hrs) 65. Identify parts and terminals of different types of single phase AC motors. (7 hrs) 66. Install, connect and determine performance of single phase AC motors. (6 hrs) 67. Identify parts and terminals of different types of single phase DC motors. (6 hrs) 68. Install, connect and determine performance of single phase DC motors. (7 hrs) 69. Connect , set proper direction of rotation and run. (6 hrs) 70. Identify and test permanent magnet DC motor. (6 hrs) 71. Identify and test brush less DC motor. (6 hrs) 72. Service and repair of mixer and	Concept of Time constant of a RC ckt. Concept of Resonance and its application in RC, RL & RLC series and parallel ckt. Wheatstone bridge circuits , Introduction, Balances, Hot plate and Magnetic Stirrer Centrifuges, Hot air oven, Incubator, Water bath, Nebulizer Construction & Testing of Baby / clinical Incubator, Radiant warmer Construction & Testing of Baby / clinical Incubator, Construction & Testing of Radiant warmer **Electrical motors**: AC Motor (single phase induction motor) construction, sub assemblies, type of winding used, interpretation of name plate specifications Conventional speed control methods. Types of AC motors and their applications. Starting of split phase motor and three phases AC motors. DC Motor construction, sub assemblies, carbon brushes interpretation of name plate Specifications, conventional speed control methods and applications. Types of DC motors and their applications.

		fan. (5 hrs) 73. Install, connect and determine performance of centrifuge. (6 hrs)	
15	Test and service different batteries used in electronics applications and record the data to estimate the repair cost.	74. Identify the rated various types of cells output voltage and Ah capacity of given battery.(3hrs) 75. Practice on grouping of cells for specified voltage and current under different conditions and care.(2hrs) 76. Measure the specific gravity of the electrolyte using hydrometer.(3hrs) 77. Practice on routine, care/maintenance and testing of batteries(3hrs). 78. Measure the resister value by colour code and verify the same by measuring with multimeter.(2hrs) 79. Identify the different type of passive components with colour code SMD and DIP package. (2hrs) 80. Identify the different type of active components of SMD and DIP package.(2hrs) 81. Identify different types of transformers and test(2hrs). 82. Verify terminals, identify HT and LT side and calculate transformation ratio of single phase transformers.(2hrs) 83. Determine voltage regulation of single phase transformer at different loads.(2hrs) 84. Identify different types of auto transformers and test.(2hrs)	**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
16	Test various electronics components using proper measuring instruments and compare the data using standard parameter.	85. Identify resistors by their appearance and check physical defects.(3hrs) 86. Identify the power rating of carbon resisters by their size.(3hrs) 87. Practice on measurement of	Working principle of a Transformer, Transformer construction, Types of cores used Specifications of a transformer. Step-up, Step down and isolation

		parameters in combinational circuit by applying Ohm's Law for different resistor values and voltage sources.(5hrs) 88. Measurement of current and voltage in circuits to verify Kirchoff's law(4hrs). 89. Verify Laws of series and parallel circuits with voltage source in different combinations.(3hrs) 90. Measure unknown resistance using Wheatstone bridge circuits(3hrs) 91. Identify and measure VI characteristics of LDR and Thermister.(4hrs)	transformers with applications. Different type of losses in Transformers.
17	Identify, place, solder and de solder and test different SMD discrete components and IC's package with due care and following safety norms using proper tools/setup.	92. Practice soldering on different electronics components, IC bases and PCB's.(3hrs) 93. Practice desoldering using pump and wick.(3hrs) 94. Join the broken PCB track and test.(2hrs) 95. Identification of 2,3,4 terminal SMD components(3hrs). 96. Desolder the SMD components from the given PCB.(3 hrs) 97. Identify various connections and setup required for SMD soldering station.(3hrs) 98. Identify different types of Si & Ge diodes and their specifications.(2hrs) 99. Measure the voltage and current through a diode in a circuit and verify its forward characteristics.(3hrs) 100. Measure the voltage and current through a Zener diode in a circuit and verify its forward characteristics.(3hrs)	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

18	Assemble simple electronics power supply circuit and test for functioning.	101. Identify the different controls on the CRO front panel and observe the function of each control.(3hrs) 102. Measure DC voltage, AC voltage, time period using CRO sine wave parameters.(4hrs) 103. Construct and test a half wave, full wave and bridge rectifier circuit with and without filter.(3hrs) 104. Construct and test voltage doubler's, tripler's and quadruple's.(4hrs) 105. Construct and test a dual power supply.(3hrs) 106. Construct and test different regulated power supply and measure output voltage with load.(3hrs) 107. Measure ripple voltage, ripple frequency and ripple factor of rectifiers for different load and filter capacitors.(5hrs)	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.
19	Execute testing, evaluate performance and maintenance of sphygmomanometers.	108. Identify terminals verify the rubber cuff which is apply to the arms.(4hrs) 109. Construct and test sphygmomanometer for measuring blood pressure(4hrs). 110. Execute planning setup for blood pressure monitor examination.(5hrs) 111. Determine the thermal effect of electric current.(3hrs) 112. Measure and test of stethoscope.(4hrs) 113. Construct and test of BP operator/ Sphygmomanometers.(5hrs)	**Sphygmomanometer:** Names, Types (manual and digital), Operation, significance

20-22	Verify characteristics of electronics, power electronics and Special Semiconductors circuits.	114. Identify different types of transistors and their specification.(4hrs) 115. Measure the voltage and current of different types of transistors in a circuit and verify its characteristics and measure Alpha, Beta and Gama.(6hrs) 116. Construct and test fixed bias, ammeter bias and voltage divider bias of a transistor amplifier circuit.(5hrs) 117. Identify different types of photo diodes, tunnel diodes, variactor diodes and lascer diodes and their specifications.(4hrs) 118. Measure the voltage and current through a photo diode in a circuit and verify its characteristics.(4hrs) 119. Construct a circuit to switch a lamp load using photo diode.(3hrs) 120. Measure the voltage and current through a tunnel diode in a circuit and verify its characteristics.(5hrs) 121. Measure the voltage and current through a variactor diode in a circuit and verify its characteristics(4hrs). 122. Measure the voltage and current through a LASCR diode in a circuit and verify its characteristics(4hrs). 123. Identify different types of DIAC, TRIAC, SCR, SCS, SBS & SUS and their specification.(5hrs) 124. Measure the voltage and current through DIAC & TRIAC in different circuits and verify its characteristics.(4hrs) 125. Measure the voltage and current through SCR & SCS in different circuit and verify its	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 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

		characteristics.(4hrs) 126. Measure the voltage and current through SBS & SUS in different circuits and verify its characteristics.(4hrs) 127. Identify Different types of UJT, PUT, FET, IGBT, GTO and MOSFET(5hrs) 128. Measure the voltage and current through UJT & PUT in different circuits and verify its characteristics.(4hrs) 129. Measure the voltage and current through FET & IGBT in different circuits and verify its characteristics.(5hrs) 130. Measure the voltage and current through GTO & MOSFET in different circuits and verify its characteristics.(5hrs)	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
23	Test various Medical gas plant operation using suitable care and safety. *Test and operate different types of Physiotherapy Equipment's technique , and general care.*	131. Identify the different gas plant safety precaution while working.(4hrs) 132. Measure & Test of Hospital Oxygen o_2 gas plant.(4hrs) 133. Construct & Test of Hospital nitrous (n_2o) plant(4hrs). 134. Identify different types of diathermy and their system.(4hrs) 135. Operate & Test of shot wave diathermy.(4hrs)	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

		136. Operate & Test of micro wave diathermy.(5hrs)	
24-25	**Project work/Industrial visit** Broad areas: a) Bridge rectifier circuit with output indicator circuit. b) Voltage quadruplers. c) Measure and plot input and output characteristics of a CE amplifier. d) Test circuit of SCR using UJT triggering. e) Construct a simple dimmer circuit using DIAC and TRIAC		
26	**Revision & Examination**		

Note: -

1. *Some of the sample project works (indicative only) are given against each semester.*
2. *Instructor may design their own project and also inputs from local industry may be taken for designing such new project.*
3. *The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit Project report.*
4. *If the instructor feels that for execution of specific project more time is required than he may plan accordingly to produce components/ sub-assemblies in appropriate time i.e., may be in the previous semester or during execution of normal trade practical.*

SYLLABUS FOR TECHNICIAN MEDICAL ELECTRONICS TRADE			
SECOND SEMESTER – 06 Months			
Week No.	**Ref. Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
27-28	• Assemble, test and troubleshoot various digital circuit.	137. Familiarize digital IC's (4 hrs) 138. Identify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them. (9 hrs) 139. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. (8 hrs) 140. Construct and verify the truth table of all the gates using NAND and NOR gates. (6 hrs) 141. Use digital IC tester to test the various digital ICs (TTL and CMOS). (8 hrs) 142. Verify the switching circuits of all logic circuit with the help of Boolean equation. (6 hrs) 143. Verify the Truth table for De-Morgans first law and second law and from the result draw the logic gates. (9 hrs)	Difference between analog and digital signals, logic levels of TTL and CMOS Introduction to Digital Electronics, Number systems and codes Digital code: binary, octal , Excess 3 code, grey code, BCD code, ASCII code and code conversions, Logic Gates and their truth tables, Study of a Digital IC Tester : Specifications & Block diagram , Operation and circuit description of a Digital IC Tester, Logic families like TTL/CMOS and sub families and their comparison. Availability of logic gates in multiple numbers in a package with examples. Combinational logic circuits such as AND-OR Logic, AND-OR invert Logic s Universal property of NAND and NOR gates. Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders. IC 7482 as 2-bit and four bit full adders. Magnitude compactors. Half adder, full adder ICs and their applications for implementing arithmetic operations
29-30	• Construct, test and verify the input/output characteristics of various analog circuits.	144. Construct & Test RC coupled Amplifier by using single stage. (6 hrs) 145. Construct & Test RC coupled Amplifier using double stage(9hrs). 146. Construct & Test of transformer Coupled Amplifier(7 hrs)	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

		147. Construct & Test of class B Push pull Amplifier(8 hrs) 148. Construct & Test Audio Amplifier(7 hrs) 149. Construct & Test FET Common-source Low frequency amplifier.(7 hrs) 150. Construct & Test FET Common-Drain Low frequency amplifier. (6 hrs)	circuits and clamping/limiting circuits and their applications. R C based Differentiator Transistor power ratings & packaging styles, Use of different heat sinks.
31	Understand the significance of different parts in the organization in the human body (Basic of human Anatomy and Physiology)	151. Identify Different parts of the human Body (4 hrs) 152. Identify the role of the main components and features of the human body cell.(8hrs) 153. Outline the structure of the main tissues of the human body.(7 hrs) 154. Identify the functions of all the main organs of human body.(6 hrs)	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
32-33	• Execute the operation of different *Bio Medical* sensors, identify, wire & test various sensors by selecting appropriate test instruments.	155. Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT PT 100 (platinum resistance sensor), water level sensor,	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

		thermostat float switch, float valve by their appearance (12 hrs) 156. Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. (8 hrs) 157. Measure temperature of a lit fire using RTD and record the readings referring to data chart (10hrs.) 158. Measure the DC voltage of a LVDT (10hrs) 159. Identify different types of Electrodes. (4 hrs) 160. Identify the electrodes used in medical devices. (6 hrs)	LEDS, Photo diode for photo transistor, its characteristics and application, optical sensor, opto-couplers, circuits with opto isolation, characteristics of LASER diodes.
34-35	• Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result.	161. Construct & Test astable Multi-vibrator by using IC 555.(5hrs) 162. Construct & Test Mono stable Multi-vibrator byusing IC 555.(6hrs) 163. Construct & Test Bi stable Multi-vibrator using IC 555.(5hrs) 164. Construct & Test of VCO (V to F converter) using IC 555(6hrs). 165. Construct and test Schmitt trigger using IC 555(5hrs). 166. Construct and test Ramp generator using IC 555.(5hrs) 167. Construct and test time delay relay using IC 555.(6hrs) 168. Construct and test water level controller using IC 555(6hrs). 169. Construct and test 555 timers as pulse width modulator.(6 hrs)	Types of multi-vibrators and study of circuit diagrams Time constants of RC & RL circuits., Block diagram of 555, functional description wrt different configurations of 555 monstable block diagram of 555, functional description wrt different configurations of 555 monstable functional description wrt different configurations of 555 monstable 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
36-38	Assemble, test and troubleshoot various digital circuits.	170. Construct Half Adder circuit using ICs and verify the truth table. (5 hrs) 171. Construct Full adder with two Half adder circuit using ICs and verify the truth table. (7 hrs) 172. Construct the adder cum	Basic Binary Decoder and four bit binary decoders. ICs 74LS138 and 74154 pin details and functionality. BCD to Decimal decoder, Decimal to BCD Encoder, IC 74147 details and functionality. Need for multiplexing of data and IC74151

		subtractor circuit and verify the result. (7 hrs) 173. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse. (8 hrs) 174. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. (10 hrs) 175. Verify Binary to Gray code converter. (6 hrs) 176. Verify Gray to Binary code converter. (6 hrs) 177. Identify and test common anode and common cathode seven segment LED display using multimeter.(10hrs) 178. Interface 7 Segment display with IC 7447/7448 decoder. (6 hrs) 179. Display the two digit count value on seven segment display using decoder/drivers(10hrs).	AS Data selector/Multiplexer.1 to 4 line De-multiplexing. IC 74154 as a De-multiplexer. S-R Latch, Gated S-R Latch, D-Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop Clocked Flip Flop, Master-Slave flip flops and Timing diagrams Basic flip flop applications like data storage, data transfer and frequency division. Specifications and block diagram, Operation of a Analog IC Tester and its Circuit description, Basics of Counters. Two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams. Basics of Counters. Two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams. 3- bit Synchronous counters and synchronous decade counters. BCD display, BCD to decimal decoder. BCD to 7 segment display circuits
39-43	• Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result.	180. Pin Identification of OP-Amp LM741, TLC274C, LF356, LM324. (8 hrs) 181. Construct & Test of Inverting Amplifier using Op –Amp. (7 hrs) 182. Construction & Testing of Non Inverting Amplifier using Op –Amp. (7 hrs) 183. Construct & Test of Summing Amplifier using Op –Amp. (7 hrs) 184. Construction & Testing of Differential Amplifier using Op –Amp. (7 hrs) 185. Construct & Test of Logarithmic Amplifier using Op –Amp. (7 hrs) 186. Construct & Test of Low - Pass Filter using Op –Amp. (6 hrs)	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,

		187. Construct & Test of High - Pass Filter using Op –Amp. 67 hrs) 188. Construct & Test of Band - Pass Filter using Op –Amp. (6 hrs) 189. Construction & Testing of RC Phase-shift Oscillator using Op-Amp. (6 hrs) 190. Construct & Test of Wien Bridge Oscillator using Op-Amp. (6 hrs) 191. Construct & Test of voltage to current converter using Op-Amp. (6 hrs) 192. Construct & Test current to voltage converter using Op-Am. (7 hrs) 193. Construct & Test Peak Detector using Op-Amp. (8 hrs) 194. Construct & Test Precision Rectifier using Op-Amp. (7 hrs) 195. Construct & Test Bio-medical Instrumentation Amplifier using Op –Amp. (8 hrs) 196. Construct & Test Basic Triangular & Square Wave Generator using Op-Amp. (8 hrs)	voltage to current converter using Op-Amp, current to voltage converter using Op-Amp, Peak Detector using Op-Amp, Precision Rectifier using Op-Amp, Triangular & Square Wave Generator using Op-Amp
44-45	Assemble, test and troubleshoot various digital circuits.	197. Construct and Test a 4 to 1 Multiplexer. (5 hrs) 198. Construct and Test a 1 to 4 De Multiplexer. (5 hrs) 199. Construct and Test 4 bit SISO shift Register. (8 hrs) 200. Construct and Test 4 bit SIPO shift Register. (8 hrs) 201. Construct and Test 4 bit PISO shift Register. (8 hrs) 202. Construct and Test 4 bit PIPO shift Register. (8 hrs) 203. Construct and test up - down counter with timing diagram. (8 hrs)	Shift Register functions, Serial to parallel and vice verse, Parallel to parallel and serial to serial, Bidirectional shift registers, Timing diagram ,important applications.pin details and functionality of universal shift register IC 74194 Memory concepts, types of memories RAM/ROM/EPROM/FLASH PROM etc. and their applications.
46-49	*Understand the working principles ,*	204. Identify various ABD kits peripherals and connect it to	Microscope, Colorimeter and Spectrophotometer (Both VIS &

	Operation , general care of Clinical Lab Equipments	the system of Blood Group using. (10 hrs) 205. Perform and execute PH Meter. (6 hrs) 206. Understand how to prepare and measure calorimeter digital / analog. (8 hrs) 207. Practically understand how to use Spectrophotometer. (8 hrs) 208. Practice and perform sugar testing using Quick check (TECO). (10hrs) 209. Practice and perform the method of patient care and handling Semi Auto Analyzer. (12 hrs) 210. Perform how to calculate Blood Cell counter. (12 hrs) 211. Practically understand how to measure uro meter. (12hrs) 212. Select and perform the appropriate syringe Destroyer & syringe Pump. (12 hrs) 213. Prepare the room apparatus and instrument for electro surgical Unit (surgical cut and coagulation). (10 hrs)	UV), Laboratory tests based on Colorimeter and Photometry, Flame photometry, Electrophoresis, Densitometry, pH meters, Semi auto analyzers, Blood, cell counter, Blood gas analyzer.
50-51	**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.		
52	**Revision & Examination**		

Note: -

1. *Some of the sample project works (indicative only) are given against each semester.*
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3. *The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned in a group (Group of at least 4*

trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit Project report.

4. *If the instructor feels that for execution of specific project more time is required than he may plan accordingly to produce components/ sub-assemblies in appropriate time i.e., may be in the previous semester or during execution of normal trade practical.*

SYLLABUS FOR TECHNICIAN MEDICAL ELECTRONICS TRADE			
THIRD SEMESTER - 06 MONTHS			
Week No.	**Ref. Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
53-54	Identify, place, solder and desolder and test different SMD discrete components and IC,s package with due care and following safety norms using proper tools/setup.	214. Identify 2/3/4 terminal SMD components.(4hrs) 215. De-solder the SMD components from the given PCB. (5hrs) 216. Solder the SMD components in the same PCB. (6 hrs) 217. Check for cold continuity of PCB. (5 hrs) 218. Identify PGA packages.(5hrs) 219. De-solder the PGA components. (8hrs) 220. Solder the PGA components. (7hrs) 221. Identify lose /dry solders, broken tracks on printed wiring assemblies. (10hrs)	PCB design making, Identification of 2/3/4 terminal SMD components. Soldering / de soldering of above components, Identification of PGA packages, Soldering / De soldering of above PGA components, Cold/Continuity check of PCBs, Identification of lose /dry solders,, broken tracks on printed wiring assemblies
55-56	Detect the faults and troubleshoot SMPS, UPS, and Inverter and Battery charger.	222. Identify various input and output sockets/connectors /indicators on the given UPS. (5hrs) 223. Make individual connections between batteries of battery stack and test for healthiness of batteries on stack. (5hrs) 224. Connect battery stack to the UPS. (5hrs) 225. Make load test to measure backup time. (5hrs) 226. Identify isolator transformer, inverting transformer and control transformers. (5hrs) 227. Adjust charging current according to number of batteries. (5hrs) 228. Identify various circuit boards and monitor voltages at vital test points. (5hrs) 229. Identify the charging section and set the charging current according to backup. Perform	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

		a load test to UPS. (5hrs) 230. Identify the semiconductor power modules and measure voltages. (5hrs) 231. Maintain, Service and troubleshoot Battery charger and UPS. (5hrs)	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
57-59	Prepare fibre optic setup and execute transmission and reception.	232. Cutting, cleaning and preparing of fibre cable for splicing. (15 hrs) 233. Splicing of OFC using splicing machine. Testing of OFC using OTDR. (25 hrs) 234. Measure propagation, return and bending losses etc. (15 hrs) 235. Measure optical signal power using optical power meter. (10 hrs) 236. Test the optical fibre cable using Visual Fault locator. (5hrs) 237. Make optical fibre setup to transmit and receive analog. (5hrs)	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
60-61	• *Understand and Maintain a CCTV system and configure the system for surveillance function in Hospital departments.*	238. Identify different CCTV components. (5 hrs) 239. Draw, trace or follow the CCTV setup of any commercial installation. (5 hrs) 240. Identify the strategic locations for the installation of camera. (5 hrs) 241. Identify various indicators, cables, connectors and ports on the computer cabinet. (5 hrs) 242. Demonstrate various parts of the system unit and motherboard components. (5 hrs) 243. Identify various computer peripherals and connect it to the system. (5 hrs) 244. Install a Printer driver	Introduction of CCTV, computer hardware, software's installation, multiple frame split in digital TV, restore old memories, format new & old hard disk

		software and test for print outs (5 hrs) 245. Install antivirus software, scan the system and explore the options in the antivirus software. (5 hrs) 246. Install MS office software (5 hrs) 247. Connect network connectivity for backup recovery. (5 hrs) 248. Prepare multiple frame split. 249. Identify LCD Display module and its decoder/driver ICs (5 hrs)	
62-68	• Identify Test , service & programs of Micro-processor 8085.	250. Identify various ICs & their functions on the given Microprocessor Kit. (15 hrs) 251. Measure the wave forms on different ICs and IC pins of the processor. (15 hrs) 252. Monitor the clock frequency. (15 hrs) 253. Write down the address range of different memory IC s and peripheral ICs on the kit. (15 hrs) 254. Enter data to different memory locations in RAM. (15 hrs) 255. Enter simple programs and execute using assembly language. (15 hrs) 256. Use assembler to assemble the programs and load them for execution by the processor. (20 hrs) 257. Use assembler to load them for execution by the processor. (20 hrs) 258. Program to Blink an LED using port pins of 8255. (15 hrs) 259. Program to Control a relay using the port pins of 8255. (15 hrs) 260. Program to read the data from memory to sequentially ON the LEDs. (15 hrs)	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.
69-70	• *Understand the ICU*	261. Plan and prepare of Kidney	kidney chart, eye chart, ear chart,

	Department functions, equipments etc calibration and basic human rating chart.	chart, eye chart, ear chart, Brain chart. (15 hrs) 262. Identify the internal procedure of heart chart, blood circulatory system. (10 hrs) 263. Practice and perform the skeletal system chart, respiratory system chart, nerve system chart, digestive system chart. (10 hrs) 264. Prepare reproductive system chart. (15 hrs)	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,
71-74	Interpret the factors, tools and techniques affecting the medical terminology image quality.	265. Perform how to calculate Pulse Oximeter. (15 hrs) 266. Perform how to prepare a EMG. (15 hrs) 267. Practice and perform the method of patient care and handling ECG. (15 hrs) 268. Plan patient setup for EEG & ERG. (15 hrs) 269. Perform techniques of applications of Multi-Para monitor. (10 hrs) 270. Plan and perform the care of Ultrasound Doppler equipments. (10 hrs) 271. Plan patient setup for Fetal Monitor, Infusion Pump & Syringe Pump. (10 hrs) 272. Practice and perform the method of patient care and handling Endo scope & Colonoscopy. (10 hrs)	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
75-76	**Project work/Industrial Visit** Broad areas a. Identify isolator transformer, inverting transformer and control transformers. b. Make optical fibre setup to transmit and receive analog . c. Draw, trace or follow CCTV setup of any commercial installation. d. Perform to control a relay using the port pins of 8255. e. Perform how to calculate pulse oximeter.		
77	**Revision**		
78	**Examination**		

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3. *The project should broadly cover maximum skills in the particular trade and must involve some problem solving skill. Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration, work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and Application of Learning. They need to submit Project report.*
4. *If the instructor feels that for execution of specific project more time is required than he may plan accordingly to produce components/ sub-assemblies in appropriate time i.e., may be in the previous semester or during execution of normal trade practical.*

SYLLABUS FOR TECHNICIAN MEDICAL ELECTRONICS TRADE			
FOURTH SEMESTER – 06 Months			
Week No.	**Ref. Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
79-82	• *Understand the ICU Department functions, equipments etc calibration and basic human rating chart.*	273. Identify & test of Pulse Oximeter, EMG, ECG different controls of the related equipments. (10 hrs) 274. Understand calibration procedure or measuring and monitoring instruments. (10 hrs) 275. Understand care of applicators used infusion pump & syringe pump. (10 hrs) 276. Prepare the room, apparatus and instrument for Endoscope & Colonoscopy. (15 hrs) 277. Troubleshooting & Maintenance aspects. (10 hrs) 278. Understand the effect on image due to variation in focal object distance, object field distance, exposer angle. (15 hrs) 279. Understand the technical aspect of quality assurance. (15 hrs) 280. Understand the quality assurance of the related equipments and its benefits with respect to visual assessment. (15 hrs)	Elements of Intensive-Care Monitoring, Patient monitoring displays, Defibrillators, Pacemakers, EMG, EEG, Monitors: Video monitors, Recorders: Strip chart recorders, Galvanometric recorders, Ultraviolet recorders, and other recorders Ventilator: The physiology of respiratory system, Instrumentation for the mechanics of breathing, Inhalators, Ventilators, Respirators, , Humidifiers , Aspirators, Surgical diathermy.
83-86	Identify Test , service & programs of Micro controller 8051.	281. Identify various ICs & their functions on the given Microcontroller Kit. (10 hrs) 282. Identify the address range of RAM & ROM. (10 hrs) 283. Measure the crystal frequency, connect it to the controller. (10 hrs) 284. Identify the port pins of the controller & configure the	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

		ports for Input & Output operation. (7 hrs) 285. Use 8051 microcontroller, connect 8 LED to the port, blink the LED with a switch. (10 hrs) 286. Perform the initialization, load & turn on a LED with delay using Timer. (8 hrs) 287. Perform the use of a Timer as an Event counter to count external events. (10 hrs) 288. Demonstrate entering of simple programs, execute & monitor the results. (10 hrs) 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. (15 hrs) 290. Write a program to use on board ADC and convert the analog voltage signal into digital value and store it memory. (10 hrs)	addressable registers (bit memories). Instruction set and various types of instructions Special function registers (SFRs) and their configuration for various applications. Input / output ports and their configuration. Implementation of various Timer and counting functions, aspects of serial communication, Utilization of on-chip resources such as ADC etc. Assembly software and compilers for 8051 Micro-controllers. 8052 and its difference with 8051.
86-88	*Understand the operation and functions of Dental Chair & Dental X-Ray.*	291. Operating & maintenance of Dental chair with suction & air compressor. (15 hrs) 292. Dental x-ray clarification Intra oral Dental x-Ray & Extra oral Dental x-ray. (10 hrs) 293. Identification Dentist handling tools. (10 hrs) 294. Basic level of Dental X ray calibration . (10 hrs) 295. Assembling and disassembling of chair & compressor. (15 hrs) 296. Assembling and disassembling of X-Ray (15 hrs)	Different components of Dental X-ray machine. Collimator, Bucky Grids, Relays, contactors, Switches, Interlocking circuits,
89-94	Execute the operation of different Imaging Equipment's used in	*297.* Identification of control Panel of Ultrasound scanners. (06 hrs)	Ultrasound scanners: Basic physics, Block diagram of Ultrasound scanner, Transducer

	hospitals.	*298.* Identification of Types Probe of Ultrasound scanners. (06 hrs) *299.* Identification of Modes imaging of Ultrasound scanners. (06 hrs) *300.* Operating Process of Ultrasound scanners. (06 hrs) *301.* Identification of control Panel of X-ray. (06 hrs) *302.* Identification & difference In CR & DR. (06 hrs) *303.* Identification & difference In Manual process of x-Ray expose & film Development. (06 hrs) *304. Calibration of X-ray Beam and tube head.* (06 hrs) *305. Digital X-ray imaging process.* (06 hrs) *306. Identify General fault finding of X-ray Equipment's.* (06 hrs) *307. Calibration of table alignment.* (06 hrs) *308. Identification of CT scanner parts.* (06 hrs) *309. Identification of CT scanner control panel parts.* (06 hrs) *310. Digital Image conversion of Ct scanner.* (06 hrs) *311. General fault finding of CT Scanner.* (06 hrs) *312. Calibration of table alignment.* (06 hrs) *313. Identification of MRI parts.* (06 hrs) *314. Identification of MRI control panel parts.* (06 hrs) *315. Digital Image conversion of MRI.* (06 hrs) *316. General fault finding of MRI.* (06 hrs) *317. Calibration of table alignment.* (06 hrs) *318. Identification of* mammography *parts.* (06 hrs) *319. Identification of* mammography *control panel*	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

		parts. (06 hrs) 320. *Digital Image conversion of* mammography. (06 hrs) 321. *General fault finding of* mammography. (06 hrs) 322. *Identification of* Bronchoscope *partsGeneral fault finding of* Bronchoscope. (06 hrs)	
95-98	Development of a Bio-medical Department in a hospital.	323. *Main role of Biomedical Engineer.* (14 hrs) 324. *SOP's of Biomedical Department's.* (14 hrs) 325. *Preventive steps care for NABH.* (15 hrs) 326. *Observe the Insurance applied for related Biomedical Instruments.* (15 hrs) 327. *Check the certification for radiations.* (14 hrs) 328. *Check the certification for registration.* (14 hrs) 329. *Check the certification for related licensee for Biomedical equipment's.* (14 hrs)	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).
99-102	**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.		
103	**Revision**		
104	**Examination**		

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

S No.	Workshop Calculation and Science	Engineering Drawing
First Semester		
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	Engineering Drawing: Introduction and its importance - Relationship to other technical drawing types - Conventions - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	**Fractions** : Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator.	Drawing Instruments : their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
3.	**Square Root** : Square and Square Root, method of finding out square roots, Simple problem using calculator.	Lines : Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
4.	**Ratio &Proportion** : Simple calculation on related problems.	Drawing of Geometrical Figures: Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	**Percentage** : Introduction, Simple calculation. Changing percentage to	Lettering and Numbering as per BIS SP46-2003: Single Stroke, Double Stroke,

	decimal and fraction and vice-versa.	inclined, Upper case and Lower case.
6.	**Material Science** : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	Dimensioning: - Definition, types and methods of dimensioning (functional, non-functional and auxiliary) - Types of arrowhead - Leader Line with text
7.	**Mass, Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	Free hand drawing of - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.
8.	**Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems.	Sizes and Layout of Drawing Sheets - Basic principle of Sheet Size - Designation of sizes - Selection of sizes - Title Block, its position and content - Borders and Frames (Orientation marks and graduations) - Grid Reference - Item Reference on Drawing Sheet (Item List)
9.	**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view
10.	-----	Symbolic Representation (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings
Second Semester		
1.	**Algebra** : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two	Construction of Scales and diagonal scale

	variables).	
2.	**Mensuration :** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, cylinder and Sphere.	Practice of Lettering and Title Block
3.	**Trigonometry:** Trigonometrical ratios, measurement of angles. Trigonometric tables	Dimensioning practice: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. - Text of dimension of repeated features, equidistance elements, circumferential objects.
4.	**Heat & Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	Construction of Geometrical Drawing Figures: - Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. - Conic Sections (Ellipse& Parabola)
5.	**Basic Electricity**: Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy.	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.
6.	**Levers and Simple Machines:** levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and	Free Hand sketch of hand tools and measuring tools used in respective trades.

	Mechanical Advantage.	
7.	–	Projections: - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification.
8.	–	Drawing of Orthographic projection from isometric/3D view of blocks
9.	–	Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw)
10.	–	Drawing details of two simple mating blocks and assembled view.
Third Semester		
1.	**Indices:** Laws of indices related problems. **Quadratic Equation:** Introduction, solution of simple Quadratic equation and related problems.	**CRO: -** Block diagram of Cathode Ray Oscilloscope (CRO). Front panel view of CRO.
2.	Solution of simple A.C. circuit with R.L.C. Calculation of power factor etc.	Symbols as per different semi-conductor devices-LDR, VDR, Thermister.
3.	**A.C Waveform Calculation:** Calculation of r.m.s, average, instantaneous value, peak value. Peak to peak value, Frequency and wavelength calculation and their relationship	AC wave form, frequency, wavelength representation, Inductors, series parallel, transformers types, cores types, lamination types, representation.
4.	**Series And Parallel Connection of Electrical and Electronic components:** 1. Calculation Series and parallel connection of Resistors. 2. Calculation Series and parallel connection of Capacitors. 3. Calculation Series and parallel connection of Inductors. 4. Calculation Series and parallel connection of Batteries. Conversion of power flow to H.P. Calculation of KVA.	**Microprocessor:-** Block diagram & Pin diagram of 8085 Microprocessor.
5.	**Elasticity:** Stress, strain, Modulus of elasticity, elastic limit, Hooks law, young's modulus.	Diodes, Forward & Reverse bias, Rectifiers, Input & Output waveforms, Regulator circuits, Clipper circuits, wave forms.

6.	**Material:** Introduction, types and properties. Uses of Conducting, Semi-conducting and insulating materials.	**Power supply:** Block diagram of SMPS. Block diagram of UPS-ONLINE, OFFLINE, LINE INTERACTING.
7.	**Magnetism:** Magnetic material, magnetic field, flux density, magnetic moment, m.m.f. Reluctance, permeability, susceptibility, electromagnet, solenoid and its practical applications.	_____
8.	**Pressure:-** Pneumatic pressure, PSI, bar, atmospheric pressure, pressure gauge and absolute pressure, Heat treatment process.	_____
Fourth Semester		
1.	**Power supply:** Calculation of SMPS, regulation, Calculation of load and wattage for selection of UPS, calculate of back up time of Battery related to UPS and Load, calculate of voltage regulation , firing angle calculation of ripple factor, voltage regulation of DC voltage. Calculate the regulation of solar power.	Exercise on blue print reading/circuit. Reading of house service connections & small power circuits, Connections of ammeter, voltmeter, KWh-meter with ISI symbols, circuit, Reading & drawing of different stages of R/R/free hand sketches of trade objects.
2.	**Modulation:** AM/FM modulation index calculation, calculation of Bandwidth, Percentage of modulation in FM/AM.	Logic gates, Combinational gates, other circuits.
3.	**Number Systems:** Introduction, Decimal, Binary, Octal, Hexadecimal, BCD code, ASCII code, Bit, Byte, KB, MB, GB, Conversion, Addition, Subtraction, Multiplication, Division, 1st and 2s complement method, 9s and 10s complement method. **Boolean Algebra:** Simplification of Boolean Algebra and equations.	Block diagram of Ultrasound scanner. Block diagram of oscillator, symbols for different wave shapes, Sq., saw-tooth, sine, triangular etc.
4.	Power transmission by shaft, belts and ropes.	Block diagram of ECG recorder.

5.	**Friction:** Law of friction, co-efficient of friction, angle of friction, advantage and disadvantage of friction.	Block diagram of Blood pressure measuring instrument.
6.	**Force:** Resolution and Composition of forces. Representation of forces by vectors, simple problems on lifting tackles like Jib wall, crane solution of problems with the aid of vectors, General condition of equilibrium for series of forces on a body.	————————
7.	**Gravity:** Centre of Gravity, simple experiments stable, unstable and neutral equilibrium.	————————

9.2 EMPLOYABILITY SKILLS

CORE SKILL – EMPLOYABILITY SKILL	
First Semester	
1. English Literacy	**Duration : 20 Hrs.** **Marks : 09**
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
Speaking / Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
2. IT Literacy	**Duration : 20 Hrs.** **Marks : 09**
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
Computer Operating System	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
Word processing and Worksheet	Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.
Computer Networking and Internet	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web

	page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills	**Duration : 15 Hrs.** **Marks : 07**
Introduction to Communication Skills	Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort.
Listening Skills	Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.
Motivational Training	Characteristics Essential to Achieving Success. The Power of Positive Attitude. Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning.
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.
Behavioral Skills	Problem Solving Confidence Building Attitude
Second Semester	
4. Entrepreneurship Skills	**Duration : 15 Hrs.** **Marks : 06**
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.

Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
Institutions Support	Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	**Duration : 10 Hrs.** **Marks : 05**
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
Comparison with developed countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education	**Duration : 15 Hrs.** **Marks : 06**
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.

Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in -house environment.
7. Labour Welfare Legislation	**Duration : 05 Hrs.** **Marks : 03**
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.
8. Quality Tools	**Duration : 10 Hrs.** **Marks : 05**
Quality Consciousness	Meaning of quality, Quality characteristic.
Quality Circles	Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.

ANNEXURE-I

LIST OF TOOLS & EQUIPMENTS			
TECHNICIAN MEDICAL ELECTRONICS			
S No.	**Name of the Tools and Equipments**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Connecting screwdriver	100 mm	21 nos
2.	Neon tester	500 V.	21 nos
3.	Screw driver set	set of 5	21 nos
4.	Insulated combination pliers	150 mm	21 nos
5.	Insulated side cutting pliers	150 mm	21 nos
6.	Long nose pliers	150 mm	21 nos
7.	Soldering iron	25 W. 240 V.	21 nos
8.	Electrician knife		21 nos
9.	Tweezers	100mm	21 nos
10.	Digital Multimeter		21 nos
11.	Soldering Iron Change able bits	15 W	21 nos
12.	De- soldering pump		21 nos
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
13.	Fire extinguisher		lno
14.	First aid kit		lno
15.	Artificial Respiration Chart		2nos
16.	Rubber mat -	180x45x2.5 cm	3nos
17.	Rubber gloves pair		1 set
18.	Steel ruler	30 cm	lOnos
19.	Scriber	15 to 20 cm	4nos
20.	Center Punch	10 cm	4nos
21.	Hammer cross pane	110 cm with handle	4nos
22.	Hammer ball pane	220 cm with handle	4nos
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	2nos
27.	Saw tenon	25 cm	2nos
28.	Chisel wood	15cm set of 6mmto 25mm	2 sets
29.	Chisel cold flat	10mm	2nos
30.	Ratchet brace drill	10mm	2nos

31.	Electric drill	10mm	2nos
32.	Hacksaw	20-25cm (adjustable)	4nos
33.	Junior saw	20cm	2nos
34.	File flat	20cm 2nd cut	4nos
35.	File flat	15 cm bastard	4nos
36.	File half round	20cm bastard	4nos
37.	File round	20cm 2nd cut	4nos
38.	Instrument files (needle)	set of 12	2nos
39.	Vice bench	10cm jaw	2nos
40.	Vice bench	5cm jaw	2nos
41.	Taps set	3mm to 10mm (set of 9)	2nos
42.	Dies set	3mm to 10mm	2nos
43.	Grinder bench electric		1no
44.	Soldering iron	25 Watt	10nos
45.	Soldering iron	10 Watt	10nos
46.	Temperature controlled soldering station	15 Watt	2nos
47.	De-soldering pump		2nos
48.	Wire gauge set		2nos
49.	Feeler gauge		2nos
50.	Permanent bar magnet	15 cm	2nos
51.	Solenoid with core		2nos
52.	Electric bells		4nos
53.	Battery eliminator		8nos
54.	Batter storage lead acid		2nos
55.	Hydrometer		2nos
56.	Rheostats asserted values and ratings		10nos
57.	Variable resistors/Potentiometer		10nos
58.	Fractional H.P. AC meters		2nos
59.	Fractional H.P. DC meters		2nos
60.	Constant voltage transformer/Auto		4nos
61.	Auto Coil winding m/c. (manual)		1nos
62.	D.C./A.C. Ammeter	0-1mA	4nos
63.	D.C./A.C. Ammeter	0-5mA	4nos
64.	D.C./A.C. Ammeter	0-50mA	2nos
65.	D.C./A.C. Ammeter	0-100mA	2nos
66.	D.C./A.C. Ammeter	0-500mA	2nos
67.	Digital multi-meter		10nos
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	4nos
73.	D.C/A.C. Voltmeter	0-500V	2nos
74.	D.C/A.C. Voltmeter	0-5KV	2nos
75.	Watt meter	5/250V	2nos
76.	Insulation Tester		2nos
77.	Service Oscillator		4nos
78.	Signal tracer		4nos
79.	A.F. Oscillator		4nos
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.	-do- 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		4 nos
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
159.	Air conditioners		2 no
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. Electrical fuses - Assorted/ different types b. Thermal paper roll for ECG recorder. c. Conductivity gel for ECG isposable skin surface electrodes. d. Chemicals for pathology lab e. Medicated cotton.		As required
Note: - All the tools and equipment are to be procured as per BIS specification.			

TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
S No.	**Name of the Equipment**	**Quantity**
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500Va	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	20 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
Note: Above Tools & Equipments not required, if Computer LAB is available in the institute.		

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor:			**Year of Enrollment:**
Name & Address of ITI (Govt./Pvt.):			**Date of Assessment:**
Name & Address of the Industry:			**Assessment location: Industry/ ITI**
Trade Name:	**Semester:**		**Duration of the Trade/course:**
Learning Outcome:			

S No.	**Candidate Name**	**Father's/Mother's Name**	Safety Consciousness (15)	Workplace Hygiene (5)	Attendance/ Punctuality (10)	Ability to Follow Manuals/ Written Instructions (5)	Application of Knowledge (10)	Skills to Handle Tools & Equipment (10)	Economical Use of Materials (5)	Speed in Doing Work (10)	Quality in Workmanship (15)	VIVA (15)	**Total Internal Assessment Marks**	**Result (Y/N)**
Maximum Marks (Total 100 Marks)			**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**		
1														
2														