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

COMPETENCY BASED CURRICULUM

SEMICONDUCTOR TECHNICIAN

(Duration: One Year)

CRAFTSMEN TRAINING SCHEME (CTS)

SECTOR – ELECTRONICS & HARDWARE

Directorate General of Training

SEMICONDUCTOR TECHNICIAN

(Engineering Trade)

(Designed in 2024)

Version: 1.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL – 4.5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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

Kolkata – 700 091

www.cstaricalcutta.gov.in

CONTENTS

1. COURSE INFORMATION

During the one-year duration of Semiconductor Technician trade a candidate is trained on professional skill, professional knowledge & Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extra- curricular activities to build up confidence. The broad components covered under Professional Skill subject are as below:

This comprehensive course provides students with a thorough understanding of semiconductor technology and its application. It covers a wide range of topics, including the exploration of passive and active electronic components, semiconductor materials, cleanroom processes, assembly and packaging techniques, wafer probe testing, device physics, and semiconductor device applications. Emphasis is placed on safety precautions and environmental considerations, as well as practical exposure to engineering drawings and workshop calculation and science for real-world application. By the end of this course, students will possess the knowledge and skills needed to work with semiconductor components and devices while adhering to industry safety standards, making them well-prepared for careers in the semiconductor technology field.

2. TRAINING SYSTEM

2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of the economy/ labour market. The vocational training programs are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programs of DGT for strengthening vocational training.

'Semiconductor Technician' trade under CTS is one of the newly designed courses. CTS courses are delivered nationwide through a network of ITIs. The course is of one-year duration. It mainly consists of Domain area and Core area. In the Domain area (Trade Theory and Practical) impart professional skills and knowledge, while the core area (Employability Skill) imparts requisite core skills, knowledge, and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read and 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 & employability skills while performing the job and modification & maintenance work.
- Check the system specification and application software as per requirement of the design of job.
- Document the technical parameter related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as Semiconductor Technician and will progress further as Senior Technician and can rise up to the level of Project Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programs in different types of industries leading to a National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming an instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

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

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	840
2	Professional Knowledge (Trade Theory)	240
3	Employability Skills	120
	Total	**1200**

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

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

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

2.4 ASSESSMENT &CERTIFICATION

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

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

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

2.4.1 PASSREGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENTGUIDELINE

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
- Computer based multiple choice question examination
- Practical Examination

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

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	

For performance in this grade, the candidate 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 skills and accuracy in the field of work/ assignments. • A fairly good level of neatness and consistency to accomplish job activities. • Occasional support in completing the task/ job.
(b) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels and accuracy in the field of work/ assignments. • A good level of neatness and consistency to accomplish job activities. • Little support in completing the task/job.
(c) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels and accuracy in the field of work/assignments. • A high level of neatness and consistency to accomplish job activities. • Minimal or no support in completing the task/ job.

3. JOB ROLE

Semiconductor Technician is responsible for performing a range of tasks in the semiconductor manufacturing industry, including the assembly, testing, and maintenance of semiconductor components and devices. Their role involves operating specialized equipment, conducting quality control checks, troubleshooting issues, and following safety protocols in cleanroom environments. They also work with engineers to assist in the production, characterization, and development of semiconductor materials and devices, playing a crucial role in ensuring the efficient and accurate production of semiconductor products.

Reference NCO-2015: -

(a) 3114.9900 - Electronics and Telecommunications Engineering Technicians, Other

Reference NOS:

a) ELE/N9499
b) ELE/N9500
c) ELE/N9501
d) ELE/N9502
e) ELE/N9503
f) ELE/N9504
g) ELE/N9505
h) ELE/N9506
i) ELE/N9507
j) ELE/N9508
k) ELE/N9509
l) PSS/N9401
m) PSS/N9402
n) MEP/N9477

4. GENERAL INFORMATION

Name of the Trade	**SEMICONDUCTOR TECHNICIAN**
NCO - 2015	3114.9900
NOS Covered	ELE/N9499, ELE/N9500, ELE/N9501, ELE/N9502, ELE/N9503, ELE/N9504, ELE/N9505, ELE/N9506, ELE/N9507, ELE/N9508, ELE/N9509, PSS/N9401, PSS/N9402, MEP/N9477
NSQF Level	Level-3.5
Duration of Craftsmen Training	One Year (1200 Hours+150 hours OJT/Group Project)
Entry Qualification	Passed 12th class examination with Science (Physics & Mathematics) or equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	60 sq. m
Power Norms	5.5 KW
Instructors Qualification for:	
1. Semiconductor Technician Trade	B.Voc/Degree in Electronics / Electronics and Telecommunication/ Electronics and communication Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Electronics / Electronics and telecommunication/ Electronics and communication from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field **OR** NTC/NAC passed in the Trade of Electronics Mechanic/ Semiconductor Technician with three years' experience in the relevant field. **Essential Qualification:** Relevant Regular / RPL variants of National Craft Instructor Certificate (NCIC) under DGT.

	NOTE: Out of two Instructors required for the unit of 2 (1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.
2. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability.
3. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

1. Describe the fundamental properties, characteristics and applications of semiconductor materials, including crystal structures, energy bands and carrier behavior. (NOS: ELE/N9499)
2. Familiarize with passive and active electronic components built with semiconductor technology and Exposure to various semiconductor component, devices, sensors, small circuits. (NOS: ELE/N9500)
3. Identify semiconductor Materials and Processes management. (Simulation) (NOS: ELE/N9501
4. Demonstrate assembly and packaging of semiconductor technology and Attain exposure to do assembly and packaging tools and operations. (NOS: ELE/N9502)
5. Perform wafer probe testing and physical characterization and attain practical exposure on wafer level and package level electrical and physical characterization; ESD safe tools used in work environment. (NOS: ELE/N9503)
6. Demonstrate Semiconductor Device Applications. (NOS: ELE/N9504)
7. Follow Safety precaution and Environmental Considerations. Safety Hazards, Hazardous gas and chemical Handling, Environment Safety containment procedure for accident handling including first aid. (NOS: ELE/N9505)
8. Interpret on chemical, gases, instrumentation, Automation, Vacuum Technology, HVAC etc. (NOS: ELE/N9506)
9. Handle and operate robotics system procedure. (NOS: ELE/N9507)
10. Exposure to Equipment e.g. RF Generator, Temperature Controller, Pressure Gauges, Pumps, Conditioners, etc. (NOS: ELE/N9508)
11. Operate and Handle of High Voltage System. (NOS: ELE/N9509)
12. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Describe the fundamental properties, characteristics and applications of semiconductor materials, including crystal structures, energy bands and carrier behavior. (NOS: ELE/N9499)	Demonstrate the fundamental properties of semiconductor materials.
	Explain energy band theory including the concepts of valence and conduction bands, the band gap and role of energy bands in semiconductor behavior.
	Describe the crystal structure of common semiconductor materials.
	Explain carrier behavior in semiconductors including the concepts of electrons and holes, carrier mobility and carrier concentration.
	Explain practical application of semiconductor materials in various fields.
2. Familiarize with passive and active electronic components built with semiconductor technology and Exposure to various semiconductor component, devices, sensors, small circuits. (NOS: ELE/N9500)	Identification of different passive, active components and ICs.
	Measure the resistor, capacitor and inductor values.
	Construction and test RC time constant circuits.
	Construct and test series and parallel resonance circuits (Use of R, L and C); RC differentiator.
	Plot the I-V characteristics of a PN junction diode under forward and reverse bias conditions.
	Use diodes and transistors to build and test simple circuits. This could include rectifier circuits, amplifier circuits, or oscillator circuits.
	Curve tracer for electrical measurements of resistors, diodes, transistors, etc.
	Measure and compare the Silicon, Germanium diode I-V (both forward and reverse) characteristics.
	Measure and compare the I-V (both forward and reverse) characteristics of diodes with different break down voltages.
	Explain use of LED and photodiodes.
	Construct and test Zener based voltage regulator circuit.
	Measure NPN and PNP I-V characteristics.
	Measure N-type and P-type MOS transistor characteristics.
	Construct and test a common emitter amplifier.
	Construct and test BJT and MOS transistor-based switching circuits.
	Construct and test a FET amplifier.
	Measure the performance and characteristics of various

	semiconductor devices.
3. Identify semiconductor Materials and Processes management. (Simulation) (NOS: ELE/N9501)	Identify and select various semiconductor materials, such as silicon, germanium, and gallium arsenide.
	Prepare semiconductor materials for device fabrication including processes like cleaning, etching, or surface passivation.
	Demonstrate the doping of semiconductors to create n-type and p-type materials.
	Carryout oxidation processes used in semiconductor fabrication, such as thermal oxidation.
	Carryout the photolithography, a key process in semiconductor fabrication.
	Demonstrate the deposition processes like chemical vapor deposition (CVD) or physical vapor deposition (PVD).
	Heat the wafer to activate dopants and repair crystal damage caused by ion implantation.
	Create MOS transistors involves defining gate source and drain regions.
	Build metal layers to connect various components on the chip.
	Insulate layers separate metal layers to prevent electrical interference.
	Mount the ICs in protective packages with pins for external connections.
	Check individual dies on a wafer for defects and electrical functionality.
	Ensure that packaged ICs meet their specifications before shipment.
	Reduce the environmental impact of semiconductor fabrication through cleaner processes and recycling.
4. Demonstrate assembly and packaging of semiconductor technology and Attain exposure to do assembly and packaging tools and operations. (NOS: ELE/N9502)	Semi-conductor packages made of plastic/ceramic; package types: DIP, PGA, BGA, CQFP, etc
	Wafer dicing, die attach, die wire bonding, sealing;
	Microscopic Inspection of assembly & packaging.
	Various packaging techniques used to protect the semiconductor device and provide external electrical connections.
5. Perform wafer probe	Using testing equipment to measure the properties of the fabricated

testing and physical characterization and attain practical exposure on wafer level and package level electrical and physical characterization; ESD safe tools used in work environment. (NOS: ELE/N9503)	semiconductor devices.
	Microscope Inspection, Wafer Nos and Ids noting
	Probe card, probe card handling, loading, alignment, wafer probing, measurement of resistance, diode, transistor IV-characteristics, etc.
	ESD safe protocols: precautions while handling packaged devices: ESD strap, ESD mats, ionisers, etc.
	Charge Induction in Electrostatics
	Charge Conduction in Electrostatics
	Pith ball pendulum Electroscope
	Relative charges of different rods with the help of Digital Display in millivolts
	Electrostatic Charge with the help of Charge Demonstration Tube
	Electrostatic Charge by the combination of different rods & cloths
6. Demonstrate Semiconductor Device Applications. (NOS: ELE/N9504)	Use software tools to design and simulate digital and analog circuits using semiconductor devices.
	Design and implement logic gates, flip-flops and memory cells using CMOS technology.
	Build analog component such as operational amplifies, voltage regulators and analog filters.
	Design and analyze power semiconductor devices like MOSFETs, IGBTs and thyristors, UJT, FET, etc.
	Fabricate simple circuits on a breadboard or printed circuit board (PCB), and test their performance.
	Measure the output of a solar cell under different light conditions, or testing the performance of an LED or laser diode.
	Observe the activities with semiconductor sensors, such as measuring temperature with a semiconductor temperature sensor, or light intensity with a photodiode.
	Measure the gain of an RF amplifier, or the frequency response of an RF filter.
	Integrate semiconductor sensors into Internet of Things (IoT) devices for data collection and control.
	Apply in smart homes, wearable devices and Industrial IoT.
	Examine semiconductor application in vehicle control systems, safety features and infotainment.
	Use in engine control units (ECUs), anti lock braking systems (ABS) and advanced driver assistance systems (ADAS).
	Implement semiconductor devices in medical imaging, monitor

	equipment and diagnostic tools.
	Identify the application of semiconductor technology in medical electronics viz. X-ray machines, MRI scanners and wearable health devices.
7. Follow Safety precaution and Environmental Considerations. Safety Hazards, Hazardous gas and chemical Handling, Environment Safety containment procedure for accident handling including first aid. (NOS: ELE/N9505)	Proper handle, storage and dispose of hazardous chemical used in semiconductor manufacturing including acids, solvents and gases
	Implement safety data sheets (SDS) and chemical hygiene plans
	Use Personal protective equipment (PPE).
	Handle safely of toxic and flammable gases, including installation and maintenance of gas delivery systems
	Care of electrical hazard awareness and precautions for working with high voltage equipment.
	Adherence to cleanroom procedures, including gowning, contamination control and strict adherence to cleanliness standards.
	Monitor and maintain controlled environments for manufacturing.
	Maintain environmental regulations.
	Measurement of the EMI radiations from electronic circuitry or machines for safe environmental conditions based on regulatory norms.
	Implement energy-efficient practices and equipment to reduce the carbon footprint of semiconductor manufacturing facilities.
8. Interpret on chemical, gases, instrumentation, Automation, Vacuum Technology, HVAC etc. (NOS: ELE/N9506)	Use of Temperature and Humidity sensor, and different type of gas sensor.
	Signal conditioning blocks likes Types of Amplifiers, Filters and Converters.
	Use of PLC Ladder Programming.
	Working of Pressure Transmitter, Temperature Transmitter, Flow Transmitter Level Transmitter
9. Handle and operate robotics system procedure. (NOS: ELE/N9507)	Program the path of 6 axis robot through PC.
	Control the motors through PC.
	Control the Arm and X-Y directions of the motors, using any external controller.
10. Exposure to Equipment e.g. RF Generator,	How to use PID Controller as on/off Controller P, PI and PID Controller.

Temperature Controller, Pressure Gauges, Pumps, Conditioners, etc. (NOS: ELE/N9508)	How to Use PID Temperature Controller as On/off Controller.
	Working of Air Conditioners
	Working of pressure gauge Bourdon Tube Pressure Gauge, Diaphragm Pressure Gauge, Capsule Pressure Gauge, Differential Pressure Gauge working and its application
	Heater Temperature Control using PID Controller.
11. Operate and Handle of High Voltage System. (NOS: ELE/N9509)	Measurement of (Dielectric Strength) of transformer oil Breakdown Voltage
	Operating principle of over voltage relay, Under voltage relay, Neutral failure protection, over current relay, Earth fault relay, Contactor, Star- delta starter & timer.
	Demonstration and operational working of dielectric Strength of Transformer Oil at 80KVolt
	Testing & measurement of electrical insulation to keep power system running smoothly.
	Handling clamp meter to measure the current flowing through a conductor without touching it.
	Illustrate operation and working of Earth Leakage Detector that simply clamp around a conductor and gives a reading of the actual leakage current
12. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
13. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	Solve different mathematical problems.
	Explain concept of basic science related to the field of study.

7. TRADE SYLLABUS

SYLLABUS FOR SEMICONDUCTOR TECHNICIAN TRADE			
DURATION: ONE YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional skills 20 Hrs. Professional Knowledge 10 Hrs.	Describe the fundamental properties, characteristics and applications of semiconductor materials, including crystal structures, energy bands and carrier behavior.	1. Testing and characterization of diodes in different configurations (rectifiers, voltage regulators, etc.). 2. Measuring diode characteristics, including forward and reverse biasing. 3. Practical testing of semiconductor material properties such as Band Gap of Diode and of wafer by using Four Probe method. 4. Measure the Hall voltage and learn Hall Effect, resistivity, mobility, and thermal conductivity. 5. Measure the junction temperature of two different materials and Potential difference by using Seeback & Peltier effect apparatus 6. Planck's constant measurement for understanding the photoconductivity 7. Identification of different	• Introduction to semiconductors, distinguishing them from conductors and insulators. • Introduction to crystal structures and their role in semiconductor materials. • Atom and Electrons • Energy band theory and the concept of valence and conduction bands. • Intrinsic and Extrinsic Semiconductors • Understanding the difference between pure (intrinsic) and doped (extrinsic) semiconductors. • Concepts of electron and hole carriers in semiconductors. • Calculating carrier concentration and mobility. • Understanding the Fermi level and its importance in carrier behavior. • How doping affects the Fermi level. • Conductivity in semiconductors and its temperature dependence.

		passive, active components and ICs. 8. Measure the resistor, capacitor and inductor, transistor, diode values. 9. Assembling basic semiconductor devices and circuits. 10. Verifying device functionality and performance.	• Carrier Generation and Recombination: • Processes of carrier generation and recombination. • How they impact the electrical behavior of semiconductors. • Detailed study of common semiconductor materials like silicon and gallium arsenide. • Thermal, mechanical, and electrical properties of these materials. • How semiconductor materials are used in various devices, including diodes, transistors, and photovoltaic cells. • Understanding defects and impurities in semiconductor materials. • Their impact on material properties and device performance. • Understanding the Energy band gap and measurement in semiconductor Diodes& Wafer – Germanium • Understanding the principle of Hall Effect in Semiconductor material • Study the Seeback & Peltier Effect • Study the Photoconductivity in semiconductor materials and Planck's constant

Professional skills 90 Hrs. Professional Knowledge 30 Hrs.	Familiarize with passive and active electronic components built with semiconductor technology and Exposure to various semiconductor component, devices, sensors, small circuits.	11. Construction and test RC time constant circuits. 12. Construct and test series and parallel resonance circuits (Use of R, L and C); RC differentiator. 13. Plot the I-V characteristics of a PN junction diode under forward and reverse bias conditions. 14. Use diodes and transistors to build and test simple circuits. This could include rectifier circuits, amplifier circuits, or oscillator circuits. 15. Understand the internal fabrication design of Transistor 16. Understand the internal fabrication design of IC 17. Familiarity with curve tracer for electrical measurements of resistors, diodes, transistors, etc. 18. Measure and compare the Silicon, Germanium diode I-V (both forward and reverse) characteristics. 19. Measure and compare the I-V (both forward and reverse) characteristics of diodes with different break down voltages. 20. Learn the use of LED and photodiodes.	• Conductors, Insulators and Semiconductors • Current, Voltage and Power • Resistors, Resistors in series and parallel • Ohms Law and Kirchhoff's Laws • Resistor colour coding, Specification of various types of resistors and their applications • Capacitors and capacitance • Series and Parallel connection of capacitors • Inductors and inductance, Types of inductors and their construction • Semiconductor material (Silicon, Germanium, Compound Semiconductors) • PN Junction diode and their construction, Diode I-V characteristics • Understanding how changes in temperature can affect the electrical properties of semiconductors. • Brief introduction to basic semiconductor devices like diodes, transistors, and their principle of operation. • Light Emitting Diode, Photodiode, Zener Diode; Solar cells • Bipolar Junction Transistors, NPN and PNP BJTs and their characteristics • Metal Oxide Semiconductor

		21. Construct and test Zener based voltage regulator circuit. 22. Measure NPN and PNP I-V characteristics. 23. Measure N-type and P-type MOS transistor characteristics. 24. Construct and test a common emitter amplifier. 25. Construct and test a FET amplifier. 26. Measure the performance and characteristics of various semiconductor devices.	(MOS) Capacitor and MOS Transistor • MOS Capacitor and MOS Transistor Characteristics • Integrated Circuits (ICs) • Identification of different ICs (Operational amplifiers, timers etc.) • Various types of sensors: temperature, flow and vacuum. • Test and measurement of Resistor, capacitor, inductor, Diode, Transistor, Sensor
Professional skills 100 Hrs. Professional Knowledge 20 Hrs.	Identify semiconductor Materials and Processes management. (Simulation)	27. Identify and select various semiconductor materials, such as silicon, germanium, and gallium arsenide. **Modelling cum simulation software for leaning fabrication process of semiconductor devices -** 28. Using simulation software to model the behavior of semiconductor devices. 29. Fabricate simple semiconductor devices and test their performance. This could involve techniques like photolithography, etching, and deposition. 30. Prepare semiconductor	**Semiconductor Materials**: Detailed study of commonly used semiconductor materials, such as silicon, germanium, and gallium arsenide. Understanding their properties, advantages, and disadvantages. **Doping**: Understanding the concept of doping and how it changes the properties of semiconductors. Studying the process of creating n-type and p-type semiconductors. **Oxidation**: Learning about the oxidation process, its purpose in semiconductor fabrication, and how it affects the properties of the semiconductor. • Photolithography: Exploring the theory behind exposing photoresist patterns

		materials for device fabrication including processes like cleaning, etching, or surface passivation. 31. the doping of semiconductors to create n-type and p-type materials. 32. Carryout the photolithography, a key process in semiconductor fabrication. 33. Demonstrate the deposition process. 34. Process documentation understating • Check sheet • QC tools • Work instruction • Process parameter Window • Audit sheet • Design of experiment • Statistical Process control • Line Balancing • OEE	onto wafers using masks and light sources. • Resolution and alignment: Factors influencing the resolution of photolithography and methods for alignment. **Deposition Processes**: Learning about various deposition processes used in semiconductor fabrication, such as chemical vapor deposition (CVD), physical vapor deposition (PVD), and atomic layer deposition (ALD). **Etching**: Understanding the purpose of etching in semiconductor fabrication and studying different etching techniques, such as wet etching and dry etching. **Ion Implantation**: Studying the process of ion implantation, which is used to dope the semiconductor wafer. Understanding how it works and how it affects the properties of the semiconductor. **Annealing**: Learning about the annealing process, which is used to repair damage to the semiconductor caused by processes like ion implantation. **Metallization**: Understanding the process of metallization, which involves depositing a thin layer of metal on the semiconductor wafer to form

			electrical connections. **Packaging**: Studying the final steps in semiconductor fabrication, which involve packaging the semiconductor device to protect it and provide electrical connections.
Professional skills 100 Hrs. Professional Knowledge 20 Hrs.	Demonstrate assembly and packaging of semiconductor technology and Attain exposure to do assembly and packaging tools and operations	35. Practical exposure to variety of semi-conductor packages made of plastic/ceramic; package types: DIP, PGA, BGA, CQFP, TQFP, SOIC, SOC, Lead frame, Flip chip etc. 36. Microscopic Inspection and measurement of various package types. 37. Observe various packaging techniques used to protect the semiconductor device and provide external electrical connections.	• Assembly and packaging process's introduction • Package types • Package design principles • Lead frames • Wire bonding (Different materials, Wire loop concept, Gold, silver and copper wire) • Lead Finish and Trim – Solder Ball Attach • Die attach • Transfer Moulding • Testing • Wafer Dicing • Glue and Chemicals in Various packaging
Professional skills 100 Hrs. Professional Knowledge 20 Hrs.	Perform wafer probe testing and physical characterization and attain practical exposure on wafer level and package level electrical and physical characterization; ESD safe tools used in work environment.	38. Using testing equipment to measure the properties of the fabricated semiconductor devices. 39. Measurement of resistance, diode, transistor IV-characteristics, etc. 40. ESD safe protocols: practices and precautions while handling packaged devices: ESD strap, ESD mats, ionizers, etc.	• Physical characterization of semiconductor structures: SEM and pre-SEM Sample preparation • Electrical test and measurement • Introduction to probe station, source measure units (SMUs) and Power supplies • Wafer probing, measurement and data analysis • Electrostatic Discharge and

		41. Measures relative intensity of charge in millivolt Charge polarity. Testing the charge behaviour of materials like Teflon, Perspex Silk, Cotton, Woolen. 42. Pith ball pendulum - Single & pair to understand the basics concepts of ESD	its prevention and measurement
Professional skills 100 Hrs. Professional Knowledge 20 Hrs.	Demonstrate Semiconductor Device Applications**.**	43. Use software tools to design and simulate digital and analog circuits using semiconductor devices. 44. Design and implement logic gates, flip-flops and memory cells using CMOS technology. 45. Build analog component such as operational amplifies, voltage regulators and analog filters. 46. Design and analyze power semiconductor devices like MOSFETs, IGBTs and thyristors. 47. Construct and test BJT and MOS transistor-based switching circuits. 48. Understanding the Power Electronics applications & circuitry of Semiconductor devices like – IGBT- MOSFET, etc 49. Fabricate simple circuits on a breadboard or	• Theoretical concepts of semiconductor devices like transistors are used in digital logic circuits, including gates, flip-flops, and memory cells. • Use of semiconductor devices in analog circuits, such as amplifiers, oscillators, and filters. • Application of power semiconductor devices in converters, inverters, and motor drives. • Semiconductor devices are used in signal processing circuits for filtering, amplification, modulation, and demodulation. • Application of opto-electronic devices in communication systems, display technologies, and solar energy conversion. • Use of semiconductor devices in sensors for temperature, pressure,

		printed circuit board (PCB), and test their performance. 50. Measure the output of a solar cell under different light conditions, or testing the performance of an LED or laser diode. 51. Observe the activities with semiconductor sensors, such as measuring temperature with a semiconductor temperature sensor, or light intensity with a photodiode. 52. Measure the gain of an RF amplifier, or the frequency response of an RF filter. 53. Integrate semiconductor sensors into Internet of Things (IOT) devices for data collection and control. 54. Apply in smart homes, wearable devices and Industrial IOT. 55. Examine semiconductor application in vehicle control systems, safety features and infotainment. 56. Implement semiconductor devices in medical imaging, monitor equipment and diagnostic tools 57. Identify the application of	light, magnetic fields, etc., and in transducers for converting one form of energy into another. • Application of semiconductor devices in integrated circuits for various functions, including microprocessors, memory chips, and application-specific integrated circuits (ASICs). • Semiconductor devices viz. microcontroller and sensors application in automobiles enabling various systems that enhance safety., performance and overall functionality. For engine control, Anti-lock Braking Systems (ABS), Electronic stability Control (ESC), Airbag systems, infotainment systems, Advance Driver Assistance systems (ADAS), Power steering, climate control, Keyless entry and start, LED lighting, Electric and Hybrid vehicles etc. • In RF circuits for wireless communication, radar systems, and microwave applications. • Emerging applications of semiconductor devices in areas like flexible electronics, quantum computing, and

		semiconductor technology in medical electronics viz. X-ray machines, MRI scanners and wearable health devices. 58. Experiment the basic concepts of PV technology like photon to electricity conversion, Series and parallel connections of solar PV Modules, VI characteristics of Solar module.	bioelectronics. • Importance of reliability and lifetime in various applications of semiconductor devices, and studying the factors that can affect these parameters. • Understanding the Solar PV Technology as an application of Semiconductor material for green Energy generation
Professional skills 100 Hrs. Professional Knowledge 20 Hrs.	Follow Safety precaution and Environmental Considerations**.** Safety Hazards, Hazardous gas and chemical Handling, Environment Safety containment procedure for accident handling including first aid.	59. Proper handle, storage and dispose of hazardous chemical used in semiconductor manufacturing including acids, solvents and gases 60. Implement safety data sheets (SDS) and chemical hygiene plans 61. Use Personal protective equipment (PPE). 62. Hanle safely of toxic and flammable gases, including installation and maintenance of gas delivery systems 63. Care of electrical hazard awareness and precautions for working with high voltage equipment. 64. Adherence to cleanroom procedures, including gowning, contamination	• Potential hazards in the semiconductor industry, including chemical hazards, electrical hazards, and radiation hazards. Learning about safety measures and best practices to mitigate these risks. • Safe handling, storage, and disposal of chemicals used in semiconductor fabrication, including acids, bases, solvents, and toxic gases. • Risks associated with high voltage equipment and electrostatic discharge (ESD), and the safety measures to protect against these risks. • Potential sources of radiation in the semiconductor industry,

		control and strict adherence to cleanliness standards. 65. Monitor and maintain controlled environments for manufacturing. 66. Maintain environmental regulations and measure the EMI Radiations to understand the regulations 67. Implement energy-efficient practices and equipment to reduce the carbon footprint of semiconductor manufacturing facilities. 68. Study and use of CO2 sensor, O2 sensor, Air temperature & humidity sensor, Atmospheric pressure sensor, PM 2.5 & PM10 sensor, UV index sensor, Solar radiation sensor.	such as ion implantation equipment and X-ray lithography systems, and the safety measures to protect against radiation exposure. • EMI EMC radiations and measurement for safe environment working conditions • The types of PPE used in the semiconductor industry, including lab coats, gloves, safety glasses, and respirators. • Environmental impact of semiconductor manufacturing processes, including resource consumption, waste generation, and greenhouse gas emissions. • Types of waste generated by semiconductor manufacturing, and the methods for treating and disposing of this waste in an environmentally responsible manner. • Energy consumption of semiconductor manufacturing processes, and strategies for improving energy efficiency. • Working ofCO2 sensor, O2 sensor, Air temperature & humidity sensor, Atmospheric pressure sensor, PM 2.5 & PM10

			sensor, UV index sensor, Solar radiation sensor. • How to Use appropriate personal protective equipment (PPE) such as gloves, goggles, masks, and protective clothing.
Professional skills 50 Hrs. Professional Knowledge 10 Hrs.	Interpret on chemical, gases, instrumentation, Automation, Vacuum Technology, HVAC etc.	69. Study and use of Temperature and Humidity sensor, and different type of gas sensor. 70. Study of Signal conditioning blocks likes Amplifiers, Filters and Converters. 71. Study and use of PLC Ladder Programming. 72. Working of Pressure Transmitter, Temperature Transmitter, Flow Transmitter Level Transmitter. 73. How to Measure vacuum of close chamber using vacuum gauge and vacuum, Pump Vacuum.	• Understanding the concept of LEL Gas Detection • Learn the detailed fundamentals of signal conditioning and its importance in instrumentation. • PLC Role in automation and Process control. • Understanding the concept of Component used in Automation like PLC, HMI, Different Pressure Transmitter, Control Valve, PID Controller. • Types of sensor working used in chemical and gas industry like Pressure Transmitter, Temperature Transmitter, Flow Transmitter Level Transmitter. • Knowledge of working of Vacuums Pump and Gauge. • Understanding of HVAC System and its component like Thermostat, Furnace or Heat Pump, Air Conditioner, Ductwork, Air Filters, Vents and Registers, Fans and Blowers, Humidifiers and

			Dehumidifiers, Controls and Sensors: HVAC systems use various controls and sensors to monitor and regulate temperature, humidity, and air quality.
Professional skills 80 Hrs. Professional Knowledge 10 Hrs.	Handle and operate robotics system procedure.	74. Program the path of 6 axis robot through PC. 75. Control the motors through PC. 76. Control the Arm and X-Y directions of the motors, using any external controller.	• Identify the Robotic Components & its application. • Study the principles of pick and place robots, including their mechanical structure, actuators, sensors, and control systems. • Working concept of DC Motor, Servo motor and stepper motor. • Study of motor driver circuits and the different types of motor drivers available for DC motors.
Professional skills 50 Hrs. Professional Knowledge 10 Hrs.	Exposure to Equipment e.g. RF Generator, Temperature Controller, Pressure Gauges, Pumps, Conditioners, etc.	77. Study and use of RF generator. 78. Measurement of Guide wavelength, Free Space Wavelength and SWR using Measuring Line. To measure the forward & Return loss Characteristics and power division, isolation. 79. Illustrate the characteristics of Isolator & Circulator. To study the characteristics of RF switch & RF Mixer. 80. Use PID Controller as on/off Controller P, PI	• Working Concept of RF Switch, RF Mixer, Isolator, Circulator, Generator. • Fundamental of Control system like open and close loop. • Identify, select, Install, wire, configure, test the performance, maintain, and service various types of ON-OFF and PID controllers. • Types of pressure gauge Bourdon Tube Pressure Gauge, Diaphragm Pressure Gauge, Capsule Pressure Gauge, Differential Pressure Gauge working and its

		and PID Controller. 81. Use PID Temperature Controller as on/off Controller. 82. Interpret Working of Air Conditioners. 83. Interpret Working of pressure gauge Bourdon Tube Pressure Gauge, Diaphragm Pressure Gauge, Capsule Pressure Gauge, Differential Pressure Gauge working and its application.	application. • Types of Conditioners and identification of its component used in AC Conditioners.
Professional skills 50 Hrs. Professional Knowledge 10 Hrs.	Operate and Handle of High Voltage System.	84. Demonstration and operational working of dielectric Strength of Transformer Oil at 80KVolt 85. Understanding the testing & measurement of electrical insulation to keep power system running smoothly. 86. Study and handling clamp meter to measure the current flowing through a conductor without touching it. 87. Illustrate operation and working of Earth Leakage Detector that simply clamp around a conductor and gives a reading of the actual leakage current. 88. Study the operating principle and working of various switchgear &	• The dielectric strength of insulating oil in high voltage Transformers • Testing and understanding the insulation tester and Clamp meter and Earth Leakage tester • A relays and contactors are basic devices for protection of HVAC System.

		protection devices to protect from various abnormal conditions such as under voltage, Neutral failure, over current, Over voltage, Earth fault, etc.	
ENGINEERING DRAWING			
Professional Knowledge ED -30 Hrs.	Read and apply engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instrument – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Freehand drawing of– • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke Symbolic representation– • Different Electronic symbols used in the related trades Reading of Electronic Circuit Diagram. Reading of Electronic Layout drawing. **Material Science** • Types metals, types of ferrous and non-ferrous metals. Introduction of iron and cast iron.	
WORKSHOP CALCULATION & SCIENCE			
Professional Knowledge WCS -30 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion. Factors, HCF, LCM and problems. Fractions - Addition, subtraction, multiplication & division. Decimal fractions - Addition, subtraction, multiplication & division. Solving problems by using calculator. **Square root, Ratio and Proportions, Percentage**	

		Square and square root. Simple problems using calculator. Applications of Pythagoras theorem and related problems. Ratio and proportion. Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction. **Material Science** Types metals, types of ferrous and non-ferrous metals. Introduction of iron and cast iron. **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals. Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature. **Basic Electricity** Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel. Ohm's law, relation between V.I.R & related problems. Electrical power, energy and their units, calculation with assignments. Magnetic induction, self and mutual inductance and EMF generation Electrical power, HP, energy and units of electrical energy. **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
On The Job Training/Project Work		

SYLLABUS FOR CORE SKILLS

1. Employability Skills (Common for all CTS trades) (120 Hrs.)

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

ANNEXURE-I

List of Tools & Equipment			
SEMICONDUCTOR TECHNICIAN (for batch of 24 candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Connecting screwdriver	10 X 100 mm	12 Nos.
2.	Neon tester 500 V.	500 V	8 Nos.
3.	Screw driver set	Set of 7	12 Nos.
4.	Insulated combination pliers	150 mm	8 Nos.
5.	Insulated side cutting pliers	150mm	10 Nos.
6.	Long nose pliers	150mm	8 Nos.
7.	Soldering iron	25Watt, 240 Volt	12 Nos.
8.	Electrician knife	100 mm	8 Nos.
9.	Tweezers	150 mm	12 Nos.
10.	Digital Multimeter	(3 3/4 digit) ,4000 Counts	12 Nos.
11.	Soldering Iron Changeable bits	15Watt, 240 Volt	8 Nos.
12.	De-soldering pump electrical heated, manual operators	230 V, 40 W	12 Nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
Lists of Tools:			
13.	Steel rule graduated both in Metric and English Unit	300 mm,	4 Nos.
14.	Precision set of screw drivers	T5, T6, T7	2 Nos.
15.	Tweezers – Bend tip		2 Nos.
16.	Steel measuring tape	3 meter	4 Nos.
17.	Tools makers vice	100mm (clamp)	1 No.
18.	Tools maker vice	50mm (clamp)	1 No.
19.	Crimping tool (pliers)	7 in 1	2 Nos.
20.	Magneto spanner set	8 Spanners	2 Nos.
21.	File flat bastard	200 mm	2 Nos.
22.	File flat second cut	200 mm	2 Nos.
23.	File flat smooth	200 mm	2Nos.
24.	Plier - Flat Nose	150 mm	4 Nos.
25.	Round Nose pliers	100 mm	4 Nos.
26.	Scriber straight	150 mm	2 Nos.

27.	Hammer ball pen	500 grams	1 No.
28.	Allen key set (Hexagonal -set of 9)	1 - 12 mm, set of 24 Keys	1 No.
29.	Tubular box spanner	Set - 6 - 32 mm	1 set.
30.	Magnifying lenses	75 mm	2 Nos.
31.	Continuity tester		6 Nos.
32.	Hacksaw frame adjustable	300 mm	2 Nos.
33.	Chisel - Cold - Flat	10 mm X 150 mm	1 No.
34.	Scissors	200mm	1No.
35.	Handsaw 450mm	Hand Saw - 450 mm	1 No.
36.	Hand Drill Machine Electric with Hammer Action	13 mm	2 Nos.
37.	First aid kit		1 No.
38.	Bench Vice	Bench Vice - 125 mm	1 No. each
		Bench Vice - 100 mm	
		Bench Vice - 50 mm	
List of Equipment			
39.	SMD Technology Kit with wall chart	SMD component identification board with SMD components Resistors, Capacitors, Inductors, Diodes, Transistors & IC's packages. Proto boards with readymade solder pads for various SMD Components. SMD Soldering Jig and Wall chart	2 nos.
40.	Smart SMD tweezer Handheld	SMD tester tweezer with Inductance, capacitance, resistance, and diode test capabilities.	2 nos.
41.	Multiple Output DC regulated power supply	0-30V, 2 Amps, + 15V Dual Tracking ,5V/5A, Display digital, Load & Line Regulation: ± (0.05 %+100 mV), Ripple & Noise <= 1 mVrms constant Voltage & Current operation	4 nos.
42.	DC Regulated Variable Programmable DC Power Supply	0-30V/3A with numeric keypad, PC interface and LCD for Voltage, Current & Power	2 nos.
43.	100 MHz Mixed Signal	100MHz Mixed Signal	1 no.

	Oscilloscope (4 Analog + 16 Digital Channel)	Oscilloscope (4 Analog + 16 Digital Channel) with 1.25GSa/s real time sampling rate, 12bit vertical resolution, 200µV/Div to 10V/div vertical sensitivity, 50Mpts Memory depth, 1,000,000 wfms/s waveform capture rate and 7 inch multi touch display.	
44.	35 MHz Arbitrary Waveform Generator with Digital Display for Frequency and Amplitude	35MHz, 2 Channel Arbitrary Function Generator with 125MSa/s sample rate, 16 bit vertical resolution, 7 Digit 240MHz frequency counter, min 150 built in waveform, 8Mpts record length, min 8th order harmonic generator and 4.3 inch touch screen display.	1 no.
45.	6½ Digit Digital Multi-meter	6.5 Digit DMM with 2,200,000 count, 200mV to 1000V (DC); 200mV to 750V (AC) voltage range, 200uA to 10A (AC/DC) current range, any sensor measurement using software, max measuring speed 10 K rdgs/s, Real time trend display and histogram display function, standard interface like USB Device, USB Host, LAN, RS-232, GPIB, support U-disc storage, 256X64 LCD.	1 no.
46.	SMD Soldering & De soldering Station with necessary accessories	SMD Soldering & De-soldering, Station Digitally Calibrated, Temperature Control SMD, Soldering & De-soldering, Power Consumption 60 Watts, I/P Voltage 170 to 270 V, De-soldering 70-Watt, Temperature Range 180 to, 480º Centigrade.	1 no.
47.	3.2GHz Spectrum Analyzer with built-in Tracking Generator	9KHz to 3.2GHz Spectrum Analyzer with tracking generator, 1Hz frequency resolution, 10Hz RBW, DANL: <-	1 no.

		161 dBm (typ.), phase noise min. < -98 dBc/Hz @ 10 kHz, offset amplitude DANL to +20 dBm, advance measurement functions like harmonic distortion, TOI, emission bandwidth, channel power, occupied bandwidth, time domain power, CNR, adjacent channel power, pass / fail and 8-inch WVGA display, PC Interface: USB Host & Device, LAN(LXI)	
48.	LCR Meter	Test Parameter: L-Q, C-D, R-Q, |Z|-Q Basic Accuracy: 0.2% Rang mode: Auto, Hold Measurement speed: Fast: 12, Med: 5.1, Slow: 2.5 (meas/sec) Correction Function: Open/Short multi frequency Zeroing Measurement Terminals: Five Terminals Test Frequency: 100Hz, 120Hz, 1kHz, 10kHz, Output impedance: 30E, 100E Signal level: 0.3Vrms, 1Vrms Measurement Display Range |Z|, R: 0.1m□ - 99.99M□ C 100Hz/120Hz: 1□F - 99999□F 1KHz: 0.1□F - 9999.9□F 10KHz: 0.01□F - 999.99□F L 100Hz/120Hz: 1pH - 99999H 1KHz: 0.1pH - 9999.9H 10KHz: 0.01pH - 999.99H D: 0.0001 - 9.999 Q: 0.0001 - 9999	1 no.

		□□: -999.99% - 999.99% Display: Large character LCD with backlight	
49.	Digital Video Microscope	Image resolution: 60F/S •White Balance: Auto •Light: Auto •Negative: Support •Mirror: Left/right, Up/Down •Freeze: Support •Working distance: 50~155mm •56 LED Adjustable Compact Microscope Ring Light: •Provides intense and focused shadow-free illumination •Lighting direction changeable •100,000 hours of life •Inside diameter of the ring light: 1.0" (27mm) •Overall outside diameter: 1.77" (45mm)	1 no.
50.	Electrical Safety Trainer	Demonstration of importance of earthing in any electrical device. Arrangement to study role of fuse and types of slow blow, high blow fuse in any electronic circuit. Arrangement to study the importance of MCB and it's working.	1 no.
51.	Analog Circuits Training Platform	Breadboard for Circuit design DC power supply: +5V,1A (Fixed); +12V, 500mA (Fixed); ±12V, 500mA (Variable) AC power Supply: 9V-0V-9V, 500mA Function Generator: Sine, Square, Triangle (1Hz to	10 no.

		100KHz) Modulating Signal Generator: Sine, Square, Triangle (1Hz to 10KHz). Voltage, current and frequency on board LCD display. PC Interface – Acquisition from two analog input channel Simulation Software Modules: Diode Characteristics (Si, Zener, LED) Rectifier Circuits Diode as Clipper Circuit, Diode as Clamping Circuit, Zener as voltage regulator.	
52.	Digital Circuits Training Platform	Breadboard: Regular DC Supply: +5 V/1 A +12V/1A Clock Frequency 4 different steps from 1Hz – 100KHz Amplitude: (TTL), 128x64 Graphical LCD, Pulser Switches, Data Switches: 8 Nos, LED: 8 Nos. (TTL), Seven Segment Display, Teaching & Learning Simulation Software	10 no.
53.	RF Signal Generator (3.6 GHz)	Frequency Range: 3.6 GHz, -100dBc/Hz Phase Noise, +13dBm to -110dBm, Amplitude Accuracy<0.5dB, 2ppm Modulation: AM, FM, Phase, IQ-modulation	1 no.
54.	Real Time Spectrum Analyzer	Frequency Range: 9 kHz to 1.5 GHz. Resolution Bandwidth (-3 dB): 1 Hz to 3 MHz Min. -141 dBm DANL Frequency span: Max. 10 MHz Built in Tracking Generator USB Host, USB Device, LAN (LXI) Real-time Analysis Bandwidth: upto 10 MHz Upto 10” touch display	1 no.

55.	Semiconductor Modelling Simulation Software	**Semiconductor Devices modelling Simulation Software** The Software License allows access to all frameworks, one tool at a time, for minimum 3 year subscription License supports any combination of products (if available) on Linux, Windows platforms Software License should be used anywhere on your wide area network Software Licenses should available in incremental blocks **Software License Framework List** 2D Core Process Simulator Advanced Implantation Simulator Advanced 2D Optical Lithography Simulator Advanced Physical Etching and Deposition Simulator 2D Deposition and Etch Simulator 2D Device Simulation Framework 2D Silicon Device Simulator 2D Device Simulator for Advanced Materials 2D Device Simulator 2D Non-Isothermal Device Simulator Mixed Mode: 2D Circuit Simulation for Advanced 2D Devices Ferroelectric Field Dependent Permitivity Model 2D Magnetic Device Simulator 2D Simulation Models for Quantum Mechanical Effects 2D Opto electric Device Simulator Light Emitting Diode Simulator	5 user

		Vertical Cavity Surface Emitting Laser Simulations Semiconductor Laser Diode Simulator 2D Amorphous and Polycrystalline Device Simulator Organic Display: OLED and OTFT Organic Display Simulator Organic Solar: Organic Solar Cell and Photo detector Simulator 2D Small Signal Noise Simulator 3D Device Simulation Framework 3D Device Simulator 3D Non-Isothermal Device Simulator 3D Circuit Simulation for Advanced Devices 3D Magnetic Device Simulator 3D Simulation Models for Quantum Mechanical Effects 3D Opto electric Device Simulator 3D Amorphous and Polycrystalline Device Simulator 3D Thermal Packaging Simulator Import capability from Athena <u>Interactive Tools</u> 1D/2D Interactive Visualization Tool 3D Interactive Visualization Tool Structure and Mesh Editor 3D Structure and Mesh Editor Run-Time Environment Integrated Layout Editor Software should have 10 Interactive Tool licenses	
56.	Electronics Circuit Simulation	Circuit Design and Simulation	1 no.

	Software (25 users)	Software with PCB Design with Gerber and G Code Generation, 3D View of PCB, Breadboard View, Fault Creation and Simulation.	
57.	CMOS Simulation Software (25 users)	A tool must support followings: Nanosheet field effect transistor (NSFET) with 3mm technology. A schematic editor and support various digital models. A Verilog description of schematic for layout generation. Facility to convert CMOS layout in schematic, compatible with DSCH, facility to convert MOSFET into FINFET structure. Facility to Import/Export CIF layout from 3rd party layout tools. FinFet device support with 2D cross section, 3D visualization, and layout construction. It should have simulation of non-volatile memories such as EPROM, EEPROM and FLASH using double-gate MOS. 200-pages documentation including several aspects of logic design It should support more than 200 basic circuits to be provided, which should be ready to simulate.	1 no.
58.	CPLD and FPGA Development Platform	Onboard input-output, ADC, DAC Memory, Displays, keyboard & peripherals.	10 nos.

		16-bit logic I/O, 8-bit ADC & DAC interface, 3 ½ digits seven segment display, LCD Interface, push buttons, hex keypads, switches FPGA Daughter Card specifications: Xilinx Family: Spartan 3, Device density: 400k gates, On board: 8 MHz crystal, Master reset Key: For hardware reset. Configuration Method: JTAG CPLD Card: Device density: 2400 gates, 108 macro cells, 8 MHz crystal, JTAG interface (boundary scan)	
59.	Multi-Instruments with Analog and Digital Boards	Consists of dual-channel Digital Storage Oscilloscope (50 MHz), sine, square, ramp, triangle, and arbitrary waveforms generator (DC to 4MHz), real time signal analyser and logic analyser Digital I/O for testing.	2 nos.
60.	Data Acquisition with sensors: temperature, humidity, noise, vibration, light, airborne particles, flow, vacuum sensors.	Data Acquisition with sensors: temperature, humidity, noise, vibration, light, airborne particles, flow, vacuum sensors.	1 no.
61.	Microcontroller kits (8051) along with programming software (Assembly level Programming) With six important different application modules	Core 8051 MCU clocked at 11.0592 MHz, supporting both programming modes Keypad and computer, LCD for both programming and run mode, ready to run programmer to support family of controllers AT89C52, DC Power Supplies +12V, -12V, +5V & -5V, Breadboard to make circuits, Learning content through	2 nos.

		simulation Software and following application modules. 1. Input Interface: 4x4 Matrix Keypad, ASCII Keypad, Four Input Switch 2. Display 16X2 LCD, Seven Segment, LED Bar Graph DAQ: 4ch analog 10bit, 22 DIO resolution,6MHz Frequency Counter (square wave), DAQ with PC interface software	
62.	Different Microcontroller / Processor Training and Development Platform for AVR, PIC, ARM and Arduino.	MCU PIC16F877A, 4MHz, Onboard programmer will program PIC Devices, USB Port MCU ATMEGA8515 ,8MHz, onboard programmer will program ATMEGA series microcontroller, USB Port MCU LPC2148, 12MHz, LED 8Nos, ADC 10 bit 10Nos, DAC 10bit, USB and RS232, RTOS support, JTAG Connector, USB2.0, Onboard Zigbee, I2C, SPI, RTC, DC motor, PWM, Sensor LM35, Display 16X2 LCD Display, Motor Drive: L293D 600mA (5-12V), Programmer USB Interface. Microcontroller ATmega328p (Arduino Based), 16MHz, Digital I/O Pins: 14 (of which 6 provide PWM output), Flash Memory: 16KB (of which 2KB used by boot loader) Each platform should have Bread DC Power Supplies +12V, -12V, +5V & - 5V, Breadboard to make circuits.	2 nos.
63.	Wireless Communication modules for interfacing with microcontrollers	Core 8051 MCU clocked at 11.0592 MHz, supporting both programming modes Key Pad and PC, LCD for both programming mode and run mode, ready to run programmer to support family	2 nos.

		of controllers AT89C51/52 & 55, DC Power Supplies +12V, -12V, +5V & - 5V, Breadboard to make circuits, detailed learning content through simulation Software and following application modules: RFID Card Reader, Finger Print, Zigbee, GPS, GSM, Bluetooth and WiFi	
64.	Semiconductor packages Demonstration Board	Observe the variety of semi-conductor packages made of plastic/ceramic; package types: DIP, PGA, BGA, CQFP, TQFP, SOIC, SOC etc.	
65.	PCB Design and Development Setup	Working area: 200mm × 300mm × 50mm, Resolution: 0.5µm, 0.03 mm Drill Performance, 40,000 RPM Spindle speed, Automatic Tool Change, Tool Length Detect and PCB Surface Detect, at least 100 strokes / min drill performance. Should be provided with Dust Enclosure	1 no.
66.	Semiconductor Energy band gap apparatus for diode	DC Power Supply: +15V, 2.5A +6V, 2.6 A Diode : O A79 P - N junction Germanium Type PC Interfacing using USB/RS232 ports and supporting software Switch : 1 Pole, 2 Way Display: 16 x 2 LCD Measurement Voltage: 0 to 15V Current: 0 to 50µA (approximate) Temperature: 0 to 60°C Oven Height : 77mm Width: 74mm Coil: Nichrome Wire Dimensions (mm): W 345 x D 240 x H 110 Fuse : 0.5A	1 no.

67.	Semiconductor Four probe Band Gap measurement Apparatus	Four Probes Contacts: Spring loaded Space between Probes: 2 mm ±2% Probes: Collinear Sample Material: Germanium crystal **Oven** Maximum Temperature: Ambient to 150 °C Heater Resistance: 45Ω Heater Voltage: 50V AC Temperature Sensor: LM35 (0 to 150 °C) **Measurement Unit** Display: LCD 16 x 2 characters Measuring Parameter: Current, voltage, temperature simultaneously Constant Current Generator Current Range : 0 to 15mA (approximately) Resolution: 1mA Open Circuit Voltage: 18V • Probes are mounted on a Teflon bush, which ensure a good electrical insulation • PC Interfacing using USB/RS232 ports and supporting software	1 no.
68.	Semiconductor behavior in magnetic field – Hall effect	1) Gauss and Tesla meter Nvis 621 Microcontroller Based LCD Display for Measurement of Magnetic Field in Gauss and Tesla, With PC Interface facility. Sensor : InAs for better sensitivity Range : 0-20kG Special feature: Indicate the direction of the magnetic field Mains: 230V AC ±10%, 50Hz PC interface: RS232 2) Measurement unit Nvis 622	1 no.

		Probe current: 20Ma (maximum) Heater current: 0-700mA Temperature: 0-100°C Hall voltage: 200mV (maximum) Mains: 230V AC ±10%, 50Hz PC Interfacing using USB/RS232 ports and supporting software **A) Hall probe** Crystal: p-type lightly doped Resistivity: As on probe Thickness: As on probe B) Temperature Sensor: Temperature is Measured with PT-100 3) Constant Current Power Supply Nvis 623 Current range: 0 to 3.5A Output voltage: 20V Display: LCD, 16 x 2 Mains: 230V AC ±10%, 50Hz 4) Electromagnet Poles: 25mm diameter Coils: 2 Nos. Resistance: 5Ω (approximate) Input current: 3.5A at 20V Weight: 16kg	
69.	EMI solution for semiconductor devises	Low frequency magnetic field 1Unit (µT) Measuring range Resolution Accuracy 20.00... 200.0 µT 0.01µT, 0.1 µT ±12% + 5 digits at50/60 Hz Unit (mG) Measuring range Resolution Accuracy 200.0... 2000 mG 0.1mG, 1 mG ±12% + 5 digits at50/60 Hz Low frequency electromagnetic field Unit V / m Measuring range Resolution Accuracy 50V/ m ... 2000V / m 1V/ m	1 no.

		±7% + 20 digits at50/60 Hz High frequency electromagnetic field Unit mV / m, V /m Measuring range Resolution Accuracy 30.0mV / m ... 11.00V / m 0.01,0.1 mV / m 1.0dB at 1V / m 0.01V/ m and900 MHz, >1V / m are only used for reference Unit µW / cm² Measuring range Resolution 0.02... 32.0 µW / cm² 0.01,0.1 µW / cm² Unit µW / m², mW /m² Measuring range Resolution 2.3µW / m² ... 320.9 µW / m² 0.1,1 µW / m² 0.1mW / m² Unit mA / m Measuring range Resolution 0.07... 29.1-mA / m 0.01,0.1-mA / m Bandwidth High frequency: 50 MHz ... 3.5GHz Low frequency: 50/60Hz Number of sensors: Magnetic field: 3, Electromagnetic field:1 Measuring rate - 1Hz	
70.	Thermal conductivity – Seeback & Peltier Effect	Display LCD (16 x 2) Temperature Range: 0 - 150°C Resolution: 0.1°C Voltage Range: 0 - 2000mV Resolution: 0.1mV Glass Beaker: 250ml Fan: 3V Adaptor Input: 220 - 240V, 50 /	1 no.

		60Hz Adaptor Output: 5V, 1A Dimension (mm): W 250 x D 300 x H 20 PC Interfacing using USB/RS232 ports and supporting software	
71.	Desktop computer with latest configuration	Desktop computer with latest configuration	12 nos.
72.	Electrostatic Charge & Discharge Training System	**Plates with Maximum surface** Wall Plate (approx.): 300mm (L) x 600mm (W) x 3mm (H) Foot Plate (approx.): 420mm (L) x 220mm (W) Low battery Indication: Warning at 7.5 V ESD Antistatic Wrist Strap: 1no. **Electrostatic Discharge (ESD) Tester** Battery: 9 Volt Battery Indication: Visual by different color LED's Digital This platform should also have a training kit to demonstrate the concept of Electrostatic charge and discharge. Display: Measures relative intensity of charge in millivolt Charge polarity Indicators: Blue LED - Negative charge, Green LED - Positive charge Rods: Teflon, Perspex Clothes: Silk, Cotton, Woolen Pith ball pendulum: Single & pair is provided for different Observations	1 no.

73.	Understanding the Basic Electricity Fundamentals	DC Power Supply: 5V, 200mA AC Power Supply: 6V, 1A Relay: 5V Galvanometer: 30 - 0 - 30 Galvanometer Resistance: 80W Light Bulbs: 6V Potentiometers: 25W, 1W, 10kW, 1W Switch: 1 Pole, 2 Way Toggle type Core Types: E, I, U **Coils** No. of Turns Wire Dimension Maximum Current Inductance (mm) (Amp) (Approximate) 200 Turn 0.818 1.46 590 mH 400 Turn 0.573 0.728 2.3 mH 800 Turn 0.404 0.363 9.2 mH 1600 Turn 0.251 0.144 34.2 mH 3200 Turn 0.170 0.072 134 mH Fuse : 1A To be supplied with **Learning simulation software**	2 nos.
74.	Fabricating Transistors using Diodes	DC Power Supply: Fixed: +5 V, -5 V, +12 V & -12 V Variable: +1.2 to +10 V & -1.2 to -10 V Transistor: BC547 & BC557 Ammeter: Range: 1µA to 200 Ma Display: 3½ digits Voltmeter: Range: 1mV to 200 V Display: 3½ digits	2 nos.

		Mains Supply: 230 V AC ±10% Dimension (mm): W 450 x D 280 x H 11 **Provided with Data acquisition facility:-** Analog Inputs : 4 Inputs with 10 bit resolution Analog Output:2 Output 10 bit resolution Digital Inputs : 11 TTL Inputs Digital Outputs: 11 TTL Outputs Unity gain amplifier: 2 (0 to 10) Counter: 0 to 6 MHz (square wave) Power Supply: 12VDC PC Interface: USB 2.0 Interactive simulation software provided for learning enhancement on the given topic.	
75.	Fabricating IC using Transistors	**Fixed DC Power Supply** DC Output Voltage (Fixed): +12V, -12V, +5V, - 5V Current (Max.) : 200mA Ripple :<2 mVrms Power Supply : 230 V ±10%, 50 / 60 Hz Dimensions (mm): W 85 × D 150 × H 65 Weight : 250gm (approx.) **Provided with Data acquisition facility :-** Analog Inputs : 4 Inputs with 10 bit resolution Analog Output:2 Output 10 bit resolution	2 nos.

		Digital Inputs : 11 TTL Inputs Digital Outputs: 11 TTL Outputs Unity gain amplifier: 2 (0 to 10) Counter: 0 to 6 MHz (square wave) Power Supply: 12VDC PC Interface: USB 2.0 Interactive simulation software provided for learning enhancement on the given topic.	
76.	VI Characteristics of Various Semiconductor Diodes	On Board DC power supply: +12V DC Ammeter Range:1µA to 200mA Display:3½ digit Voltmeter Range :1mV to 200V Display:3½ digit Facility to test Silicon, Germanium, LED , Zener Diodes in forward and reverse mode	2 nos.
77.	Transistor Characteristics	DC Power Supply: Fixed: +5 V, -5 V, +12 V & -12 V Variable: +1.2 to +10 V & -1.2 to -10 V Transistor: BC547 & BC557 Ammeter: Range: 1µA to 200 Ma Display: 3½ digits Voltmeter: Range: 1mV to 200 V Display: 3½ digits Facility for testing PNP & NPN transistors in CC – CB – CE Modes	2 nos.

78.	MOSFET – FET – UJT Semiconductor devices Characteristics	DC Fixed Power Supply: -5V, +15V, +35V DC Variable Power Supply: 1.5V to 14 V 1.5V to 34V Voltmeter: 0-200V Ammeter: 0-200mA Bread Board Dimension: 175x61x10mm Distribution strips: 2 Distribution holes: 200 Terminal Strips: 1 Terminal holes: 640 Resistor Bank: M.F.R. 100E 1W (3 Nos.): M.F.R. 470E 1W (3 Nos.): M.F.R. 1K 1W (3 Nos.) Variable Resistances: 5 KΩ Ten turn Potentiometer (1 No.): 10 KΩ Ten turn Potentiometer (1 No.): 5 KΩ Single turn Potentiometer (1 No.) Fuse: 500 mA, slow blow	2 nos.
79.	Experiment with Solar Energy – An application of Silicon Semiconductor material	Solar Panel: Consists of 6 solar cells Maximum Voltage of each solar cell: 2V DC Maximum Current of each solar cell: 150mA DC Voltmeter : 0-10V DC Ammeter : 0-500mA DC Potentiometer: 5K Rechargeable Ni-Cd Battery: 1.2V DC Bulb : ~2V, ~250mA DC Fan : ~2V, ~400mA DC FM Band Radio : 12V DC Solar PV Module Analyzer :	1 no.

		Provided with PC interface facility and its analysis software Power Supply : +5V DC DC Voltage Range : 0-50V DC Current Range : 10A Measurement Max. Voltage (Vmax) : at P max Max. Current (Imax) : at P max Voltage at Open Circuit :Voc Current at Short Circuit :Isc Instant Power : W Battery : 9V Rheostat 100Ω, 15A	
80.	Photoconductivity Experiment of Semiconductor material	Planck's Constant Experiment by using - DC Power Supply : 0-5 V LED Type : Super bright Size : 5 mm Colours : Blue, Green, Orange, Red and Yellow DC Voltmeter Display : 3½ digit Range : 200mV - 200V DC Ammeter Display : 3½ digit Range : 2µA- 200mA	1 no.
81.	Power Electronics Semiconductor Devices Experiment Lab	Size of Breadboard : 172.5 mm × 128.5 mm DC Power Supply : +5 V, -5 V 500 mA, +12V, -12 V 500 mA +15 V, 250 mA +35V, -35V, 250 mA AC Power Supply : 18V-0V-18V, 0V-15V On board Firing Circuits	2 nos.

		Frequency range : 30Hz to 900Hz variable Amplitude : 12V PWM control of G1, G2, G3 and G4 Duty cycle control of "Gate" Signal is 0 to 100% SCR Assembly : 4 SCRs 2P4M, 400V/2A Power Devices : IGBT-G4BC20S, MOSFET- IRFZ44N, UJT-2N2646, DIAC- DB3, TRIAC-BT136, PUT-2N6027 Pulse transformer on board : 2 nos. PT4502 1:1 and one is PT4503 1:1:1 Circuit Components on board: Electrolytic Capacitor 1uF, 63V Metalized Capacitor 0.1uF, 63V Metalized Capacitor 0.33uF, 63V Diode 1N4007, Inductor 68mH, Inductor 68mH, Inductor 10mH Load selector : 6 load resistances- 47E/7W, 120E/5W, 270E/5W, 2K2/2W, 1K/1W, 1K/10W Power Supply (Mains) : 220V/110V, 50Hz/60Hz **Power Electronics Modelling &Simulation Software –**	
82.	Sensor Signal Conditioning System	7" capacitive display , Connectivity USB, Ethernet & HDMI , Square Wave Generator : up to 40KHz Low Pass Filter : up to 30KHz High Pass Filter : after 40KHz Inverting Amplifier : Variable Gain 1-10 Non Inverting Amplifier : Variable Gain 2-10 Differential Amplifier : Variable Gain 1-10	1 no.

		Instrumentation Amplifier : Variable Gain 10-20 F/V converter : 1KHz –1V 10 KHz – 10V V/F Converter : 1V – 1KHz 10V – 10 KHz A/D Converter : 4 Channel (0-5V) D/A Converter : 1 Channel (0-3.3V) Input/Output Ports : 4-IP / 4-0P	
83.	Automation training kit	Toggle switches : 4 nos. Push to ON switches : 3 nos. Proximity sensor : 1 no. Selector switch : 1 no. Visual indicators : 4 nos. Audio indicator : 1 no. DC motor : 1 no. Relay card : 1 no. (Contains 2 relays) Contactor : 1 no. , PLC with 12 Digital Inputs , 8 Digital Outputs and Programming cable with Ladder Programming and Simulation Software.	1 no.
84.	Industrial Sensor Kit	**For Temperature Measurement** RTD/Thermocouple temperature display: 1 no. Display: 4 digit, 7 segment digital display Keys: 3 for digital setting Input type: RTD (PT100) & thermocouple Resolution: 1 or 0.1 degree S Thermistor temperature display: 1 no. Display: 4 digit«, 7 segment digital display Keys: 3 for digital setting Input type: Thermistor Resolution: 1 or 0.1 degree S RTD sensors: 1 no. Type : RTD (PT100) Wire: 3 wire Temperature range: (-99 to 850°C) Thermocouple sensors : 1 no. Type : K type Wire : 2 wire Temperature range :-200 to 1250°C Thermistor : 1 no.	1 no.

		Temperature measuring range :-50 to 99°C. **For Pressure Measurement** Capacitive pressure transducer: 1 no. Range: 0-90 Psi Output: 4-20mA Type: Capacitive Load cell: 1 no. Maximum bearable weight: 5kg. Load cell type : Strain guage/shear beam Output : 10 gram/10mV Current display : 1 no. Display : 4 digit, 7 segment digital display Keys : 3 for digital setting Input type : Current (4-20mA) Supply voltage : 230V AC **For Level Measurement** Capacitive transducer : 1 no. Housing enclosure : Cast aluminum weather proof Supply : +24V DC Response time : 0.5s to 5 sec Output : 4 to 20mA Range : 230mm User interface : 4 digit display with 4 keys and LED Float switch : 1 no. Contact rating : 10 W. Switching voltage : 220 V. Contact resistance : 100 m?. Current display : 1 no. Display : 4 digit, 7 segment digital display Keys : 3 for digital setting Input type : Current (4-20mA) Resolution : 1 or 0.1 degree Supply voltage : 230V AC	
85.	6-Axis Robotic Kit	Work Area (mm) : 400 x 400 Gripper AOF : 180° Gripper Payload : 250g Stepper Motors : 3 nos. Servo Motors : 4 nos.	1 no.

		Control System : PWM 1520 µsec Neutral Drive type X & Y Axis: Belt Driven – 2 Axis Z Axis: Servo Motor Driven – 4 Axis	
86.	Air Conditioner Training kit	Compressor wobble plate type • condenser parallel flow type suitable for car • Evaporator serpentine type with thermostatic expansion valve, blower motor and grill. • Receiver with sight glass and other accs. • All ideal controls and safety controls for car ac. • Single phase electric motor 1.0 HP to run the compressor • evaporator fan and to operate magnetic clutch of compressor. • Other accs. like on/off switch, fan speed selector and complete wiring jack and clips. Digital temperature indicator in test chamber.	1 no.
87.	RF Generator Training KIT	**Microwave Generator** Frequency Range : 2.2 - 3GHz continuously variable Display : 16 x 2 LCD Display , RF level : 5mW Output Level Variation : 10 - 20 dB Operating Modes : Sweep, CW, Int. AM, Int. FM, Ext. AM, PC communication Modulating VSWR Meter Sensitivity : 0.1µV for 200 ohm input impedance for full scale deflection Also should be provided with Isolator	1 no.

		Circulator RF Mixer RF Switch Power divider	
88.	Breakdown voltage training system	Mains Supply: 230V AC ±10%, 50Hz Single Phase Variac : 230V/ 0-270V High Voltage Source : 80kV, 20mA HV Control Motor Type : Servo RPM : 500 (No Load) Voltmeter : 0 to 100kV	1 no.
89.	Industrial Electrical Protection Training System	Over current relay: 1-63 A(adjustable) : Default- 40A Earth fault relay : 1 no. RCCB Current : 25 Amp Pole : 2 Earth leakage sensitivity : 30 mA Push button : 3 nos.(ON, OFF, Reset) Contactor : 3 nos. Over load relay : 1no Timer : 1 no. Earth leakage sensitivity : 30 mA Frequency:47 Hz to 53 Hz Function: Detection & tripping for undervoltage / over voltage / neutral fail / reverse phase	1 no.
90.	PID Training kit	Temperature Sensor : 10mV/C Light Sensor : Photo Conductive Cell (LDR) Light Source : 2 LED's V/F : Input 0-5V Output 0-5 KHz Approximately) F/V : Input 0-5 KHz Output 0-5V (Approximately) V/I : 4 to 20mA Clock Generator : 0-43.50 KHz Analog Inputs : 4 Inputs with 10 bit resolution DAQ Analog Output : 1 Output 10 bit resolutions DAQ Digital Inputs : 11 TTL Inputs DAQ Digital Outputs : 11 TTL Outputs DAQ Unity gain amplifier: 2 (0V to 10V) DAQ Frequency Counter : 0 to 6 MHz (Square Wave) DAQ PC Interface : USB 2.0	1 no.
91.	Intelligent Environment	Microcontroller: ATMega2560	1 no.

	Parameters measurement	Sensors and actuator 1 no. each Color LCD : 1.77 inch Battery : 3.7V/4400mAh USB : 2.0 Wi-Fi module : 1 no. (2.4GHz) Zigbee transceiver: 2 nos. (2.4GHz/63mW) Flash memory: 256 KB of which 8 KB used by boot loader SRAM: 8 KB Temperature sensor: 0 - 100C Humidity sensor: 0 – 100 %RH CO2 sensor: 0-2000ppm Atmospheric pressure sensor: 15- 115kPa Solar radiation sensor: 0 to 2000W/m2 O2 sensor: 0-25% Dust sensor: PM2.5 and PM10 UV Index sensor: 200nm-370nm Power Supply: 5V DC adaptor	
92.	Types of pressure gauge	Bourdon Tube Pressure Gauge, Diaphragm Pressure Gauge, Capsule Pressure Gauge, Differential Pressure Gauge Line Size: ¼" Pressure: 0-150Psi	1 no.
C. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			
93.	Instructor's table		1 no.
94.	Instructor's chair		2 nos.
95.	Metal Rack	100cm x 150cm x 45cm	4 nos.
96.	Lockers with 16 drawers standard size		2 nos.
97.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 nos.
98.	Black board/white board		1 no.
99.	Fire Extinguisher	Arrange all proper NOCs and equipment from Municipal/ Competent authorities.	

Note:

1. Internet facility is desired to be provided in the classroom.

ANNEXURE - II

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

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

List of Expert members participated for finalizing the course curriculum of Semiconductor Technician trade held at CSTARI, Kolkata on 29.11.2023			
S No.	**Name & Designation Sh/Mr./Ms.**	**Organization**	**Mentor Council Designation**
1.	S.K. Gupta, DDG (ER)	CSTARI, Kolkata	Chairman
2.	N. R. Aravindan, Director	CSTARI, Kolkata	Member
3.	G. C. Saha, Joint Director	CSTARI, Kolkata	Member
4.	P. Mukhopadhyay, Professor	MAKAUT	Member
5.	Uday Bhole, Dy. CEO	NVIS Technologis	Member
6.	S. Janardhanam, TO	NSTI, Chennai	Member
7.	N. P. Bannibagi, Deputy Director	NIMI Chennai	Member
8.	Rupa Chakraborty, Supervisior	P. Roy ITI, Amtala	Member
9.	Ruma Majumder (Mukhopadhyay), Foreman	Govt. ITI Kalyani, Now Deputed AT Govt. Women ITI Kolkata	Member
10.	Sarbani Majumder (Kar), Foreman	Govt. ITI, Tollygunge, Now Deputedat Women ITI, Banipur	Member
11.	Ananta Nandi, Supervisor	Govt. ITI Durgapur, Muchipara, West Bardhaman, West Bengal	Member
12.	Nitesh Kumar, Scientist 'B'	STQC ERTL (E), Salt Lake, Sec-V, Kolkata	Member
13.	Amit Kumar Mandal, Aristant Professor, BIT(TIG)	Bengal Imtitute of Technology (Unit of TIG)	Member
14.	Patra Kusum Misra, Asst. Prof., TCEA (TIG)	Techno College of Engineering, Agartala (Unit of TIG)	Member
15.	Asok Bandyopadhyay, Associate Director & Se-F, Head ICT & Services Group, C-DAC, Kolkata	C-DAC, Kolkata	Member

16.	Goutam Roy, P/L	Primeinfoserv, Kolkata	Member
17.	Ayan Saha	Primeinfoserv, Kolkata	Member
18.	Abhishek Anand, Asst. Director, RDSDE, WB	RDSDE, WB	Member
19.	Tapas Kumar Chini, Retied Senior Professor, Saha Institute of Nucular Physics	RKM Shilpavidyaatan, Belur	Member
20.	Sayan Mondal, Asst. Prof.	Bengal Institute of Technology Jantech, Kolkata	Member
21.	K. Bhagya Lakshni, TO	NSTI, Howrah	Member
22.	Manish Mishra, Asst. Director	NSTI, Howrah	Member
23.	Swami Gunindrananda, Principal	Ramakrishna Mission Shilpavidyalaya Private Industrial Training Institute Belurmath PU19000086	Member
24.	B. Umapathi, Group Head, VLSI Process Technology Development Group	Semi-Conductor Laboratory, MeitY, Mohali	Member
25.	Dr. S S KERUR, ASSOCIATE PROFESSOR	SDM COLLEGE OF ENGINEERING AND TECHNOLOGY, DHARWAD-580 002	Member
26.	Ishtiaq Kha, Program Director	TATA Technologies, Pune	Member
27.	Akshay Jadhav, Sr. Engineer	TATA Technologies, Pune	Member
28.	Rohit Yadav, Technical Lead	TATA Technologies, Pune	Member
29.	Neddhe Mahajan, Head of Human Resources	CDIL, New Delhi	Member
30.	Nitin Jain, Freelance Consultants	Electronics	Member
31.	Smitanjali Rout, Asst. Prof.	Centurion University	Member
32.	KVS Narayan, TO	CSTARI, Kolkata	Member
33.	B. Sharanappa, AD	CSTARI, Kolkata	Member
34.	B. K. Nigam, TO	CSTARI, Kolkata	Member
35.	Akhilesh Pandey, Asst. Director	CSTARI, Kolkata	Member
36.	Sk. Altaf Hossain, Asst. Director	CSTARI, Kolkata	Member
37.	PK Bairagi, TO	CSTARI, Kolkata	Member
38.	Budhaditya Biswas, TO	CSTARI, Kolkata	Member

ABBREVIATIONS:

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


कौशलं बलम्