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

COMPETENCY BASED CURRICULUM

IoT TECHNICIAN (SMART AGRICULTURE)
(INTERNET OF THINGS)
(Duration: One year)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 3.5

SECTOR –IT & ITES

Directorate General of Training

IoT TECHNICIAN (SMART AGRICULTURE)

(INTERNET OF THINGS)

(Non-Engineering Trade)

(Revised in March 2023)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL – 3.5

Developed By

Ministry of Skill Development and Entrepreneurship

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1. COURSE INFORMATION

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

In the first year, the trainee will select and perform electrical/ electronic measurement of meters and instruments. They will test various electronic components using proper measuring instruments and compare the data using standard parameter. The trainees will be able to Identify, place, solder and de-solder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. They will construct, test and verify the input/ output characteristics of various analog circuits. They will also assemble simple electronic power supply circuit and test for functioning and test and troubleshoot various digital circuits. They will install, configure, interconnect given computer system(s) and networking to demonstrate & utilize application packages for different applications. They will develop troubleshooting skills in various standard electronic circuits using electronic simulation software. Trainees will apply the principle of sensors and transducers for various IoT applications. They can explore the need of different signal conditioning and converter circuits. They will also identify, test and troubleshoot the various families of Microcontroller. Trainees will plan and interface input and output devices to evaluate performance with Microcontroller.The trainee will identify different IoT Applications with IoT architecture.

The trainees will identify different IoTapplications with IoT architecture. They willalso identify and select various types of sensors used in Smart Agriculture. Trainees will position the appropriate sensors and collect the information required in Smart Agriculture. The will identify and select different wireless communication modules and topology to generate and record the data. They will get knowledge of Solar Panel Basics Testing, Characteristics, Charge Controller Circuit. They can perform installation, configuration and working of IoT devices, network, database, app and web services. They will identify and install the devices used in green house. They will monitor soil moisture, temperature etc. for controlling irrigation & record data. They can select plant health monitoring system and apply proper water, fertilizer and pesticides. They will also Identify and install the appropriate device for livestock monitoring and Identify, select, install and troubleshoot the components of drones.They will be able to collect data using drones.

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 economy/ Labour market. The vocational training programmes 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 schemes of DGT for strengthening vocational training.

IoT Technician (Smart Agriculture)Trade under CTS is one of the newly designed courses. CTS courses are delivered nationwide through 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 & Practical) impart professional skills and knowledge, while Core area(Employability Skills) impart requisite core skill, knowledge and life skills.After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGTwhich is recognizedworldwide.

Trainee needs to demonstrate broadly 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 repair & maintenance work.
- Document the technical parameter related to the task undertaken.

2.2 PROGRESSION PATHWAYS

- Can join industry as IoT Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join as a technician in different IoT application industries for repair, servicing and installation of IoT devices.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of 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 DGTfrom time to time.

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

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

2.4.1 PASS REGULATION

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

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examination 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.

IoT Technician(Smart Agriculture);tests electronic components and circuits to locate defects, using instruments such as oscilloscopes, signal generators, ammeters and voltmeters. Replaces defective components and performs basic/SMD soldering/desoldering. Assembles, tests and troubleshoot various digital circuits. Constructs & tests electronic power supply circuit for proper functioning. Install, configure and interconnect different computer systems & networking for different applications. Develop various standard electronic circuits using electronic simulator software's. Applies the principle of sensors & transducers for various IoT applications. Plans & interfaces input & output devices to evaluate performance with microcontrollers.

The individual in this job identifies different IOT enabled system/application in agricultural field such as **Precision Farming, Livestock Monitoring, Agricultural Drones** etc. for farmers to maximize yields using minimal resources such as water, fertilizer and seeds. Selects **various types of sensors** as per requirement for Smart Agriculture. Positions appropriate sensors and collects necessary data like various types of soil properties including compaction, structure, pH and nutrient levels etc., soil temperature at various depths, rainfall etc. at predetermined intervals. Identifies and selects different **wireless communication** modules and topology such as Zigbee, Bluetooth, GSM module, WiFi, Ethernet, M2M Wireless Sensor Network (WSN) etc. Uses signals from GPS, Geographical information system (GIS) for more detailed analysis of fields. Identifies and install the appropriate devices such as Location Sensors, GPS & GPS integrated circuits, Wearable sensors to cattle for **livestock monitoring** by collecting data regarding the location, well-being and health of cattle. Installs the devices used in **green house** such as Carbon dioxide, Oxygen, Air temperature sensors etc. Apply various Precision Agriculture tools like Soil Mapping, Yield Mapping, Remote Sensing, Variable Rate Technology, Integrated Pest & Weed Management, Water Management etc. for precision irrigation. Applies knowledge of **Solar Panel** Basics Testing, Characteristics, Charge Controller Circuit etc. Selects **plant health monitoring system** and measures leaf health, lighting brightness, chlorophyll amount, ripeness level, Leaf Area Index (LAI) etc. for crop mapping, disease/pest location alerts, solar radiation predictions and right amount of fertilizing etc. Installs and troubleshoots the components of **drones/UAV** equipped with appropriate cameras, sensors (Optical Sensors etc.)and integrating modules (Raspberry Pi 3 B module) for crop monitoring & spraying, soil & field analysis, plant counting and yield prediction, plant height measurement, canopy cover mapping and so on.

Information and Communications Technology Installers and Servicers, Other; include installers and servicers who install, repair and maintain telecommunications equipment, data transmission equipment, cables, antennae and conduits and repair, fit and maintain computers not elsewhere classified

Reference NCO-2015: 7422.9900

Reference NOS: --

i.	ELE/N9401	viii.	SSC/N9445	xv.	SSC/N9452
ii.	ELE/N7001	ix.	SSC/N9446	xvi.	SSC/N9453
iii.	ELE/N7812	x.	SSC/N9447	xvii.	SSC/N9454
iv.	ELE/N5804	xi.	SSC/N9448	xviii.	SSC/N9455
v.	SSC/N9408	xii.	SSC/N9449	xix.	SSC/N9456
vi.	ELE/N1201	xiii.	SSC/N8239	xx.	SSC/N9457
vii.	SSC/N9444	xiv.	SSC/N9451		

4. GENERAL INFORMATION

Name of the Trade	**IoT TECHNICIAN (SMART AGRICULTURE)**
NCO - 2015	7422.9900
NOS Covered	ELE/N9401, ELE/N7001, ELE/N7812, ELE/N5804, SSC/N9408, ELE/N1201, SSC/N9444, SSC/N9445, SSC/N9446, SSC/N9447, SSC/N9448, SSC/N9449, SSC/N8239, SSC/N9451, SSC/N9452, SSC/N9453, SSC/N9454, SSC/N9455, SSC/N9456, SSC/N9457
NSQF Level	Level-3.5
Duration of Craftsmen Training	One Year(1200 hours + 150 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. Of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	70 Sq. m
Power Norms	3.45 KW
Instructors Qualification for	
1. **IoT Technician (Smart Agriculture) Trade**	B.Voc/Degree in Electronics / Electronics and Telecommunication/ Electronics and communication Engineering / Electronics & Instrumentation from AICTE/UGC recognized Engineering College/university with one-year experience in the relevant field. **OR** Diploma (Minimum 2 years) in Electronics / Electronics and telecommunication/ Electronics and communication/ Electronics & Instrumentation 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 "IoT Technician (Smart Agriculture)" 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 Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
Minimum Age for Instructor	21 Years
List of Tools & Equipment	As per Annexure – I

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. Perform electrical/ electronic measurement by selecting of single range with following safety precautions. (NOS: ELE/N9401)

2. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS: ELE/N7001)

3. Identify, place, solder and de-solder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. (NOS: ELE/N7812)

4. Construct, test and verify the input/ output characteristics of various analog circuits. (NOS: ELE/N5804)

5. Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N7812)

6. Install, configure, interconnect given computer system(s) and networking to demonstrate & utilize application packages for different applications. (NOS: SSC/N9408)

7. Develop troubleshooting skills in various standard electronic circuits using Electronic simulation software. (NOS: ELE/N1201)

8. Apply the principle of sensors and transducers for various IoT applications. (NOS: SSC/N9444)

9. Identify, select and test different signal conditioning and converter circuits. Check the specifications, connections, configuration and measurement of various types of sensor inputs as well as control outputs. (NOS: SSC/N9444)

10. Identify, Test and troubleshoot the various families of Microcontroller. (NOS: SSC/N9445)

11. Identify, test and interconnect components/parts of IoT system. (NOS: SSC/N9446)

12. Identify and select various types of sensors used in Smart Agriculture. (NOS: SSC/N9447)

13. Identify, select different wireless communication modules and topology to generate and record the data. (NOS: SSC/N9448)

14. Identify and test Wired & Wireless communication medium such as RS232, RS485, Ethernet, Fibre Optic, Wi-Fi, GSM, GPRS, RF etc. and Communication protocol. (NOS: SSC/N9448)

15. Test Solar Panel and Charge Controller Circuit. (NOS: SSC/N9449)

16. Perform installation, configuration and Check working of IOT devices, network, database, app and web services. (NOS: SSC/N8239)

17. Establish and troubleshoot IoT connectivity of devices to cloud having multiple communication medium, protocols, device management and monitoring. (NOS: SSC/N9451)

18. Demonstrate and Deploy responsive Web Application using APIs and generate reports using templates. (NOS: SSC/N9452)

19. Identify and install the devices used in green house. (NOS: SSC/N9453)

20. *Monitor soil moisture, temperature etc. for controlling irrigation & record data. (NOS: SSC/N9453)

21. *Select plant health monitoring system and apply proper water, fertilizer and pesticides. (NOS: SSC/N9454)

22. *Identify and install the appropriate device for livestock monitoring. (NOS: SSC/N9455)

23. * Identify, select and operate drone in various applications. (NOS: SSC/N9456)

24. *Collect data using Drones. (NOS: SSC/N9457)

*Note: * Artificial Intelligence (AI) and Machine Learning approach can be used by using AI enabled devices/Apps/ APIs. This can be achieved with the help of industry.*

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Perform electrical/ electronic measurement by selecting of single range with following safety precautions. (NOS: ELE/N9401)	Plan work in compliance with standard safety norms.
	Identify the type of electronic instruments.
	Measure the value of resistance, voltage and current using digital multimeter.
2. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS: ELE/N7001)	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Identify the different types of resistors.
	Measure the resistor values using colour code and verify the reading by measuring in multi meter.
	Identify the power rating using size.
	Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter.
	Identify different inductors and measure the values using LCR meter.
	Identify the different capacitors and measure capacitance of various capacitors using LCR meter.
3. Identify, place, solder and de-solder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. (NOS: ELE/N7812)	Identify the various crimping tools for various IC packages.
	Identify different types of soldering guns and choose the suitable tip for the application.
	Practice the soldering and de-soldering the different active and passive components, IC base on GPCBs using solder, flux, pump and wick.
	Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety norms.
	Identify SMD components, de-solder and solder the SMD components on the PCB.
	Check the cold continuity, identify loose/dry solder and broken

		track on printed wired assemblies and rectify the defects.
		Avoid waste, ascertain unused materials and components for safe disposal.
4.	Construct, test and verify the input/ output characteristics of various analog circuits. (NOS: ELE/N5804)	Ascertain and select tools and instruments for carrying out the jobs.
		Plan and work in compliance with standard safety norms.
		Practice on soldering components on lug board with safety.
		Identify the passive /active components by visual appearance, Code number and test for their condition.
		Construct and test the transistor based switching circuit
		Construct and test CE amplifier circuit
		Ascertain the performance of different oscillator circuits.
		Construct and test Clipper, Clamper circuit.
5.	Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N7812)	Illustrate to practice the digital trainer kit with safety.
		Identify various digital ICs, test IC using digital IC tester and verify the truth table.
		Test and verify the truth table of all gates using NOR and NAND gates.
		Test a decoder and encoder, multiplexer and de-multiplexer circuits and verify the truth table.
		Test a multiplexer and de-multiplexer and verify the truth table.
		Construct and verify the truth table of various flip flop, counter and shift register circuits.
6.	Install, configure, interconnect given computer system(s) and networking to demonstrate & utilize application packages for different applications. (NOS: SSC/N9408)	Plan, work in compliance with standard safety norms.
		Select hardware and software component.
		Install and configure operating systems and applications.
		Integrate IT systems into networks.
		Deploy tools and test programmes.
		Avoid e-waste and dispose the waste as per the procedure.
7.	Develop troubleshooting skills in	Identify & Select the component
		Prepare simple digital and electronic circuits using the software.

various standard electronic circuits using Electronic simulation software. (NOS: ELE/N1201)	Test the simulation circuit.	
	Convert the circuit into layout diagram.	
	Follow the instruction manual.	
8. Apply the principle of sensors and transducers for various IoT applications. (NOS: SSC/N9444)	Identify the sensor.	
	Select the sensor for proper applications.	
	Check the functioning of the sensor.	
	Measure the voltage of LVDT.	
	Measure the voltage output of Thermocouple, Resistance of RTD	
	Measure the voltage output of Load Cell/Strain Gauge, Smoke	
	Test Digital Output of Speed Sensor, Limit Switch, Optocoupler, Photo and Proximity Sensor	
	Follow instruction manual.	
9. Identify, select and test different signal conditioning and converter circuits. Check the specifications, connections, configuration, calibration and measurement of various type of sensor inputs as well as control outputs. (NOS: SSC/N9444)	Explore different driving circuits used for sensors.	
	Explore different converters like V/I, I/V, F/V and V/F.	
	Explore low pass and high pass filter.	
	Explore analog to digital and digital to analog converter ICs like ADC0808, DAC0808.	
	Connect and measure AC/DC Analog Input such as voltage / current / RTD two-three-four wire AC mV etc. signals.	
	Configure Electrical zero/span – mV, 0-10VDC, 4-20mA, 0-20mA	
	Configure Engineering zero/span – understanding various units and zero span configuration as per sensor datasheet such as temperature, pressure, flow, level, lux level, environment, soil, moisture etc.	
	Test the Analog Input as per configuration and sensor selection.	
	Generate 0-10VDC and measure analog outputs to operate control valves and actuators	
	Connect and measure Digital Inputs of various voltage level such as TTL (0-5V), 24VDC (0-24 VDC) and verify the expected output.	
	Connect and measure Pulse Inputs of various frequency ranging from 10 Hz to 1 KHz and configure the filters and verify the expected output.	
	Select, Configure and Connect Digital Outputs and Relay Outputs to	

	take On and Off action for various actuators and verify the expected output.
10. Identify, Test and troubleshoot the various families of Microcontroller. (NOS: SSC/N9445)	Understand and interpret the procedure as per manual of Micro controller.
	Identity various ICs & their functions on the given Microcontroller Kit.
	Identify the address range of RAM & ROM.
	Write data into RAM & observe its volatility.
	Identify the port pins of the controller & configure the ports for Input & Output operation.
	Demonstrate entering of simple programs, execute & monitor the results.
11. Identify, test and interconnect components/parts of IoT system. (NOS: SSC/N9446)	Connect and test Arduino board to computer and execute sample programs from the example list.
	Write and upload computer code to the physical Arduino board Micro controller to sound buzzer.
	Set up & test circuit to interface potentiometer with Arduino board and map to digital values.
	Rig up the circuit and upload a program to interface temperature sensor – LM35 with a controller to display temperature on the LCD.
	Set up Circuit and upload program to Interface DC motor (actuator) with microcontroller to control on/off/forward/reverse operations.
12. Identify and Select various types of sensors used in Smart Agriculture. (NOS: SSC/N9447)	Identify Roles and characteristics of various sensors.
	Select appropriate sensor as per requirement.
	Use signals from GPS satellites in Location Sensors.
	Place self-contained units of Agricultural Weather Stations at various locations throughout growing fields.
	Combine sensors appropriate for the local crops and climate for Agricultural Weather Stations
	Measure pH using Electrochemical Sensors and soil nutrient levels.
	Detect specific ions in the soil by Electrochemical Sensor electrodes
	Apply Electrochemical Sensor to gather process and map soil chemical data.
	Measure soil compaction or "mechanical resistance" by Mechanical

	Sensors
	Use Mechanical Sensors on large tractors to predict pulling requirements for ground engaging equipment.
	Measure soil air permeability by Airflow Sensors at singular locations or dynamically while in motion
	Identify various types of soil properties including compaction, structure, soil type, and moisture level by Airflow Sensors.
13. Identify, select different wireless communication modules and topology to generate and record the data. (NOS: SSC/N9448)	Create Wireless sensor network with interfacing of Zigbee module.
	Identify interfacing of Bluetooth module to create local sensor network.
	Interfacing of GSM module to make node as a gateway.
	Use WiFi and Ethernet for IoT Gateway.
	Apply GPS satellites in Location Sensors.
	RS485 interface for industrial agriculture sensors.
	Create a combine sensor appropriate for the local crops.
	Use portable Agricultural Weather Stations.
	Operate Global Positioning System (GPS).
	Apply satellites broadcasting signals in IoT.
	Apply Precision irrigation through water management in precision agriculture.
14. Identify and test Wired & Wireless communication medium such as RS232, RS485, Ethernet, Fiber Optic, Wi-Fi, GSM, GPRS, RF etc. and Communication protocol. (NOS: SSC/N9448)	Cable selection and Termination for Wired Communication Mediums: Pin Diagram, Cable Core, characteristics and specifications, Connector and crimping of various RJ9/RJ11/RJ45 connectors.
	Frequency Band, Gain, Antenna and Modulation selection for wireless communication Mediums.
	Basic Network Configuration of Local Area Networks - Ethernet, Wi-Fi.
	Basic Configuration of Cellular Wide Area Networks - GSM, GPRS.
	Basic Configuration of Personal Area Networks -RF, Zigbee.
15. Test Solar Panel and Charge Controller Circuit. (NOS: SSC/N9449)	Test series combination of Solar PV Modules.
	Test parallel combination of Solar PV Modules
	Test VI Characteristics of Solar PV Module.
	Test series-parallel combination of Solar PV Modules.

		Test blocking diode and its working in Solar PV Module.
		Test bypass diode and its working in Solar PV Module.
		Follow the instruction manual.
16. Perform installation, configuration and Check working of IOT devices, network, database, app and web services. (NOS: SSC/N8239)		Install Linux Operating System porting.
		Configure Local cloud & server.
		Configure GUI based parameter.
		Manage user access and security.
		Test Qt based GUI.
17. Establish and troubleshoot IoT connectivity of devices to cloud having multiple communication medium, protocols and networking topology and device management and monitoring. (NOS: SSC/N9451)		Configure and integrate multiple devices with serial protocol working on RS485 MODBUS Master –Slave architecture such as Solar Inverter, Solar Pump Controller, Energy Meter etc.
		Configure and integrate multiple devices with serial protocol working on RS232 DLMS Server – Client architecture
		Configure Wired and Wireless Local Area Networks (Ethernet and Wi-Fi) for MODBUS over MQTT in IoT Applications
		Configure cellular IoT Connectivity using GSM/GPRS networks for MODBUS over MQTT in IoT Applications
		Select, Configure and Acertain various media converters to convert serial devices to Ethernet, Wi-Fi and GPRS Devices
		Select, Configure and Acertain various protocol converters to convert serial as well as networking devices to IoT Devices
		Create / Modify and Configure IoT Devices and its parameters on cloud platform
		Monitor and Diagnose IoT Devices on cloud platform
		Configure parameters, alarms, notifications on cloud platform
		Create / Modify organization and users to access device data with user management roles and security
18. Demonstrate and Deploy responsive Web Application using APIs and generate reports using templates. (NOS: SSC/N9452)		Develop and Deploy web application using ready to use API of IoT platform or architecture
		Display and Configure graphs, charts and other ready to use controls and widgets
		Generate reports using readily available API, templates and to export it to excel, word pdf and other required formats
19. Identify and install the		Select and Installation of Carbon dioxide sensors.

devices used in green house. (NOS: SSC/N9453)	Select and Install of Oxygen sensors.
	Install solar pump, motors and drip irrigation systems.
	Observe safety precaution.
	Follow instruction manual.
20. Monitor soil moisture, temperature etc. for controlling irrigation & record data. (NOS: SSC/N9453)	Carry out Crop and soil observations logged in the form of snapped pictures, pinpoint locations, soil colours, water, plant leaves, and light properties.
	Measure leaf health, lighting brightness, chlorophyll amount, ripeness level, Leaf Area Index (LAI), soil organic and carbon makeup by using Smartphone Camera.
	Perform predictive maintenance of machinery using Microphone.
	Determine Leaf Angle Index using Accelerometer.
	Apply Precision irrigation through water management in precision agriculture.
	Apply various Precision Agriculture tools.
	Identify various benefits of application of Precision Agriculture in Smart Farming.
21. Select plant health monitoring system and apply proper water, fertilizer and pesticides. (NOS: SSC/N9454)	Explore and test Non-contact surface temperature measurement.
	Test Air temperature, humidity and pressure.
	Test Conductivity, water content and soil temperature.
	Test Soil temperature and volumetric water content.
	Test Leaf wetness.
	Apply safe working practices.
22. Identify and install the appropriate device for livestock monitoring. (NOS: SSC/N9455)	Apply Wireless IoT in livestock monitoring.
	Collect data regarding the location.
	Well-being and health of cattle.
	Use Location Sensors, GPS & GPS integrated circuits.
	Apply WearableElectronics to cattleexample Fly off
	Select wireless technology with enough battery power to list the lifespan of the animal.
	Follow manual.
23. Identify, select and operate drone in various applications. (NOS: SSC/N9456)	Identify different types of drones.
	Select drones in smart agriculture for particular operation
	Identify and Select various components of drones.
	Follow proper safety procedure as per manual

24. Collect data using Drones. (NOS: SSC/N9457)	Use ground-based and aerial based drones in agriculture.
	Assess crop health, irrigation, crop monitoring, crop spraying, planting and soil & field analysis
	Use thermal camera in smart farming
	Carry out real-time data collection and processing
	Analyse Drone data for insights regarding plant health indices.
	Perform in-flight monitoring and observations.

		SYLLABUS FOR IoT TECHNICIAN (SMART AGRICULTURE) TRADE	
		DURATION: ONE YEAR	
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 30Hrs. Professional Knowledge 12Hrs.	Perform electrical/ electronic measurement by selecting of single range with following safety precautions.	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. 2. Identify safety signs for danger, warning, caution & personal safety message. 3. Use of personal protective equipment (PPE). 4. Practice elementary first aid. 5. Preventive measures for electrical accidents & steps to be taken in such accidents. 6. Use of Fire extinguishers.	Familiarization with the working of Industrial Training Institute system. Introduction to IoT techniques. Explain each block of the IoT block diagram. Brief on opportunities in the applications of IoT. Introduction to Safety and PPEs.
		Basics of AC and Electrical Cables 7. Identify the single Phase and three phase, Neutral and Earth on power socket, use a tester to monitor AC power. 8. Construct a test lamp and use it to check mains healthiness. Measure the voltage between phase and ground and rectify earthing. 9. Prepare terminations, skin the electrical wires /cables using wire stripper and cutter. 10. Measure the gauge of the wire using SWG and outside micrometer.	Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Various terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, Instantaneous value. Single phase and Three phase supply. Different type of electrical cables

		11. Demonstrate various test and measuring instruments 12. Measure voltage and current using clamp meter.	
Professional Skill 34 Hrs. Professional Knowledge 12Hrs.	Test various electronic components using proper measuring instruments and compare the data using standard parameter.	**Active and Passive Components** 13. Identify the different types of active and passive electronic components including SMD. 14. Measure the resistor value by colour code, SMD Code and verify the same by measuring with multimeter. 15. Identify resistors by their appearance and check physical defects. 16. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. 17. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Law. 18. Verify laws of series and parallel circuits with voltage source in different combinations. 19. Identify different inductors, capacitors and measure capacitance of various capacitors using LCR meter. 20. Identify and test the circuit breaker and other protecting devices (Fuse). 21. Test Step-up, Step-down, Isolation Transformer. **AC & DC measurements**	Ohm's law. Resistors; types of resistors, their construction & specific use, color-coding, power rating. Equivalent of series circuits. Distribution of V & I in series parallel circuits. Principles of induction, inductive reactance & types. Capacitance and Capacitive Reactance & Types. Functions of DSO, Regulated power supply multimeter and LCR meter.

		22. Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R). 23. Identify the different controls on the Digital Storage Oscilloscope front panel and observe the function of each control. 24. Measure DC voltage, AC voltage, time period, sine wave parameters using DSO. 25. Identify and use different mathematical functions +,-,X, diff, intg, AND, OR of DSO on the observed signal. 26. Identify and use different acquisition modes of normal, average, persistence mode.	
Professional Skill 60Hrs. Professional Knowledge 18 Hrs.	Identify, place, solder and de-solder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup.	**Soldering/ De-soldering** 27. Practice soldering on different electronic components, small transformer and lugs. 28. Practice soldering on IC bases and PCBs. 29. Practice de-soldering using pump and wick. 30. Check for cold continuity of PCB.	Soldering and De-soldering stations and procedure.
Professional Skill 30 Hrs. Professional Knowledge 12Hrs.	Construct, test and verify the input/ output characteristics of various analog circuits.	31. Identify and test different types of diodes, diode modules using multi meter and determine forward to reverse resistance 32. Construct and test a transistor-based switching circuit to control a relay. 33. Construct instrumentation amplifier using OPAMP.	Semiconductor materials, components, number coding for different electronic components such as Diodes and Zeners etc. PN Junction, Forward and Reverse biasing of diodes. Introduction to Operational Amplifiers (OP-AMP) and its applications.

Professional Skill 15 Hrs. Professional Knowledge 12Hrs.	Assemble, test and troubleshoot various digital circuits.	34. Identify and verify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them.	Introduction to Digital Electronics. Difference between analog and digital signals. Introduction to CMOS techniques (Decimal, binary, octal) Understanding of BCD code & Study on logic gates Combinational logic circuits such as Half Adder, Full adder, Need for multiplexing of data. 1:4 line Multiplexer / De-multiplexer. Introduction to Flip-Flop. data transfer and frequency division. Types of seven segment display. BCD display and BCD to decimal decoder. BCD to 7 segment display circuits.
Professional Skill 24 Hrs. Professional Knowledge 12Hrs.	Install, configure, interconnect given computer system(s) and networking to demonstrate & utilize application packages for different applications.	35. Identify various indicators, cables, connectors and ports on the computer cabinet. 36. Demonstrate various parts of the system unit and motherboard components. 37. Identify various computer peripherals and connect it to the system. 38. Boot the system from Different options and install OS in a desktop computer. 39. Browse search engines, create email accounts, practice sending and	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working. Various ports in the computer. Working principle of SMPS, its specification. Windows OS MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting

		receiving of mails and configuration of email clients. 40. Identify different types of cables and network components e.g. Hub, switch, router, modem etc. 41. Configure a wireless Wi-Fi network.	and using of control panel., application of accessories, various IT tools and applications. Concept of Internet, Browsers, Websites, search engines, email, chatting and messenger service. Downloading the Data and program files etc. **Computer Networking:-** Network features - Network medias Network topologies, protocols- TCP/IP, UDP, FTP, models and types. Specification and standards, types of cables, UTP, STP, Coaxial cables. Network components like hub, Ethernet switch, router, NIC Cards, connectors, media and firewall. Difference between PC & Server. Wifii and wireless network
Professional Skill 30Hrs. Professional Knowledge 06Hrs.	Develop troubleshooting skills in various standard electronic circuits using Electronic circuit designsoftware.	42. Prepare simple digital and analog electronic circuits using the software.	Circuit design software. Design of any electronic circuit using the software.
Professional Skill 15 Hrs. Professional Knowledge 06Hrs.	Apply the principle of sensors and transducers for various IoT applications.	43. Identify and test RTDs, Temperature ICs and Thermo couples. 44. Identify and test proximity switches (inductive, capacitive and photoelectric). 45. Identify and test, load cells,	Basics of passive and active transducers. Role, selection and characteristics. Sensor voltage and current formats. Thermistors / Thermocouples -

		strain gauge, LVDT.	Basic principle, salient features, operating range, composition, advantages and disadvantages.
			Strain gauges/ Load cell – principle, gauge factor, types of strain gauges.
			Inductive/ capacitive transducers - Principle of operation, advantages and disadvantages. Principle of operation of LVDT, advantages and disadvantages. Proximity sensors – applications, working principles of eddy current, capacitive and inductive proximity sensors.
Professional Skill 35 Hrs. Professional Knowledge 08 Hrs.	Identify, select and test different signal conditioning and converter circuits. Check the specifications, connections, configuration and measurement of various types of sensor inputs as well as control outputs.	**Integration of Analog sensors** 46. Select appropriate Analog sensor. 47. Connect & measure AC/DC Analog Input such as voltage / current / RTD two-three-four wire AC mV signal etc. 48. Configure Engineering & Electrical zero/span configuration mV, 0-10VDC, 4-20mA, 0-20mA. 49. Understand various units and zero span configuration as per sensor datasheet such as temperature, pressure, flow, level, lux level, environment, soil, moisture etc. 50. Measure the Analog Input as per configuration and sensor selection.	Explain circuit diagram with controller and sensor. The specification and working of Analog sensor inputs as well as Analog control outputs. The specifications and working of Digital sensor inputs, Pulse Input as well as Digital control outputs.

		51. Generate and measure Analog Output to operate control valves and actuators. **Integration of Digital sensors** 52. Identify various Digital sensors. 53. Identify Roles and Characteristics of each sensor. 54. Select appropriate Digital sensor. 55. Connect and Measure Digital Inputs of various voltage level such as TTL (0-5V), 24VDC (0-24 VDC) signals. 56. Connect Pulse Inputs of various frequency ranging from 10 Hz to 1 KHz and configure the filters. 57. Select, Configure and ascertain of Digital Outputs and Relay Outputs to take On and Off action for actuators.	
Professional Skill 30Hrs. Professional Knowledge 06Hrs.	Identify, Test and troubleshoot the various families of Microcontroller.	58. Explore different microprocessor, microcontroller and IOT Gate way. 59. Raspberry pi , RP 2040, and Arduino. 60. Explore the different Software IDE for IoT applications	Introduction to microprocessor and microcontroller. Difference between microprocessor and microcontroller. Raspberry Pi and RP2040 Introduction to ADC and DAC, schematic diagram, features and characteristic with the applications.
Professional Skill 30Hrs. Professional	Identify, test and interconnect components/parts of IoT system.	61. Connect and test Arduino with ESP-32 & ESP-8266, RP-2040, Raspberry-pi board to computer and execute	Arduino development board, Pin diagram, Functional diagram, Hardware familiarization and operating instructions.

Knowledge 06Hrs.		sample programs from the example list.	Integrated development Environment, Running Programs on IDE, simple Programming concepts.
		62. Upload computer code to the physical board (Microcontroller) to blink a simple LED.	
		63. Write and upload computer code to the physical Arduino board Micro controller to sound buzzer.	
		64. Circuit and program to Interface light sensor – LDR with arduino to switch ON/OFF LED based on light intensity.	
		65. Set up & test circuit to interface potentiometer with Arduino board and map to digital values for e.g. 0-1023.	
		66. InterfacePushbuttons or switches, connect two points in a circuit while pressing them. This turns on the built-in LED on pin 13 in Arduino, while pressing the button.	
		67. Rig up the Circuit and upload a program to Control a relay and switch on/off LED light using Arduino.	
		68. Make Circuit and upload a program to Interface of LCD display with a microcontroller to display characters.	
		69. Rig up the circuit and upload a program to interface temperature sensor – LM35 with a controller to display	

		temperature on the LCD. 70. Set up Circuit and upload program to Interface DC motor (actuator) with microcontroller to control on /off /forward/reverse operations. 71. Rig up Circuit and upload program micro-controller to switch on/off two lights using relay.	
Professional Skill 60Hrs. Professional Knowledge 12Hrs.	Identify and Select various types of sensors used in Smart Agriculture.	72. Identify various sensors used in Precision Farming viz. Location Sensors, Optical Sensors, Electrochemical Sensors, Mechanical Sensors, Airflow Sensors and Agricultural Weather Stations. 73. Identify andSelect appropriate sensor as per requirement. 74. Determine clay, organic matter and moisture content of the soil by Optical Sensors. 75. Measure Phby Electrochemical Sensor and soil nutrient. 76. Apply Electrochemical Sensor to gather process and map soil chemical data. 77. Measure soil compaction or "mechanical resistance" by Mechanical Sensors. 78. Use of probe that penetrates the soil and records resistive forces through use of load	Basics of Location Sensors – Role, selection and characteristics, advantages and disadvantages. Use of signals from GPS satellites. Optical Sensors - Basic principle, salient features, operating range selection and characteristics. Electrochemical Sensors - Role, selection and characteristics, advantages and disadvantages. Mechanical Sensors –Operation Fundamentals, selection, advantages and disadvantages. Airflow Sensors – Basic principle, salient features, operating range, advantages and disadvantages. Agricultural Weather Stations – Fundamentals of self-contained units that are placed at various locations throughout growing fields.

		cells or strain gauges for Mechanical Sensors. 79. Use Mechanical Sensors on large tractors to predict pulling requirements for ground engaging equipment. 80. Detect the force used by the roots in water absorption that are very useful for irrigation interventions by Tensiometers. 81. Measure soil air permeability by Airflow Sensors at singular locations or dynamically while in motion. 82. Identify various types of soil properties including compaction, structure, soil type, and moisture level by Airflow Sensors.	Knowledge of Stations, combination of sensors appropriate for the local crops and climate. Advantages - portability and decreasing prices for farms of all sizes.
Professional Skill 32 Hrs. Professional Knowledge 18 Hrs.	Identify, select different wireless communication modules and topology to generate and record the data.	83. Identify the interfacing of Bluetooth module to create local sensor network. 84. Identify the interfacing of GSM module to make node as a gateway. 85. Apply IoT Gateway using WiFi and Ethernet. 86. Check UART Communication, RS485 Communication,I2C Protocol device interfacing SPI Protocol device interfacing, Ethernet configuration, Zigbee interfacing, Wi-Fi AP and Router interfacing. 87. Identify the Wi-Fi module	Concept of interfacing of Bluetooth module to local sensor network, interfacing of GSM module and other gateways. IoT Gateway using WiFi and Ethernet. Application of GPSsatellites in Location Sensors. RS485 interface for industrial agriculture sensors. Creation of a combine sensor appropriate for the local crops and for agricultural climate monitoring. Concept of portable Agricultural Weather Stations. Application of Precision

		and lua script for data communication. 88. Check USB and Ethernet connectivity for data communication. 89. Check RS485 interface for industrial agriculture sensors.	irrigation through water management in precision agriculture. Identification of zones in the field that are irrigated with differing amounts and frequencies in precision irrigation.
Professional Skill 30Hrs. Professional Knowledge 06Hrs.	Identify and test Wired & Wireless communication medium such as RS232, RS485, Ethernet, Fiber Optic, Wi-Fi, GSM, GPRS, RF etc. and Communication protocol.	90. Identify LAN Cable and its Pin Mapping. 91. Crimp and Test RJ45 connectors. 92. Design and Test Local Area Networks over Ethernet & Wi-Fi.	Basic blocks of networking, - Specifications, Standards and types of cables, - Concept of wired or wireless communication medium
Professional Skill 23 Hrs. Professional Knowledge 06Hrs.	Test Solar Panel and Charge Controller.	93. Identify, test and check series, parallel and series-parallel combination of Solar PV Modules. 94. Measure VI Characteristics of Solar PV Module. 95. Identify and test blocking diode and its working in Solar PV Module. 96. Observe bypass diode and its working in Solar PV Module. 97. Measure effect of inclination angle of Solar PV Module. 98. Identify and test different charging techniques. 99. Check the use of P V Analyzer.	Basics of solar Electricity, Working principle of PV panel, advantages of solar electricity and components of solar electricity, Various combinations, VI characteristics of solar PV module, effect of inclination angle on PV module, different battery charging techniques.
Professional	Perform installation, configuration and	100. Install Linux Operating System porting.	IoT gateway with internet and WiFi

Skill 35Hrs. Professional Knowledge 12Hrs.	Check working of IoT devices, network, database, app and web services.	101. Configure Local cloud & server. 102. Work with the command line and the Shell. 103. Configure Cloud and Server for IoT. 104. Test Web and Application Development Tools for IoT.	Installation of Linux Operating System porting. Cloud and Server Configuration for IoT. IoT Web and Application Development Tools for IoT.
Professional Skill 57 Hrs. Professional Knowledge 12Hrs.	Establish and troubleshoot IoT connectivity of devices to cloud having multiple communication medium, protocols, device management and monitoring.	105. Power up the Solar Inverter (similar device) as per the device manual. 106. Integrate Solar Inverter (similar device) with serial protocol working on Modbus RTU. 107. Communicate and Verify the parameters on Modbus Master Software 108. Power up the DLMS device as per the device manual. 109. Setup Ethernet IoT Data Acquisition system, connect to cloud and verify 110. Setup WiFi IoT Data Acquisition system, connect to cloud and verify. 111. Setup Cellular (GSM / GPRS) IoT Data Acquisition system, connect to cloud and verify. 112. Explore IoT Cloud Configuration utility. 113. Create / modify organization, Connect devices over cloud. 114. Configuration of parameters, alarms, notifications on cloud platform. 115. Explore user management	- Basics of Industrial protocols ModbusRTU, ModbusTCP, DLMS - Client server communication Basics of Protocol Converters. Basics of IoT Data Acquisition System. Device connectivity over cloud and troubleshooting. GUI based IoT Cloud Configuration utility. IoT device and its parameter configuration Cloud Device Management and troubleshooting.

		roles and security. 116. Observer Device Diagnostics for troubleshooting.	
Professional Skill 30Hrs. Professional Knowledge 06Hrs.	Demonstrate and deploy responsive Web Application using APIs and generate reports using templates.	117. Explore Web API, required input parameters and output 118. Map Web API to Widget / Control / Plugin 119. Display and configure graphs, charts and other ready to use controls and widgets 120. To generate reports using readily available API, templates and to export it to excel, word pdf and other required formats.	Usage of Web Services / Web API Development of Sample Web Application. Generation and export of Reports User access and rights management. IOT Security
Professional Skill 20Hrs. Professional Knowledge 06Hrs.	Identify and install the devices used in green house.	121. Carry out Selection and Installation of Volatile organic compound sensor. 122. Execute Selection and Installation of Air temperature, Air humidity and atmospheric pressure sensor. 123. Select and Install Soil Moisture and Soil Temperature sensor. 124. Carry out Installation of Solar pump, motors and drip irrigation systems.	Principle of selection and installation of Carbon dioxide sensor, Oxygen sensors &Volatile organic compound sensor. Selection and Installation of Air temperature, Air humidity and atmospheric pressure sensor. Selection and Installation of Soil Moisture and Soil Temperature sensor. Installation of Solar pump, motors and drip irrigation systems.
Professional Skill 60Hrs. Professional Knowledge 12Hrs.	Monitor soil moisture, temperature etc. for controlling irrigation & record data.	125. Carry out Crop and soil observations logged in the form of snapped pictures, pinpoint locations, soil colours, water, plant leaves, and light properties. 126. Measure leaf health, lighting	Process of carrying out Crop and soil observations logged in the form of snapped pictures, pinpoint locations, soil colours, water, plant leaves, and light properties. Measurement of leaf health,

		brightness, chlorophyll amount, ripeness level, Leaf Area Index (LAI), soil organic and carbon makeup by using Smartphone Camera. 127. Use Smartphone GPS for location for crop mapping, disease/pest location alerts, solar radiation predictions, and fertilizing. 128. Perform predictive maintenance of machinery using Microphone. 129. Determine Leaf Angle Index using Accelerometer. 130. Apply Precision irrigation through water management in precision agriculture. 131. Identify zones in the field that are irrigated with differing amounts and frequencies in precision irrigation. 132. Apply Variable Rate Technology - Implement gathered information and decisions for site specific agriculture consisting of the machines and systems for applying a desired rate of crop production materials at a specific time and a specific location. 133. Apply various Precision Agriculture tools: Soil Mapping, Yield Mapping, Remote Sensing, GIS Analysis, Nutrient	lighting brightness, chlorophyll amount, ripeness level, Leaf Area Index (LAI), soil organic and carbon makeup by using Smartphone Camera. Usage of Smartphone GPS for location for crop mapping, disease/pest location alerts, solar radiation predictions, and fertilizing. Predictive maintenance of machinery using Microphone Determination of Leaf Angle Index using Accelerometer. Application of Precision irrigation through water management in precision agriculture. Identification of zones in the field that are irrigated with differing amounts and frequencies in precision irrigation. Application of Variable Rate Technology - Implement gathered information and decisions for site specific agriculture consisting of the machines and systems for applying a desired rate of crop production materials at a specific time and a specific location. Application of various Precision Agriculture tools: Soil Mapping, Yield Mapping, Remote Sensing, GIS Analysis, Nutrient Management, Variable Rate Technology, Integrated Pest

		Management, Variable Rate Technology, Integrated Pest & Weed Management, Water Management etc. for controlling irrigation & record data. 134. Identify various benefits of application of Precision Agriculture in Smart Farming: Optimising Production Efficiency, Optimising Quality, Minimising Environmental Impact, Minimising Risk, Information To Act On.	&Weed Management, Water Management etc. for controlling irrigation & record data. Identification of various benefits of application of Precision Agriculture in Smart Farming: Optimising Production Efficiency, Optimising Quality, Minimising Environmental Impact, Minimising Risk, Information To Act On.
Professional Skill 40Hrs. Professional Knowledge 10Hrs.	Select plant health monitoring system and apply proper water, fertilizer and pesticides.	135. Test Non-contact surface temperature measurement. 136. Test Leaf and flower bud temperature. 137. Check Soil oxygen level. 138. Test Solar radiation (shortwave, PAR and UV). 139. Measure Air temperature, humidity and pressure. 140. Observe Conductivity, water content and soil temperature. 141. Test Soil temperature and volumetric water content. 142. Measure Soil water potentials. 143. Test Vapor pressure, humidity, temperature, and atmospheric pressure in soil and air. 144. Check Leaf wetness. 145. Measure Stem, truck and fruit diameter.	Non-contact surface temperature measurement. Test of Leaf and flower bud temperature. Checking of Soil oxygen level. Test of Solar radiation (shortwave, PAR and UV). Measurement of Air temperature, humidity and pressure. Observation of Conductivity, water content and soil temperature. Test of Soil temperature and volumetric water content. Measurement of Soil water potentials. Test of Vapor pressure, humidity, temperature, and atmospheric pressure in soil and air. Checking of Leaf wetness. Measurement of Stem, truck and

		146. Test Wind speed and precipitations. 147. Check Luminosity (Luxes Accuracy).	fruit diameter. Exploration and test of Wind and precipitations. Checking of Luminosity (Luxes Accuracy).
Professional Skill 40Hrs. Professional Knowledge 10Hrs.	Identify and install the appropriate device for livestock monitoring.	148. Apply Wireless IoT in livestock monitoring - collect data regarding the location, well-being and health of cattle. 149. Use Location Sensors, GPS &GPS integrated circuits. 150. Apply Wearable Electronics to cattle. 151. Use wireless retrofitted bolus in cow's stomach which can communicate via Bluetooth to an ear tag. 152. Select wireless technology with enough battery power to list the lifespan of the animal.	Application of Wireless IoT in livestock monitoring – collection of data regarding the location, well-being and health of cattle. Usage of Location Sensors, GPS &GPS integrated circuits. Application of Wearable Electronics to cattle. Usage of wireless retrofitted bolus in cow's stomach which can communicate via Bluetooth to an ear tag. Selection of wireless technology with enough battery power to list the lifespan of the animal.
Professional Skill 40Hrs.; Professional Knowledge 10Hrs.	Identify, select and operate drone in various applications.	153. Identify different types of drones – ground based and aerial based drones & their functions. 154. Select various components of drones equipped with appropriate cameras, sensors (Optical Sensors etc.) and integrating modules (Raspberry Pi 3 B module - Single-board computer with wireless LAN and Bluetooth connectivity).	Identification of different types of drones – ground based and aerial based drones & their functions. Selection of various components of drones equipped with appropriate cameras, sensors (Optical Sensors etc.) and integrating modules (Raspberry Pi 3 B module - Single-board computer with wireless LAN and Bluetooth connectivity).
Professional Skill 40Hrs.;	Collect data using Drones.	155. Use ground-based and aerial based drones in agriculture for crop health assessment,	Usage of ground-based and aerial based drones in agriculture for crop health

Professional Knowledge 10Hrs.		irrigation, crop monitoring, crop spraying, planting and soil & field analysis.	assessment, irrigation, crop monitoring, crop spraying, planting and soil & field analysis.
		156. Identify and apply thermal camera in smart farming.	Explore the use of thermal camera in smart farming.
		157. Carry out real-time data collection and processing, crop health imaging, integrated GIS mapping gathering valuable data via a series of sensors that are used for imaging, mapping, and surveying of agricultural land through drones/UAV.	Process of Carrying out real-time data collection and processing, crop health imaging, integrated GIS mapping gathering valuable data via a series of sensors that are used for imaging, mapping, and surveying of agricultural land through drones/UAV.
		158. Select what field to survey altitude or ground resolution on the basis of farmer's information.	Selection of what field to survey altitude or ground resolution on the basis of farmer's information.
		159. Perform in-flight monitoring and observations.	Principle of in-flight monitoring and observations.
		160. Collect multispectral, thermal and visual imagery during the flight of drones/UAV.	Collection of multispectral, thermal and visual imagery during the flight of drones/UAV.
		161. Analyse Drone data for insights regarding plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, mapping, scouting reports, stockpile measurement, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping and so on.	Analysis of Drone data for insights regarding plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, scouting reports, stockpile measurement, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping and so on.
Project Work/Industrial Visit (Optional)			

Broad Area:-
a) Measurement of different soil moisture & temperature
b) Measurement of solar radiation/oxygen for green house
c) Construct wireless communication link between different nodes.
d) Industrial visit for the applications of DRONE

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

List of Tools &Equipment			
IoT TECHNICIAN (SMART AGRICULTURE) (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.	Screwdriver set	Set of 7	12 Nos.
4.	Insulated combination pliers	150 mm	8 Nos.
5.	Insulated side cutting pliers	150mm	8 Nos.
6.	Long nose pliers	150mm	8 Nos.
7.	Soldering iron	25 Watt, 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	15 Watt, 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 meters	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	With 4 ½ Digit Display and 20k Count	6 Nos.
32.	Hacksaw frame adjustable	300 mm	2 Nos.
33.	Chisel - Cold - Flat	10 mm X 150 mm	1 No.
34.	Scissors	200mm	1 No.
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	
		Bench Vice - 100 mm	1 No. each
		Bench Vice - 50 mm	
39.	Wire stripper		12 Nos.
List of Equipment			
40.	Multiple Output DC regulated power supply	0-30V, 2 Amps, $\pm$ 15V Dual Tracking,5V/5A, Display digital,	4 Nos.
41.	Regulated Variable DC Power Supply	0-30V/3A with seven segment LED display	2 Nos.
42.	LCR meter (Digital) Handheld		2 Nos.
43.	Digital Storage Oscilloscope	30 MHz	2 Nos.
44.	Multi Waveform Signal Generators	10 MHz	4 No.
45.	3GHz Spectrum Analyzer with built-in Tracking Generator	Frequency Range 9 kHz to 3.2 GHz Resolution Bandwidth(-3 dB): 10 Hz to 1 MHz	1 No.
OR **Electronics Workbench**	**Item no. 39, 41, 42, 43, 44 and 45 can be preferred in the form of workbench.**		1No.

46.	Multi Function Test & Measuring Tool for Field Applications and Testing compatible with Laptop	300 MHz Bandwidth 2 Channel Digital Storage Oscilloscopes, Arbitrary Waveform Generator Sine ,Square Triangle AM –FM Modulation,	1No.
47.	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.	1No.
48.	Analog Component Trainer with following Seven Basic Modules - Diode Characteristics (Si,Zener,LED) - Rectifier Circuits - Diode as Clipper Circuit - Diode as Clamping Circuit - Zener as voltage regulator. - Transistor Type NPN & PNP and CE Characteristics - Transistor as a switch	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, TriangleModulating Signal Generator: Sine, Square, Triangle	2Nos.
49.	Digital IC Trainer	Breadboard: Regular DC Supply: +5 V/1 A +12V/1A Clock Frequency 4 different steps from 1Hz – 100KHz Amplitude: Seven Segment Display, Teaching &Learning Simulation Software	2 Nos.

50.	IT Workbench for computer hardware and networking	As per Requirement	2 Nos.
51.	Laptop latest configuration		1 No.
52.	Desktop computer	Latest configuration	24+1 No.
53.	UPS	5 KVA	As required
54.	Laser jet Printer		1 No.
55.	Internet Broadband Connection		1 No.
56.	Electronic circuit design software with five user licenses	Circuit Design and Simulation Software with PCB Design with Gerber and G Code Generation, 3D View of PCB, Breadboard View, Fault Creation and Simulation.	1 No.
57.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
58.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB		As required
59.	SMD Soldering & De soldering Station with necessary accessories	SMD Soldering &Desoldering Station Digitally Calibrated Temperature Control SMD Soldering &Desoldering Power Consumption: 60 Watts De-soldering : 70 Watt Power Consumption : 270 Watts Hot Air Temperature : 200 to 550º Centigrade	1 No.
60.	SMD Technology Kit	SMD component identification board with SMD components Resistors, Capacitors, Inductors, Diodes, Transistors & IC's packages. Proto boards with readymade solder pads for various SMD	1 No.

		Components. SMD Soldering Jig.	
61.	Arduino and Raspberry-pi based IoT system with cloud access, accessories, analog and digital ports, support for stepper motor, servo motors, UART port for serial data communication and separate port for I2C	Arduino, Raspberry-pi and RP 2040 based IoT system with all accessories sensors and cloud access minimum 10 sensors	12 Nos.

62.	Sensor Trainer kit with sensor Containing following Sensors
	   a) Air humidity and Temperature
	   b) RTD
	   c) Atmospheric Pressure
	   d) Air Quality
	   e) Smoke Detector Sensors
	   f) Limit Switch
	   g) Photo sensors
	   h) Capacitive displacement
		Interfacing all listed sensors and test their working status	12 Nos.

63.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
64.	Internet of Things Explorer	System with attached and database modules for sensors, controllers, gateway and application control facility	1 No.
65.	Field Interface and Protocol Simulation Kit	A console including :Any Branded Desktop Computer with Windows Operating System 1. Ethernet Devices with Isolated Supply and port ▪ 4 AI(0.1% FSR), 4 AO ▪ Ethernet Port – Qty 1 ▪ 8 Relay Outputs, Ethernet Port – Qty 1 ▪ 8 Pulse Outputs, Ethernet	12 Nos.

		Port – Qty 1	
		▪ 8 Digital Inputs, Ethernet Port – Qty 1	
		▪ 4 RS485 Slave ports, 1 Ethernet Port – Qty 4	
		2. 16 Port Ethernet Switch for networking of field ethernet devices	
		3. SMPS to power up multiple ethernet based field simulation devices	
		4. Required Connectors, Switches and LED indicators for Field Interface circuits such as Digital Inputs, Relay Outputs, Analog Inputs, Analog Outputs, Pulse Signals	
		5. Software	
		▪ Communication with simulation device on ethernet MODBUS TCP Protocol	
		▪ Field Interface simulation using HMI replica of Console for easy understanding of students	
		▪ Port Simulation – Serial Port Terminal, TCP/IP, UDP, HTTP	
		▪ Protocol Simulation – MODBUS RTU Master/Slave, MODBUS TCP Master/Slave	
LIST OF THE MACHINERIES			
66.	Solar Power Lab	Solar PV Modules. Open Circuit Voltage Voc 10V,	12 Nos.

		Short Circuit Current ISC0.60mA Maximum Power Voltage (Vmp) 8.80V, Maximum Power Current (Imp): 0.57A, Batteries , Voltage 6V, 4Ah. Buck & Boost Converter, Dusk to Dawn Sensing, LCD for Voltage and Current. Interactive Solar Training Software	
67.	Solar PV Module Analyzer	Micro-controller Based with 16X2 LCD, PC Interface, mains & battery operated. Capable to measure Open Circuit Voltage and Short Circuit Current, Maximum Voltage and Current at Maximum Power DCV Range 0-50V, DCA Range 10A	12 Nos.
68.	Wireless Communication modules for interfacing with microcontrollers a) RFID Card Reader b) Finger Print c) GPS d) GSM e) Bluetooth f) WiFi	programmable controller supporting both programming modes Key Pad and PC ,LCD for both programming mode and run mode, ready to run programmer to support family of controllers Breadboard to make circuits, detailed learning content through simulation Software and following application modules: RFID Card Reader, Finger Print, GPS, GSM, Bluetooth and WiFi	12 Nos.
69.	Sensors trainer kit for Green House Application	All should be compatible with Sensor Training Platform & IOT Explorer mentioned above:	12 Nos.

		CO2: Range: (0-2000ppm), O2 Range: (0-25%), VOC, Air Temperature& humidity, Atmospheric Pressure, Soil Moisture& Temperature, NO2, Leaf Wetness, Solar Radiation, UV Index.	
70.	Solar Water Pump	1HPSolar Panel 40W (36Nos) MPPT 400 TO 700V DC Operating Frequency : 30Hz to 50Hz, Protection : Dry Run , Short Circuit Maximum PV Voltage 750V DC Remote Operation through GSM module	1 No.
71.	Weather Monitoring System	Temperature Range : -10°C to 90°C, Relative Humidity Operating Range 0 to 95% ,Wind Speed Sensor Speed : 0 to 20m/S Resolution 1m/S ,Wind Direction, Rainfall Bucket collector, Solar Radiation, UV Index, Atmospheric Pressure, Air Quality, PM2.5, GSM based cloud connectivity, Application Software for Dashboard for remote monitoring and analysis. Power Supply Battery : 12V/42AH Solar Panel : 100W	12 Nos.
72.	Sensors & Actuator for Irrigation Application	All should be compatible with Sensor Training Platform & IOT Explorer mentioned above: Capacitive Soil Moisture & Temperature, Leaf Wetness, Solar Radiation(0-2000mw/m2), Thermal Imager **Actuators :**Sprinklers, Relay, Flow sensor	12 Nos.
73.	Sensors for Livestock Monitoring	All should be compatible with Sensor Training Platform & IOT Explorer mentioned above:	12 Nos.

		Active & Passive RFID tags with reader, Bluetooth tags with application software, GPS and PIR.	
74.	DRONE **(optional)**	Including the Flight Controller, and a RF Sensing System that provides reliability during flight. Also It should have spraying system and flow sensor ensures accurate operations. Intelligent Operation Planning System and should have Agriculture Management Platform, User can plan operations, manage flights in real-time, and closely monitor aircraft operating status Spray System : Tank Volume minimum 8L Payload Approx 8 Kg	1 No.
75.	IoT based Smart Roof Top / Solar Pump system (Application Project)	a) Inverter (can be existing inverter of Solar Kit) b) IoT based Energy Monitoring DCU with Three Phase 415 VAC input, Two RS485 MODBUS Communication Port, Local Ethernet connectivity, Four Analog Inputs (24-bit ADC, 0.1%FSR) for integration of weather sensors, SD Card Storage, Remote GSM/GPRS connectivity using Quad Band GSM/GPRS Module c) Embedded Calculations for %CUF (capacity utilization factor), %PR (Performance Ratio)	2 Nos.

		d) SMC box with IP65 and IK10 ratings Responsive Web application for Smart Energy management system having with map view based dash board and individual system details with various energy management reports such as load profile, consumption pattern, generation pattern, %CUF (capacity utilization factor), %PR (Performance Ratio) etc.	
76.	IoT Data Acquisition Systems &Protocol Converters	Connectivity to Cloud (IBM, Microsoft, Amazon)24 VDC Isolated Supply, 4 Analog Inputs (0.1% FSR), 8 Pulse Inputs (up to 1 kHz), 8 Digital Inputs, 4 Relay Outputs Ethernet IOT DAQ, WiFi IoT DAQ, Cellular (GSM / GPRS) IoT DAQ MODBUS RTU to MODBUS TCP 24 VDC Isolated Power Supply, 4 Isolated MODBUS RTU Master Port Serial to Ethernet, Serial to Wi-Fi, Serial to GPRS	12 Nos.
77.	IoT EDGE Computing Device	Embedded SCADA for 500 Tags, 24 VDC Isolated Power Supply, 4 MODBUS RTU Master, 32 GB Built in SD Card, 1 Wi-Fi Port, 1 Ethernet Port, 1 GPRS Port, 4	12 Nos.

		Analog Inputs (0.1% FSR), 8 Pulse Inputs (up to 1 kHz), 8 Digital Inputs, 4 Relay Outputs	
78.	Cloud Based IoT SCADA	1000 Tag License for Cloud based SCADA to connect IoT Devices and IoT based Smart Systems with Device Manager, IO Server, Alarm Server, Historian and Reporter, Web Server. Cloud Hosting Services for 20 devices for 7 years	1 No.
79.	Arduino Board with accessories	Arduino Moule - latest specifications	As required
80.	Raspberry-pi Board with accessories	Raspberry Pi Module - latest specifications	As required
C. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			
81.	Instructor's table		1 No.
82.	Instructor's chair		2 Nos.
83.	Computer Table		24+1 No.
84.	Computer Chair		24+1 No.
85.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
86.	Lockers with 16 drawers standard size		2 Nos.
87.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 Nos.
88.	Interactive Smart Board with Projector		1 No.
89.	Fire Extinguisher	Arrange all proper NOCs and equipments from Municipal/Competent authorities.	

Note:

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

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.

S No.	Name & Designation	Organization	Remarks
	List of Expert Members participated/ contributed for finalizing the course curriculum of IoT Technician (Smart Agriculture) trade held on 16.03.2023 at Bengaluru.		
1.	Shri. B.N. Sridhar	Regional Director RDSDE, Bengaluru	Chairman
2.	Ms. Naina Nagpal	Assistant Director NSTI (W), Bengaluru	Co-Ordinator
3.	Shri. V. Babu	Principal/ Deputy Director NSTI (W), Bengaluru	Member
4.	Shri M.J. Vijaya Raju	Assistant Director CSTARI, Kolkata	Co-Ordinator
5.	Shri. B.K. Nigam	Training Officer CSTARI, Kolkata	Member
6.	Shri P.K. Bairagi	Training Officer CSTARI, Kolkata	Member
7.	Ms. Pooja Singh	Training Officer NSTI, Bengaluru	Member
8.	Shri. Rohit Prajapathi	Technical Director Digito AD Technologies Bengaluru	Member
9.	Shri N. Ramesh	Taining Assistant Manager BOSCH	Member
10.	Girish. H	Engg. Head Phantan BOSCH	Member
11.	Shri Lohit. M.V	Technology and Innovation Head SIEMENS	Member
12.	Shri Kondinya S. R	Technology and Innovation AI/ML SIEMENS	Member

13.	Shri S. Janardhanam	Training Officer NSTI, Chennai	Member
14.	Shri N.P. Bannibagi	Deputy Director NIMI, Chennai	Member
15.	Shri D.Subhashree	Deputy Director RDSDE, Bengaluru	Member
16.	Shri Nitin S Komawar	CEO, GROK Learning Pvt. Ltd.	Member
17.	Shri Brajesh Sing	E.D, GROK Learning Pvt. Ltd.	Member
18.	Shri R. Malathi	Training Officer, NSTI (W), Bengaluru	Member
19.	Shri Rajeswari	Vocational Instructor, NSTI (W), Bengaluru	Member
20.	Shri Basavaraj	Training Officer, NSTI (W), Bengaluru	Member
21.	Shri Navaneeth Ganesh	MGNF, Bengaluru Urban	Member
22.	Shri Dinesh K. P	NASSCOM, Bengaluru	Member
23.	Shri Darshak Upadhyaya	Bengaluru	Member
24.	Shri Vijay Singh Kushwah	Manager, 3V Technix Pvt. Ltd. Hyderabad	Member
25.	Shri G.Jayakumar	Manager, NTTF, Bengaluru	Member
26.	Shri George Jacob	CEO, Semicon Design Tech. Benguluru	Member
27.	Shri N. Srikanth	Iobit Solutions Benguluru	Member
28.	Shri G.N. Eswarappa	Ex. JDT, CSTARI, Kolkata	Member
29.	Dr. A.PhaniRatna	Director, Nano Ram Technologies	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