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- 4

SECTOR –IT & ITES

Directorate General of Training

IoT TECHNICIAN (SMART AGRICULTURE)

(INTERNET OF THINGS)

(Non-Engineering Trade)

(Designed in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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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 IoT applications with IoT architecture. They will also 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 DGT which is recognized worldwide.

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 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)	1200
2	Professional Knowledge (Trade Theory)	240
3	Employability Skills	160
	Total	**1600**

2.4 ASSESSMENT & CERTIFICATION

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

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

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted **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%. There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence based comprising the following:

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

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

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional	• Demonstration of good skills and accuracy in the field of work/ assignments. • A fairly good level of neatness and consistency to accomplish job activities.

guidance, and due regard for safety procedures and practices	• Occasional support in completing the task/ job.
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and 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) Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels 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

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.

Reference NCO-2015: NIL (To be prepared)

4. GENERAL INFORMATION

Name of the Trade	**IoT TECHNICIAN (SMART AGRICULTURE)**
Trade Code	DGT/2005
NCO - 2015	Not Available
NSQF Level	Level-4
Duration of Craftsmen Training	One Year (1600 Hours)
Entry Qualification	Passed 10th class examination with Science and Mathematics
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 National Craft Instructor Certificate (NCIC) in any of the variants 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 from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.
Minimum Age for Instructor	21 Years
List of Tools & Equipment	As per Annexure – I

Distribution of training on Hourly basis: (Indicative only)

Total Hrs. /week	Trade Practical	Trade Theory	Employability Skills
40 Hours	30 Hours	6 Hours	4 Hours

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Perform electrical/ electronic measurement by selecting of single range with following safety precautions.
2. Test various electronic components using proper measuring instruments and compare the data using standard parameter.
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.
4. Construct, test and verify the input/ output characteristics of various analog circuits.
5. Assemble, test and troubleshoot various digital circuits.
6. Install, configure, interconnect given computer system(s) and networking to demonstrate & utilize application packages for different applications.
7. Develop troubleshooting skills in various standard electronic circuits using Electronic simulation software.
8. Apply the principle of sensors and transducers for various IoT applications.
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.
10. Identify, Test and troubleshoot the various families of Microcontroller.
11. Plan and Interface input and output devices to evaluate performance with Microcontroller.
12. Identify different IoT Applications with IoT architecture.
13. Identify, test and interconnect components/parts of IoT system.
14. Identify and select various types of sensors used in Smart Agriculture.
15. Position the appropriate sensors and collect the information required in Smart Agriculture.
16. Identify, select different wireless communication modules and topology to generate and record the data.
17. Identify and test Wired & Wireless communication medium such as RS232, RS485, Ethernet, Fibre Optic, Wi-Fi, GSM, GPRS, RF etc. and Communication protocol
18. Identify Solar Panel Basics Testing, Characteristics, Charge Controller Circuit.
19. Perform installation, configuration and Check working of IOT devices, network, database, app and web services.

20. Establish and troubleshoot IoT connectivity of devices to cloud having multiple communication medium, protocols, device management and monitoring.
21. Demonstrate and Deploy responsive Web Application using APIs and generate reports using templates.
22. Identify and install the devices used in green house.
23. Monitor soil moisture, temperature etc. for controlling irrigation & record data.
24. Select plant health monitoring system and apply proper water, fertilizer and pesticides.
25. Identify and install the appropriate device for livestock monitoring.
26. * Identify, select and operate drone in various applications.
27. *Collect data using Drones.

Note: * Can be achieved with the help of industry

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Perform electrical/ electronic measurement by selecting of single range with following safety precautions.	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.	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.	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.	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.	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.	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 various standard electronic circuits using	Identify & Select the component
	Prepare simple digital and electronic circuits using the software.
	Test the simulation circuit.
	Convert the circuit into layout diagram.

Electronic simulation software.	Follow the instruction manual.
8. Apply the principle of sensors and transducers for various IoT applications.	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.	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.	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. Plan and Interface input and output devices to evaluate performance with Microcontroller.	Use 8051 microcontroller, connect 8 LED to the port, blink the LED with a switch
	Use 8051 microcontroller, connect LCD, Relay, Keypad and seven segments
	Perform the use of a ADC and DAC to read input voltage and provide output voltage
	Perform the use of RS232 and USB interface with Computer interface.
	Demonstrate entering of simple programs, execute & monitor the results.
12. Identify different IoT Applications with IoT architecture.	Identify various IoT Applications in Smart Agriculture viz. Precision Farming, Livestock Monitoring, Agricultural Drones etc.
	Recognise the functions of various IoT Technician (Smart Agriculture) (IoT) applications & their distinctive advantages.
	Identify and explore different functional building blocks of IoT enabled system / application.
	Explore signal flow into IoT enabled system/application as per the IoT architecture.
13. Identify, test and interconnect components/parts of IoT system.	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.
14. Identify and Select various types of sensors used in Smart Agriculture.	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.
15. Position the appropriate sensors and collect the information required in Smart Agriculture.	Identify sensors node block diagram and its components.
	Connect sensors and send data wirelessly to a central data logger at program.
	Perform interfacing of wireless modules with IoT platform.
	Select and Install sensors like CO2, O2, VOC, air temperature, humidity, moisture, etc.
	Identify and use sensor node configuration tool.
	Configure Sensor node using USB and Over the air programming.
	Connect solar panel with sensor node.
	Control Variable rate controllers manually
	Observe safety precaution

16. Identify, select different wireless communication modules and topology to generate and record the data.	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.
17. Identify and test Wired & Wireless communication medium such as RS232, RS485, Ethernet, Fiber Optic, Wi-Fi, GSM, GPRS, RF etc. and Communication protocol.	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.
18. Identify Solar Panel Basics Testing, Characteristics, Charge Controller Circuit.	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.
19. Perform installation, configuration and Check working of IOT devices, network,	Install Linux Operating System porting.
	Configure Local cloud & server.
	Configure GUI based parameter.
	Manage user access and security.

database, app and web services.	Test Qt based GUI.
20. Establish and troubleshoot IoT connectivity of devices to cloud having multiple communication medium, protocols and networking topology and device management and monitoring.	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
21. Demonstrate and Deploy responsive Web Application using APIs and generate reports using templates.	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
22. Identify and install the devices used in green house.	Select and Installation of Carbon dioxide sensors.
	Select and Install of Oxygen sensors.
	Install solar pump, motors and drip irrigation systems.
	Observe safety precaution.
	Follow instruction manual.
23. Monitor soil moisture, temperature etc. for controlling irrigation & record data.	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.
24. Select plant health monitoring system and apply proper water, fertilizer and pesticides.	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.
25. Identify and install the appropriate device for livestock monitoring.	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 Wearable Electronics to cattle example Fly off
	Select wireless technology with enough battery power to list the lifespan of the animal.
	Follow manual.
26. Identify, select and operate drone in various applications.	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
27. Collect data using Drones.	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) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 60Hrs.; 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. (06 hrs.) 2. Identify safety signs for danger, warning, caution &personal safety message. (04 hrs.) 3. Use of personal protective equipment (PPE). (06 hrs.) 4. Practice elementary first aid. (06 hrs.) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (03 hrs.) 6. Use of Fire extinguishers. (05 hrs.)	Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/shop floor. Introduction to PPEs. Introduction to First Aid. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Occupational Safety & Health**:** Health, Safety and Environment guidelines, legislations & regulations as applicable. (06 hrs.)
		Basics of AC and Electrical Cables 7. Identify the Phase, Neutral and Earth on power socket, use a tester to monitor AC power. (03 hrs.) 8. Construct a test lamp and use it to check mains healthiness. Measure the voltage between phase and ground and rectify earthing. (06 hrs.)	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.

		9. Prepare terminations, skin the electrical wires /cables using wire stripper and cutter. (04 hrs.) 10. Measure the gauge of the wire using SWG and outside micrometer. (02 hrs.) 11. Crimp the lugs to wire end. (03 hrs.) 12. Measure AC Voltage in three phase, Three phase star and delta correction, Three phase power measurement. (04 hrs.) 13. Demonstrate various test and measuring instruments (03 hrs.) 14. Measure voltage and current using clamp meter. (05 hrs.)	Different type of electrical cables and their Specifications. Types of wires & cables, standard wire gauge (SWG). Classification of cables according to gauge (core size), number of conductors, material, insulation strength, flexibility etc. Introduction to electrical and electronic measuring instruments. (06 hrs.)
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Test various electronic components using proper measuring instruments and compare the data using standard parameter.	**Active and Passive Components** 15. Identify the different types of active and passive electronic components. (02 hrs.) 16. Measure the resistor value by colour code, SMD Code and verify the same by measuring with multimeter. (02 hrs.) 17. Identify resistors by their appearance and check physical defects. (02 hrs.) 18. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. (03 hrs.) 19. Measurement of current and voltage in electrical circuits to	Ohm's law. Resistors; types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. Principles of induction, inductive reactance. Types of inductors, construction, specifications, applications and energy storage concept. Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel

		verify Kirchhoff's Law. (03 hrs.) 20. Verify laws of series and parallel circuits with voltage source in different combinations. (03 hrs.) 21. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. (04 hrs.) 22. Identify different inductors and measure the values using LCR meter. (03 hrs.) 23. Identify the different capacitors and measure capacitance of various capacitors using LCR meter. (03 hrs.) 24. Identify and test the circuit breaker and other protecting devices (Fuse). (03 hrs.) 25. Dismantle and identify the different parts of a relay. (04 hrs.) 26. Connect a timer relay in a circuit and test for its working. (03 hrs.) 27. Test Step-up, Step-down, Isolation Transformer. (03 hrs.) **AC & DC measurements** 28. Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R). (02 hrs.)	connection of capacitors. Properties of magnets and their materials, preparation of artificial magnets, significance of electro Magnetism, types of cores. Relays, types, construction and specifications etc. Multi meter, use of meters in different circuits. Use of DSO, Function generator, Arbitrary Waveform Generator ,LCR meter. (12 hrs.)

		29. Identify the different controls on the Digital Storage Oscilloscope front panel and observe the function of each control. (03 hrs.) 30. Measure DC voltage, AC voltage, time period, sine wave parameters using DSO. (02 hrs.) 31. Identify and use different mathematical functions +,-,X, diff, intg, AND, OR of DSO on the observed signal. (03 hrs.) 32. Identify and use different acquisition modes of normal, average, persistence mode. (03 hrs.) 33. Understand the difference of low memory and high memory DSO and relation with real time sampling of DSO. (02 hrs.) 34. Identify the different controls on the Arbitrary Waveform Generator front panel and observe the different signals to be derived from Arbitrary Waveform Generator. (05 hrs.) 35. Identify the different controls on the power supply and to understand CV/CC Mode, Dual Tracking Mode. (02 hrs.)	
Professional Skill 60Hrs.; Professional Knowledge	Identify, place, solder and de-solder and test different SMD discrete components and ICs package with	**Soldering/ De-soldering** 36. Practice soldering on different electronic components, small transformer and lugs. (03 hrs.)	Different types of soldering guns, related to Temperature and wattages, types of tips. Solder materials and their grading. Use of flux and other

12Hrs.	due care and following safety norms using proper tools/setup.	37. Practice soldering on IC bases and PCBs. (03 hrs.) 38. Practice Soldering on various SMD Components including SMD IC packages. (05 hrs.) 39. Practice de-soldering using pump and wick. (02 hrs.) 40. Practice Desoldering of SMD Components using SMD Hot Air Gun. (03 hrs.) 41. Join the broken PCB track and test. (03 hrs.) **Basic SMD (2, 3, 4 terminal components** 42. Identification of 2, 3, 4 terminal SMD components. De-solder the SMD components from the given PCB. (05 hrs.) 43. Solder the SMD components in the same PCB. Check for cold continuity of PCB. (05 hrs.) 44. Identification of loose /dry solder, broken tracks on printed wired assemblies. (04 hrs.) **SMD Soldering and De-soldering** 45. Identify various connections and setup required for SMD Soldering station. (05 hrs.) 46. Identify crimping tools for various IC packages. (04 hrs.) 47. Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least	materials. Selection of soldering gun for specific requirement. Soldering and De-soldering stations and their specifications. Different switches, their specification and usage. Introduction to SMD technology Identification of 2, 3, 4 terminal SMD components. Advantages of SMD components over conventional lead components. Introduction to Surface Mount Technology (SMT). Advantages, Surface Mount components and packages. Cold/ Continuity check of PCBs. Identification of lose / dry solders, broken tracks on printed wiring assemblies. (12 hrs.)

		four) by choosing proper crimping tools (06 hrs.) 48. Make the necessary settings on SMD soldering station to solder various ICs of different packages (at least four) by choosing proper crimping tools (06 hrs.) 49. Make the necessary setting rework of defective surface mount component used soldering / de-soldering method. (06 hrs.)	
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Construct, test and verify the input/ output characteristics of various analog circuits.	50. Identify and test different types of diodes, diode modules using multi meter and determine forward to reverse resistance ratio. Compare it with specifications. (07 hrs.) 51. Measure the voltage and current through a diode in a circuit and verify its forward/Reverse characteristic. (08 hrs.) 52. Construct and test a half wave, full wave and Bridge rectifier circuit. (06 hrs.) 53. Measure ripple voltage, ripple frequency and ripple factor of rectifiers. (06 hrs.) 54. Construct and test shunt clipper and clamper circuits using diodes. (06hrs.) 55. Identify and test Zener diode and construct peak clipper. (06 hrs.) 56. Identify different types of	Semiconductor materials, components, number coding for different electronic components such as Diodes and Zeners etc. PN Junction, Forward and Reverse biasing of diodes. Interpretation of diode specifications. Forward current and Reverse voltage. Working principle of a Transformer, construction, Specifications and types of cores used. Step-up, Step down and isolation transformers with applications. Losses in Transformers. Phase angle, phase relations, active and reactive power, power factor and its importance. Construction, working of a PNP and NPN Transistors, purpose of E, B & C Terminals. Significance of α, β and relationship of a Transistor.

		transistors and test them using digital multimeter. (06 hrs.) 57. Measure and plot input and output characteristics of a CE amplifier. (08 hrs.) 58. Construct and test a transistor-based switching circuit to control a relay. (07 hrs.)	Transistor applications as switch and CEamplifier. Transistor input and output characteristics. Transistor power ratings & packaging styles and use of different heat sinks. (12 hrs.)
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Assemble, test and troubleshoot various digital circuits.	59. Identify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them. (04 hrs.) 60. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. (02 hrs.) 61. Use digital IC tester to test the various digital ICs (TTL and CMOS). (03 hrs.) 62. Construct and Test a 2 to 4 Decoder. (02 hrs.) 63. Construct and Test a 4 to 2 Encoder. (02 hrs.) 64. Construct and Test a 4 to 1 Multiplexer. (02 hrs.) 65. Construct and Test a 1 to 4 De Multiplexer. (02 hrs.) 66. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. (05 hrs.) 67. Construct and test a four bit asynchronous binary counter (05 hrs.) 68. Construct and test a four bit Synchronous binary counter.	Introduction to Digital Electronics. Difference between analog and digital signals. Logic families and their comparison, logic levels of TTL and CMOS. Number systems (Decimal, binary, octal, Hexadecimal). BCD code, ASCII code and code conversions. Various Logic Gates and their truth tables. Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit and four-bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations. Concept of encoder and decoder. Basic Binary Decoder and four bit binary decoders. Need for multiplexing of data. 1:4 line Multiplexer / De-

		(04 hrs.) 69. Construct and test synchronous Decade counter. (04 hrs.) 70. Construct and test an up/down synchronous decade counter and monitor the output on LEDs. (03 hrs.) 71. Identify and test common anode and common cathode seven segment LED display using multi meter. (04 hrs.) 72. Test the shift register using IC 7495. (05hrs.) 73. Construct and test four-bit SIPO register. (05 hrs.) 74. Construct and test four-bit PIPO register. (04 hrs.) 75. Construct and test bidirectional shift registers. (04 hrs.)	multiplexer. Introduction to Flip-Flop. S-R Latch, Gated S-R Latch, D-Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop. Master-Slave flip flops and Timing diagrams. Basic flip flop applications like data storage, data transfer and frequency division. Types of seven segment display. BCD display and BCD to decimal decoder. BCD to 7 segment display circuits. Basics of Register, types and application of Registers. (12 hrs.)
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Install, configure, interconnect given computer system(s) and networking to demonstrate & utilize application packages for different applications.	76. Identify various indicators, cables, connectors and ports on the computer cabinet. (03 hrs.) 77. Demonstrate various parts of the system unit and motherboard components. (05 hrs.) 78. Identify various computer peripherals and connect it to the system. (05 hrs.) 79. Disable certain functionality by disconnecting the concerned cables SATA/	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working. Different types of printers, HDD, DVD. Various ports in the computer. Working principle of SMPS, its specification. Windows OS MS widows: Starting windows and its operation, file management using explorer,

		PATA. (05 hrs.) 80. Replace the CMOS battery and extend a memory module. (05 hrs.) 81. Test and Replace the SMPS. (05 hrs.) 82. Replace the given DVD, RAM and HDD on the system. (05 hrs.) 83. Boot the system from Different options and install OS in a desktop computer. (05 hrs.) 84. Install antivirus software, printer, scan the system and explore the options in the antivirus software. (04 hrs.) 85. Browse search engines, create email accounts, practice sending and receiving of mails and configuration of email clients. (04 hrs.) 86. Identify different types of cables and network components e.g. Hub, switch, router, modem etc. (05 hrs.) 87. Prepare terminations, make UTP and STP cable connectors and test. (03 hrs.) 88. Connect network connectivity hardware and check for its functioning. (03 hrs.) 89. Configure a wireless Wi-Fi network. (03 hrs.)	Display & sound properties, screen savers, font management, installation of program, setting 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. (12 hrs.)
Professional	Develop	90. Prepare simple digital and	Study the library components

Skill 30Hrs.; Professional Knowledge 06Hrs.	troubleshooting skills in various standard electronic circuits using Electronic simulation software.	electronic circuits using the software. (06 hrs.) 91. Simulate and test the prepared digital and analog circuits. (06 hrs.) 92. Create fault in particular component and simulate the circuit for its performance. (06 hrs.) 93. Convert the prepared circuit into a layout diagram. (06 hrs.) 94. Prepare simple, power electronic and domestic electronic circuit using simulation software. (06 hrs.)	available in the circuit simulation software. Various resources of the software. (06 hrs.)
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Apply the principle of sensors and transducers for various IoT applications.	95. Identify and test RTDs, Temperature ICs and Thermo couples. (06 hrs.) 96. Identify and test proximity switches (inductive, capacitive and photoelectric). (06 hrs.) 97. Identify and test, load cells, strain gauge, LVDT, PT 100 (platinum resistance sensor). (06 hrs.) 98. Detect different objectives using capacitive, Inductive and photo electric proximity sensors. (12 hrs.)	Basics of passive and active transducers. Role, selection and characteristics. Sensor voltage and current formats. Thermistors / Thermocouples - 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. (06 hrs.)
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	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.	99. Explore different driving circuits used for sensors.(07hrs.) 100. Amplification of low power signals using current, power, instrumentation, differential, inverting, non-inverting and buffer amplifier circuits.(07hrs.) 101. Identify analog to digital and digital to analog converter ICs like ADC0808, DAC0808.(07hrs.) 102. Explore different converters like V/I, I/V, F/V and V/F.(07 hrs.) 103. Explore low pass and high pass filter. (05hrs.) **Integration of Analog sensors** 104. Identify various Analog sensors. (02 hrs.) 105. Identify Roles and Characteristics of each sensor. (02 hrs.) 106. Select appropriate Analog sensor. (02 hrs.) 107. Connect & measure AC/DC Analog Input such as voltage / current / RTD two-three-four wire AC mV signal etc. (02 hrs.) 108. Configure Engineering &	Working principle of different types of control circuits and their applications for sensors. Principle of operation of signal generator, distinguish between voltage and power amplifier. Working principle of different converters. Demonstrate different types of filter circuits and their applications. 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. (12 hrs.)

		Electrical zero/span configuration mV, 0-10VDC, 4-20mA, 0-20mA. (02 hrs.) 109. Understand various units and zero span configuration as per sensor datasheet such as temperature, pressure, flow, level, lux level, environment, soil, moisture etc. (02 hrs.) 110. Measure the Analog Input as per configuration and sensor selection. (02 hrs.) 111. Generate and measure Analog Output to operate control valves and actuators. (02 hrs.) **Integration of Digital sensors** 112. Identify various Digital sensors. (02 hrs.) 113. Identify Roles and Characteristics of each sensor. (02 hrs.) 114. Select appropriate Digital sensor. (02 hrs.) 115. Connect and Measure Digital Inputs of various voltage level such as TTL (0-5V), 24VDC (0-24 VDC) signals. (02hrs.) 116. Connect Pulse Inputs of various frequency ranging from 10 Hz to 1 KHz and configure the filters. (02 hrs.) 117. Select, Configure and ascertain of Digital Outputs and Relay Outputs to take	

		On and Off action for actuators. (01 hr.)	
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Identify, Test and troubleshoot the various families of Microcontroller.	118. Explore different microcontroller families' architecture like 8051, AVR, PIC, ARM, Raspberry pi and Arduino. (06 hrs.) 119. Explore the different Software IDE used for microcontroller. (06 hrs.) 120. Explore ICs & their functions on the given Microcontroller Kit. (06 hrs.) 121. Identify the port pins of the controller & configure the ports for Input & Output operation. (06 hrs.) 122. Explore Universal IC programmer to program burn output file on different ICs. (06 hrs.)	Introduction Microprocessor &8051Microcontroller, architecture, pin details & the bus system. Function of different ICs used in the Microcontroller Kit. Differentiate microcontroller with microprocessor. Interfacing of memory to the microcontroller. Internal hardware resources of microcontroller. I/O port pin configuration. Different variants of 8051 & their resources. Register banks & their functioning. SFRs & their configuration for different applications.
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Plan and Interface input and output devices to evaluate performance with Microcontroller.	123. Use 8051 microcontroller, connect 8 LED to the port, blink the LED with a switch. (05 hrs.) 124. Perform with 8051 microcontroller assembling language program, check the reading of an input port and sending the received bytes to the output port of the microcontroller, used switches and LCD for the input and output. (05 hrs.) 125. Use 8051 microcontroller, connect LCD, Relay, Keypad and seven segments. (05 hrs.)	Comparative study of 8051 with 8052. Introduction to PIC Architecture. Introduction to ADC and DAC, schematic diagram, features and characteristic with the applications. (12 hrs.)

		126. Use 8051 microcontroller, connect servo, DC and stepper motor. (05 hrs.) 127. Perform the use of a ADC and DAC to read input voltage and provide output voltage. (05 hrs.) 128. Perform the use of RS232 and USB interface with Computer interface.(03 hrs.) 129. Demonstrate entering of simple programs, execute & monitor the results. (02 hrs.)	
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Identify different IoT Applications with IoT architecture.	130. Identify various IoT Applications in smart agriculture viz. Precision Farming, Livestock Monitoring, Agricultural Drones etc.(07 hrs.) 131. Recognise the functions of various Internets of Things (Smart Agriculture)(IoT) applications & their distinctive advantages. (08 hrs.) 132. Identify and explore different functional building blocks of IOT enabled system / application. (08 hrs.) 133. Test signal flow into IOT enabled system/application as per the IOT architecture. (07 hrs.)	Introduction to Internet of Things applications in smart agriculture& their distinctive advantages - Precision Farming, Livestock Monitoring, Agricultural Drones etc. What is an IOT? What makes embedded system an IOT? Role and scope of IOT in present and future marketplace. Smart objects, Wired – Cables, hubs etc. Wireless – RFID, WiFi, Bluetooth etc. Different functional building blocks of IOT architecture. (06 hrs.)
Professional Skill 30Hrs.; Professional Knowledge	Identify, test and interconnect components/parts of IoT system.	134. Connect and test Arduino board to computer and execute sample programs from the example list. (04 hrs.)	Arduino development board, Pin diagram, Functional diagram, Hardware familiarization and operating instructions.

06Hrs.		135. Upload computer code to the physical board (Microcontroller) to blink a simple LED. (02 hrs.) 136. Write and upload computer code to the physical Arduino board Micro controller to sound buzzer. (02 hrs.) 137. Circuit and program to Interface light sensor – LDR with arduino to switch ON/OFF LED based on light intensity. (03 hrs.) 138. Set up & test circuit to interface potentiometer with Arduino board and map to digital values for e.g. 0-1023. (03 hrs.) 139. Interface Pushbuttons 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. (03 hrs.) 140. Rig up the Circuit and upload a program to Control a relay and switch on/off LED light using Arduino. (02 hrs.) 141. Make Circuit and upload a program to Interface of LCD display with a microcontroller to display characters. (03 hrs.) 142. Rig up the circuit and upload a program to interface temperature sensor – LM35 with a controller to display	Integrated development Environment, Running Programs on IDE, simple Programming concepts. (06 hrs..)

		temperature on the LCD. (02 hrs.) 143. Set up Circuit and upload program to Interface DC motor (actuator) with microcontroller to control on /off /forward/reverse operations. (03 hrs.) 144. Rig up Circuit and upload program micro-controller to switch on/off two lights using relay. (03 hrs.)	
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Identify and Select various types of sensors used in Smart Agriculture.	145. Identify various sensors used in Precision Farming viz. Location Sensors, Optical Sensors, Electrochemical Sensors, Mechanical Sensors, Airflow Sensors and Agricultural Weather Stations. (04 hrs.) 146. Select appropriate sensor as per requirement. (04 hrs.) 147. Determine clay, organic matter and moisture content of the soil by Optical Sensors. (04 hrs.) 148. Measure Ph by Electrochemical Sensor and soil nutrient. (04 hrs.) 149. Apply Electrochemical Sensor to gather process and map soil chemical data. (04 hrs.) 150. Measure soil compaction or “mechanical resistance” by Mechanical Sensors. (04 hrs.) 151. Use of probe that penetrates	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

		the soil and records resistive forces through use of load cells or strain gauges for Mechanical Sensors. (04 hrs.) 152. Use Mechanical Sensors on large tractors to predict pulling requirements for ground engaging equipment. (05 hrs.) 153. Detect the force used by the roots in water absorption that are very useful for irrigation interventions by Tensiometers. (07 hrs.) 154. Measure soil air permeability by Airflow Sensors at singular locations or dynamically while in motion. (06 hrs.) 155. Identify various types of soil properties including compaction, structure, soil type, and moisture level by Airflow Sensors. (07 hrs.) 156. Measure and record Information such as air temperature, soil temperature at a various depths, rainfall, leaf wetness, chlorophyll, wind speed, dew point temperature, wind direction, relative humidity, solar radiation and atmospheric pressure at predetermined intervals by Agricultural Weather Stations.(07 hrs.)	fields. Knowledge of Stations, combination of sensors appropriate for the local crops and climate. Advantages - portability and decreasing prices for farms of all sizes. (12hrs.)

Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Position the appropriate sensors and collect the information required in Smart Agriculture.	157. Study and interpret the result of sensors node block diagram and its components. (10 hrs.) 158. Connection with sensors and send data wirelessly to a central data logger at program.(10 hrs.) 159. Interface of wireless modules with IoT platform. (10 hrs.) 160. Select and Install sensors like CO2, O2, VOC, air temperature, humidity, moisture, etc.(05 hrs.) 161. Identify and select the data packet and sensor node configuration tool. (10 hrs.) 162. Configure Sensor node using USB and Over the air programming. (05 hrs.) 163. State the battery level and solar panel connects with sensor node. (05 hrs.) 164. Control Variable rate controllers manually or automatically using an on-board computer guided by real GPS location. (05 hrs.)	Location Sensors - Determination of latitude, longitude and altitude, Concept of GPS integrated circuits. Optical Sensors - Measurement of different frequencies of light reflectance in near-infrared, mid-infrared, and polarized light spectrums, Placement on vehicles or aerial platforms. Determination of clay, organic matter and moisture content of the soil. Electrochemical Sensors - Collection of information like pH and soil nutrient levels, detection of specific ions in the soil. Applications to gather, process, and map soil chemical data. Mechanical Sensors – Measurement of soil compaction or “mechanical resistance”, Use of probe that penetrates the soil and records resistive forces through use of load cells or strain gauges. Detection of the force used by the roots in water absorption that are very useful for irrigation interventions. Airflow Sensors – Measurement of soil air permeability. Measurements at singular

			locations or dynamically while in motion. Knowledge of desired output - the pressure required to push a predetermined amount of air into the ground at a prescribed depth. Various types of soil properties, including compaction, structure, soil type and moisture level. Agricultural Weather Stations – Measurement and record Information such as air temperature, soil temperature at a various depth, rainfall, leaf wetness, chlorophyll, wind speed, dew point temperature, wind direction, relative humidity, solar radiation, and atmospheric pressure at predetermined intervals. Compilation and sending of data wirelessly to a central data logger at programmed intervals. (12 hrs.)
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Identify, select different wireless communication modules and topology to generate and record the data.	165. Identify the interfacing of Zigbee module to create wireless sensor network. (02 hrs.) 166. Check the M2M Wireless Sensor Network (WSN) in IoT Zigbee router, end device and coordinator configuration. (04 hrs.) 167. Identify the interfacing of Bluetooth module to create local sensor network. (03	Introduction to Zigbee. Block diagram of Zigbee based sensor network. Introduction to wireless personal area network system. Introduction to Zigbee networking system. Concept of interfacing of Bluetooth module to local sensor network, interfacing of GSM module to make node as a gateway. IoT Gateway using WiFi and

		hrs.) 168. Identify the interfacing of GSM module to make node as a gateway. (03 hrs.) 169. Apply IoT Gateway using WiFi and Ethernet. (04 hrs.) 170. Check UART Communication, RS485 Communication, I2C Protocol device interfacing SPI Protocol device interfacing, Ethernet configuration, Zigbee interfacing, Wi-Fi AP and Router interfacing. (08 hrs.) 171. Identify the Wi-Fi module and lua script for data communication. (04 hrs.) 172. Check USB and Ethernet connectivity for data communication. (02 hrs.) 173. Check RS485 interface for industrial agriculture sensors. (02 hrs.) 174. Create a combine sensor appropriate for the local crops and for agricultural climate monitoring. (04 hrs.) 175. Use portable Agricultural Weather Stations.(03 hrs.) 176. Use signals from GPS satellites to determine latitude, longitude and altitude to within feet by Location Sensors for precise positioning. (03 hrs.) 177. Measure yield and grain moisture in a field using crop	Ethernet. Application of GPS satellites 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. Usage of signals from GPS satellites to determine latitude, longitude and altitude to within feet by Location Sensors for precise positioning. Use of Yield Monitors – measurement of yield and grain moisture in a field using crop yield measuring devices installed on harvesting equipment. Principle of operation & Application of Global Positioning System (GPS): satellites broadcasting signals that allow GPS receivers to calculate their position. Working principle & Use of Geographical information system(GIS) consisting of a computer software data base system used to input, store, retrieve, analyze, and display in map like form, spatially referenced geographical information for more detailed analysis of fields.

		yield measuring devices installed on harvesting equipment. (02 hrs.) 178. Use Geographical information system(GIS) consisting of a computer software data base system used to input, store, retrieve, analyze and display in map like form, spatially referenced geographical information for more detailed analysis of fields.(05hrs.) 179. Analyze the data collected by yield monitor and GPS and supply it to user in usable format such as maps, graphs, charts or reports using suitable Computer Hardware and Software. (05hrs.) 180. Apply Precision irrigation through water management in precision agriculture. (05hrs.) 181. Identify zones in the field that are irrigated with differing amounts and frequencies in precision irrigation.(05hrs.)	Data Integration Through a Geographical Information System Use of Computer Hardware and Software to analyze the data collected by yield monitor and GPS and supply it to user in usable format – such as maps, graphs, charts or reports. 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. (12 hrs.)
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	182. Identify Cable and its Pin Mapping. (04 hrs.) 183. Crimp and Test RJ9 / RJ11 / RJ45 connectors. (04 hrs.) 184. Understand Frequency Band, Gain, Antenna and Modulation for WiFi. (04	Basic blocks of networking, - Specifications, Standards and types of cables, - Concept of wired or wireless communication medium - Different types of networks - Design and establish networks

	etc. and Communication protocol.	hrs.) 185. Understand Frequency Band, Gain, Antenna and Modulation for GPRS. (04 hrs.) 186. Understand Frequency Band, Gain, Antenna and Modulation for RF. (04 hrs.) 187. Design and Test Local Area Networks over Ethernet & Wi-Fi. (03 hrs.) 188. Design and Test Cellular Wide Area Networks over GSM & GPRS. (02 hrs.) 189. Design and Test Personal Area Networks over RF. (05 hrs.)	(06 hrs.)
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Identify Solar Panel Basics Testing, Characteristics, Charge Controller Circuit.	190. Identify, test and check series, parallel and series-parallel combination of Solar PV Modules. (08 hrs.) 191. Measure VI Characteristics of Solar PV Module.(03 hrs.) 192. Identify and test blocking diode and its working in Solar PV Module.(03 hrs.) 193. Observe bypass diode and its working in Solar PV Module.(02 hrs.) 194. Measure effect of inclination angle of Solar PV Module.(02 hrs.) 195. Identify and test different charging techniques.(02 hrs.) 196. Test Buck &Boost converter.(02 hrs.) 197. Check effect of change in solar radiation on Solar PV	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. (6 hrs.)

		Module.(02 hrs.) 198. Identify and test running different applications i.e. LEDs, Dusk to Dawn sensing. (03 hrs.) 199. Check the use of P V Analyzer. (03 hrs.)	
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Perform installation, configuration and Check working of IoT devices, network, database, app and web services.	200. Install Linux Operating System porting. (05 hrs.) 201. Configure Local cloud & server. (05 hrs.) 202. Configure Over the air (OTA) node. (05 hrs.) 203. Parameter configuration using GUI. (05 hrs.) 204. Check IoT Gateway using WiFi and Ethernet. (05 hrs.) 205. Work with the command line and the Shell. (05 hrs.) 206. Manage directories and files. Manage user access and data security (Cyber security) by Cryptography.(03 hrs.) 207. Set up a Linux file system. Perform system initialization.(05 hrs.) 208. Install and Configure Linux. (05 hrs.) 209. Create Shell Scripts, flow control in the Shell, Advanced Shell features.(04 hrs.) 210. Apply Database management system.(03 hrs.) 211. Configure Cloud and Server for IoT.(04 hrs.)	Installation of Linux Operating System porting. Configuration of Local cloud & server. Over the air (OTA) node configuration. GUI based parameter configuration, GUI based IoT application. IoT Gateway using WiFi and Ethernet. User access and data security management (Cyber security) by Cryptography. The command line and the Shell, directories and files. Linux file system, understanding system initialization. Connection of a system to the network. Installation and Configuration of Linux. Shell Scripts, flow control in the Shell, Advanced Shell features. Database management system. Cloud and Server Configuration for IoT. Qt based GUI, IoT Web and Application Development Tools for IoT. (12 hrs.)

		212. Test Qt based GUI. (03hrs.) 213. Test Web and Application Development Tools for IoT. (03 hrs.)	
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Establish and troubleshoot IoT connectivity of devices to cloud having multiple communication medium, protocols, device management and monitoring.	214. Power up the Solar Inverter (similar device) as per the device manual. (02 hrs.) 215. Integrate Solar Inverter (similar device) with serial protocol working on Modbus RTU. (03 hrs.) 216. Communicate and Verify the parameters on Modbus Master Software (03 hrs.) 217. Power up the DLMS device as per the device manual. (02 hrs.) 218. Integrate device with serial protocol working DLMS protocol. (03 hrs.) 219. Communicate and Verify the parameters on DLMS server software. (02 hrs.) 220. Setup wired Local Area Network and wireless network. (03 hrs.) 221. Setup environment for Modbus TCPIP server client testing. (03 hrs.) 222. Communicate and Configure Modbus devices through GSM GPRS network (03 hrs.) 223. Setup Serial to Ethernet protocol converter and verify. (04 hrs.) 224. Setup Serial to WiFi protocol converter and verify. (03 hrs.)	- 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. (12 hrs.)

		225. Setup Serial to GPRS protocol converter and verify. (03 hrs.) 226. Setup Ethernet IoT Data Acquisition system, connect to cloud and verify (04 hrs.) 227. Setup WiFi IoT Data Acquisition system, connect to cloud and verify. (04 hrs.) 228. Setup Cellular (GSM / GPRS) IoT Data Acquisition system, connect to cloud and verify. (03 hrs.) 229. Explore IoT Cloud Configuration utility. (03 hrs.) 230. Create / modify organization, Connect devices over cloud. (04 hrs.) 231. Configuration of parameters, alarms, notifications on cloud platform. (02 hrs.) 232. Explore user management roles and security. (03 hrs.) 233. Observer Device Diagnostics for troubleshooting. (03 hrs.) 234. Setup Environment for embedded SCADA testing. (04 hrs.)	
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Demonstrate and deploy responsive Web Application using APIs and generate reports using templates.	235. Explore Web API, required input parameters and output (04 hrs.) 236. Map Web API to Widget / Control / Plugin (10 hrs.) 237. Display and configure graphs, charts and other ready to use controls and widgets (07hrs.)	Usage of Web Services / Web API Development of Sample Web Application. Generation and export of Reports User access and rights management. (06 hrs.)

		238. To generate reports using readily available API, templates and to export it to excel, word pdf and other required formats. (09hrs.)	
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Identify and install the devices used in green house.	239. Select and Install Carbon dioxide sensors. (05 hrs.) 240. Install Oxygen sensors. (05 hrs.) 241. Carry out Selection and Installation of Volatile organic compound sensor. (05 hrs.) 242. Execute Selection and Installation of Air temperature, Air humidity and atmospheric pressure sensor. (05 hrs.) 243. Select and Install Soil Moisture and Soil Temperature sensor. (05 hrs.) 244. Carry out Installation of Solar pump, motors and drip irrigation systems. (05 hrs.)	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. (06 hrs.)
Professional Skill 60Hrs.; Professional Knowledge 12Hrs.	Monitor soil moisture, temperature etc. for controlling irrigation & record data.	245. Carry out Crop and soil observations logged in the form of snapped pictures, pinpoint locations, soil colours, water, plant leaves, and light properties. (05 hrs.) 246. Measure leaf health, lighting brightness, chlorophyll amount, ripeness level, Leaf Area Index (LAI), soil organic and carbon makeup by using Smartphone Camera. (05	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, lighting brightness, chlorophyll amount, ripeness level, Leaf Area Index (LAI), soil organic and carbon makeup by using Smartphone Camera. Usage of Smartphone GPS for

		hrs.) 247. Use Smartphone GPS for location for crop mapping, disease/pest location alerts, solar radiation predictions, and fertilizing. (05 hrs.) 248. Perform predictive maintenance of machinery using Microphone. (05 hrs.) 249. Determine Leaf Angle Index using Accelerometer. (05 hrs.) 250. Apply Precision irrigation through water management in precision agriculture. (05 hrs.) 251. Identify zones in the field that are irrigated with differing amounts and frequencies in precision irrigation.(05 hrs.) 252. 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. (10 hrs.) 253. Apply various Precision Agriculture tools: Soil Mapping, Yield Mapping, Remote Sensing, GIS Analysis, Nutrient Management, Variable Rate Technology, Integrated Pest	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 & Weed Management, Water Management etc. for controlling irrigation & record data. Identification of various benefits of application of Precision Agriculture in Smart Farming:

		& Weed Management, Water Management etc. for controlling irrigation & record data.(10 hrs.) 254. 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. (05 hrs.)	Optimising Production Efficiency, Optimising Quality, Minimising Environmental Impact, Minimising Risk, Information To Act On. (12 hrs.)
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Select plant health monitoring system and apply proper water, fertilizer and pesticides.	255. Test Non-contact surface temperature measurement. (02 hrs.) 256. Test Leaf and flower bud temperature. (02 hrs.) 257. Check Soil oxygen level. (02 hrs.) 258. Test Solar radiation (shortwave, PAR and UV). (02 hrs.) 259. Measure Air temperature, humidity and pressure. (02 hrs.) 260. Observe Conductivity, water content and soil temperature. (03 hrs.) 261. Test Soil temperature and volumetric water content. (03 hrs.) 262. Measure Soil water potentials. (03 hrs.) 263. Test Vapor pressure, humidity, temperature, and atmospheric pressure in soil	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 fruit diameter.

		and air. (03 hrs.) 264. Check Leaf wetness. (02 hrs.) 265. Measure Stem, truck and fruit diameter. (02 hrs.) 266. Test Wind speed and precipitations. (02 hrs.) 267. Check Luminosity (Luxes Accuracy). (02 hrs.)	Exploration and test of Wind and precipitations. Checking of Luminosity (Luxes Accuracy). (06 hrs.)
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Identify and install the appropriate device for livestock monitoring.	268. Apply Wireless IoT in livestock monitoring - collect data regarding the location, well-being and health of cattle.(06 hrs.) 269. Use Location Sensors, GPS &GPS integrated circuits.(06 hrs.) 270. Apply Wearable Electronics to cattle.(06 hrs.) 271. Use wireless retrofitted bolus in cow's stomach which can communicate via Bluetooth to an ear tag.(06 hrs.) 272. Select wireless technology with enough battery power to list the lifespan of the animal. (06 hrs.)	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. (06 hrs.)
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Identify, select and operate drone in various applications.	273. Identify different types of drones – ground based and aerial based drones & their functions. (10 hrs.) 274. 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	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

		wireless LAN and Bluetooth connectivity). (20 hrs.)	Bluetooth connectivity). (06 hrs..)
Professional Skill 30Hrs.; Professional Knowledge 06Hrs.	Collect data using Drones.	275. Use ground-based and aerial based drones in agriculture for crop health assessment, irrigation, crop monitoring, crop spraying, planting and soil & field analysis.(04hrs.) 276. Identify and apply thermal camera in smart farming. (02 hrs.) 277. 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. (04 hrs.) 278. Select what field to survey altitude or ground resolution on the basis of farmer's information. (05 hrs.) 279. Perform in-flight monitoring and observations. (05 hrs.) 280. Collect multispectral, thermal and visual imagery during the flight of drones/UAV. (04 hrs.) 281. Analyse Drone data for insights regarding plant health indices, plant counting and yield prediction, plant height measurement, canopy cover mapping, mapping, scouting	Usage of ground-based and aerial based drones in agriculture for crop health assessment, irrigation, crop monitoring, crop spraying, planting and soil & field analysis. Explore the use of thermal camera in smart farming. 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. Selection of what field to survey altitude or ground resolution on the basis of farmer's information. Principle of in-flight monitoring and observations. Collection of multispectral, thermal and visual imagery during the flight of drones/UAV. Analysis of 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. (06

		reports, stockpile measurement, chlorophyll measurement, nitrogen content in wheat, drainage mapping, weed pressure mapping and so on.(06 hrs.)	hrs.)
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) (160Hrs.)

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

ANNEXURE-I

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	1 No. each
		Bench Vice - 100 mm	
		Bench Vice - 50 mm	
List of Equipments			
39.	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 mV rms. Constant Voltage & Current operation	4 Nos.
40.	DC Regulated Variable Programmable DC Power Supply	0-30V/3A with numeric keypad, PC interface and LCD for Voltage, Current & Power	2 Nos.
41.	LCR meter (Digital) Handheld	It can Measure six basic parameters R,C,L equipped with SMD Component Test Fixture	1 No.
42.	70 MHz Mixed Signal Oscilloscope (4 Analog + 16 Digital Channel)	With more than 20Mpt memory Real time Sampling 1GSa/sec , having LAN	1 No.

		Interface with, I2C , SPI, Runt etc .. And RS232/UART, I2C and SPI trigger decoding functions, two channel 25MHz awg plus math functions like differentiation, integration, abs, AND,OR,NOT etc.	
43.	25 MHz Arbitrary Waveform Generator with Digital Display for Frequency and Amplitude	Two Channel, 200MSa/Sec and 2Mpt memory with more than 150 different arbitrary waveforms and built-in 8th order harmonic generation and 150MHz Frequency counter PC Connectivity USB Device/Host and LAN	1 No.
44.	6 1/2 Digit Digital Multimeter	Measurement Functions: DC &AC Voltage, DC&AC Current, 2-wire & 4-wire Resistance, CAP, Diode, Connectivity, Frequency, Period, Any Sensor. Temperature: RTD, THERM,TC (B/E/J/K/N/R/S/T) PC Interface USB Host, USB Device, LAN(LXI-C) Measurement Speed 10k readings/sec	1 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 Built in tracking generator Min. -148 dBm DANL Display 8” TFT or more PC Interface: USB Host & Device, LAN(LXI)	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, Spectrum Analyzer. Arbitrary Waveform Generator Sine 50MHz ,Square 15MHz,Triangle 100KHz , AM – FM Modulation, 16 Channel Logic Analyzer Frequency and Phase Meter USB 2.0/ 3.0 Interface	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, Triangle (1Hz to 100KHz) Modulating Signal Generator: Sine, Square, Triangle (1Hz to 10KHz). Voltage, current and frequency on board LCD display. PC Interface – Acquisition from	1 No.

		two analog input channel Simulation Software	
49.	Digital IC Trainer	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	1 No.
50.	IT Workbench for computer hardware and networking	The bench comprises with Computer Hardware Training System (02 Nos.) The different circuit boards of PC/AT Computer are exposed on a PCB, LAN Training System with Wireless LAN as well to study Peer to Peer, STAR, RING Topology. Protocols: CSMA /CD, CSMA /CA, Stop N Wait, Go back to N, Selective repeat, Sliding Window, Token Bus, Token Ring, Colored representation of data in transmission & reception. Data transmission speed: 10/100 Mbps, Smart managed 3 Layer and 2 Layer Switch, Media converter, POE Switch, Wi-Fi LAN card, IP Camera, Energy meter, LED tube light, Voltmeter and Ammeter will be fitted. Networking Fundamentals Teaching Simulation Software	1 No.

		DSO 50MHz 4 Channel , 1GSa/Sec ,more than 20 Mpt memory DSO DMM : $4^{1/2}$ Digit with LCD Display	
51.	Laptop latest configuration		1 No.
52.	Laser jet Printer		1 No.
53.	Internet Broadband Connection		1 No.
54.	Electronic circuit simulation 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.
55.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
56.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB		As required
57.	SMD Soldering & De soldering Station with necessary accessories	SMD Soldering & Desoldering Station Digitally Calibrated Temperature Control SMD Soldering & Desoldering Power Consumption: 60 Watts I/P Voltage: 170 to 270 V De-soldering : 70 Watt Temperature Range : 180 to 480º Centigrade Power Consumption : 270 Watts Hot Air Temperature : 200 to 550º Centigrade	1 No.
58.	SMD Technology Kit	SMD component identification board with SMD	1 No.

		components Resistors, Capacitors, Inductors, Diodes, Transistors & IC's packages. Proto boards with readymade solder pads for various SMD Components. SMD Soldering Jig.	
59.	Microcontroller kits (8051) along with programming software (Assembly level Programming) With six important different application modules 1. Input Interface Switch, Matrix Keypad, ASCII Keypad 2. Display LCD, Seven Segment, LED Matrix 3. ADC & DAC 4. PC Interface module 5. Motor DC, Stepper, Servo 6. DAQ	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 simulation Software and following application modules 1. Input Interface : 4x4 Matrix Keypad, ASCII Key PAD, Four Input Switch 2. Display 16X2 LCD, Seven Segment, LED Bar Graph 3. ADC/DAC with ADC/DAC0808 4. PC Interface: RS232 & USB 5. Motor Drive: DC, Servo, Stepper 6. DAQ: 4ch analog 10bit, 22 DIO resolution,6MHz Frequency Counter (square wave), DAQ with PC interface software	1 No.
60.	Sensor Trainer Kit Containing following Sensors a) Air humidity and Temperature b) RTD c) Atmospheric Pressure	IoT enabled Android based 7" Graphical touch LCD with inbuilt cortex processor & DAQ for acquiring analog data and software for viewing the output waveforms with USB storage and HDMI output. Ethernet	2 Nos.

	d) Air Quality e) Smoke Detector Sensors f) Limit Switch g) Photo sensors h) Capacitive displacement	port to connect real world. Inverting, Non – Inverting, Power, Current, Instrumentation and Differential Amplifier, F to V, V to F, I to V, V to I Converter, High Pass and Low Pass Filter, Buffer, LED, Buzzer, LED Bar Graph, Touch Switch Included Sensors :RTD,NTC Thermistor,LM35,Photovoltic, Air humidity and Temperature, Gas(Smoke), Air Quality, Atmospheric Pressure, Limit switch, Capacitive displacement	
61.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
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	1 No.

		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.	
63.	Internet of Things Explorer	Processor : 64bit ARMv7 with 1GB RAM , Memory 32GB ,OS: Open source Linux, Connectivity: Wireless LAN, Bluetooth, Zigbee, USB & Ethernet, HDMI interface, 1.77" Color TFT LCD , Driver for Stepper and DC Motor, six 16 bit Analog Input, RTC and 4-20mA input. Zigbee: 2.4GHz, Sensors: Temperature and Humidity, Air Quality, Soil Moisture, Ambient Light, Soil/Water temperature, PIR Sensor. GSM IoT Gateway - Quad-Band 850/900/1800/1900 MHz - GPRS multi-slot class, Control via AT commands. Explore physical and application layer protocols like RS232, RS485, GSM, Ethernet and MQTT, CoAP, HTTP, FTP. Cloud/server configuration includes HTML, Java, php and mySQL. IoT Node: Wireless 2.4GHz Zigbee, 5 Analog Inputs and at least 3 Digital Outputs, At least one	1 No.

		I2C Channel, support OTA. Online Cloud/Server Services for 2 years. Battery 3.7V/4400mAH with Solar Panel, USB interface.	
64.	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 (0-10VDC), Ethernet Port – Qty 1 ▪ 8 Relay Outputs, Ethernet Port – Qty 1 ▪ 8 Pulse Outputs, Ethernet 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	1 No.

		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, DLMS Client IoT Protocol Simulations – MQTT topic publish subscribe simulation	
LIST OF THE MACHINERIES			
65.	Solar Power Lab	Solar PV Modules. Open Circuit Voltage Voc 10V, Short Circuit Current ISC 0.60mA 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	1 No.
66.	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	1 No.

		and Current at Maximum Power DCV Range 0-50V, DCA Range 10A	
67.	Wireless Communication modules for interfacing with microcontrollers a) RFID Card Reader b) Finger Print c) Zigbee d) GPS e) GSM f) Bluetooth g) WiFi	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 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	1 No.
68.	Sensors for Green House Application	All should be compatible with Sensor Training Platform & IOT Explorer mentioned above: CO2: Range: (0-2000ppm), O2 Range: (0-25%), VOC, Air Temperature& humidity, Atmospheric Pressure, Soil Moisture& Temperature, NO2, Leaf Wetness, Solar Radiation, UV Index.	1 No.
69.	Solar Water Pump	1HPSolar Panel 40W (36Nos) MPPT 400 TO 700V DC Operating Frequency : 30Hz to 50Hz, Protection : Dry Run , Short CircuitMaximum PV Voltage 750V DC Remote Operation through GSM module	1 No.
70.	Weather Monitoring System	Temperature Range : -10°C to 90°C, Relative Humidity Operating Range 0 to 95%	1 No.

		,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	
71.	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	1 No.
72.	Sensors for Livestock Monitoring	All should be compatible with Sensor Training Platform & IOT Explorer mentioned above: Active & Passive RFID tags with reader, Bluetooth tags with application software, GPS and PIR.	1 No.
73.	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	1 No.

		Spray System : Tank Volume minimum 8L Payload Approx 8 Kg	
74.	IoT based Smart Roof Top / Solar Pump system (Application Project)	1. Inverter (can be existing inverter of Solar Kit) 2. 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 3. Embedded Calculations for %CUF (capacity utilization factor), %PR (Performance Ratio) 4. 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),	1 No.

		%PR (Performance Ratio) etc.	
75.	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	1 No.
76.	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 Analog Inputs (0.1% FSR), 8 Pulse Inputs (up to 1 kHz), 8 Digital Inputs, 4 Relay Outputs	1 No.
77.	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.
C. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			

78.	Instructor's table		1 No.
79.	Instructor's chair		2 Nos.
80.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
81.	Lockers with 16 drawers standard size		2 Nos.
82.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 Nos.
83.	Interactive Smart Board with Projector		1 No.
84.	Fire Extinguisher		2 Nos.
85.	Fire Buckets		2 Nos.

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.

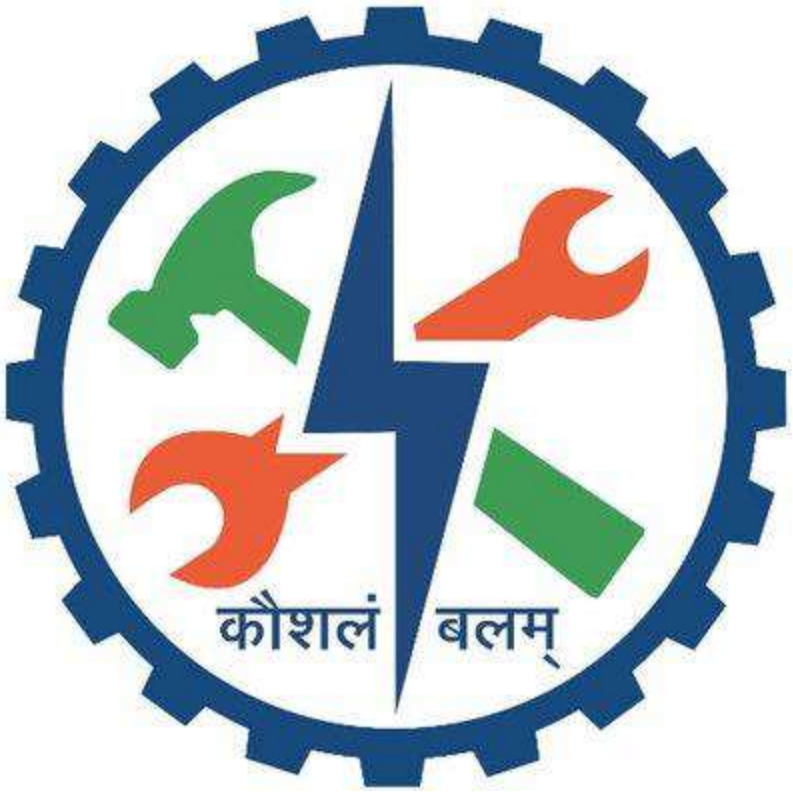
Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert Members participated/ contributed for finalizing the course curriculum of IoT Technician (Smart Agriculture) trade held on 21.06.2018 at Indore.			
S No.	**Name & Designation Sh/Mr./Ms.**	**Organization**	**Remarks**
1.	Deepankar Mallick, DDG (C&P)	DGT, MSDE, New Delhi	Chairman
2.	Sanjay Kumar, Director	DGT, New Delhi	Member
3.	B.V.S. Sesha Chari, Director	CSTARI, Kolkata	Member
4.	L. K. Mukherjee, Dy. Director Of Trg.	CSTARI, Kolkata	Member/ Co-ordinator
5.	Pranay Wagale, Manager R&D	Nivo Control Pvt. Ltd., Indore	Expert
6.	Dr. Rakesh Saxena, Director	SGSITS, Indore	Expert
7.	Paul Antony ,Principal	RVTI, Indore	Expert
8.	Satish Thakare, CTO	Scientech Technologies Pvt. Ltd. Indore	Expert
9.	Saurabh Dutta, Technical Architect	Impetus Infotech India Pvt. Ltd., Indore	Expert
10.	Sameer Bhide, Senior Solution Architect	Impetus Infotech India Pvt. Ltd., Indore	Expert
11.	Vineet Karandikar, Team Leader	Yash Technologies, Indore	Expert
12.	Dr. Swapnil Jain, Asst. Professor	SRI. Vaishnav Vidyapeeth VIshwavidyalaya	Expert
13.	Nilesh Mahwshwari, CEO	Emorphis Technologies	Expert
14.	Varun Toshniwal, Engineer Manager	Nivo Control PVT. LTD. Indore	Expert
15.	M G Tiwari, Joint Director	Skill Development DET, Indore	Expert
16.	D K Sharma, MD & Chairman	Technology Exchange Services Pvt. Ltd., Ahamedabad	Expert
17.	Rajeev Karothia, Head R&D – Embedded &IoTDomain	Scientech Technologies PVT. LTD. Indore	Expert
18.	Sohan Yadav, Territory Manager	Nvis Technologies, INDORE	Expert

19.	Arvind Mishra, Director	Techlene Software Solution PVT. LTD., Indore	Expert
20.	Dr. Amrit Mukherjee, Post-Doc Research Fellow	Jiangsu University, China	Expert
21.	P. K. Bairagi, Training Officer	CSTARI, Kolkata	Member
22.	Dr. Sandhya Chintala, Vice President	NASSCOM, Noida	Member
23.	Dr. Sushil Chandra, Head, Bio-Medical Engg.	INMAS, New Delhi	Member
24.	Rajesh Kumar Pandey, CMD	Omniscient IT Solutions PVT. LTD., New Delhi	Member
25.	Dr. Y .Jayanta Singh, Director	NIELIT, Kolkata	Member
26.	Biswanath Khan, Jr. Consultant	CSTARI, Kolkata	Expert
27.	Ganapati Hegde, Consultant	KPMG, New Delhi	Expert
28.	Abhilasha Rajan, Consultant	KPMG, New Delhi	Expert
29.	Pallav Gandhi, Director	Harikrupa Automation Pvt. Ltd, Ahmedabad	Expert
30.	Sachin Munot, Director	Novatrice Technologies Pvt. Ltd, Ahmedabad	Expert

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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