

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

Instrument Mechanic

NSDA Code

2020/EHW/DGT/03691

### CONTACT DETAILS OF THE BODY SUBMITTING THE QUALIFICATION FILE

Directorate General of Training (DGT)  
Government of India, Ministry of Skill Development and Entrepreneurship,  
1st and 2nd Floor, CIRTES Building  
Next to Pusa ITI, Pusa Campus  
New Delhi – 110012.

#### Name and address of submitting body:

Directorate General of Training (DGT)  
Government of India, Ministry of Skill Development and Entrepreneurship,  
1st and 2nd Floor, CIRTES Building  
Next to Pusa ITI, Pusa Campus  
New Delhi – 110012.

#### Name and contact details of individual dealing with the submission

Name: Shri Deepankar Mallick

Position in the organisation: Deputy Director General (C & P)

Address if different from above:

Tel number(s): 011-25847035

E-mail address: deepankar.mallick60@nic.in

#### List of documents submitted in support of the Qualifications File

1. Competency-based curriculum with following details:

Model Curriculum to be added which will include the following:

1. Indicative list of tools/equipment to conduct the training: Enclosed with curriculum
2. Trainers qualification: Indicated in the curriculum
3. Lesson Plan: All DGT curricula are designed indicating specific practical to be carried out during training along with details of trade theory. Based on this the

concerned instructor prepares the Lesson Plan and demonstration plan with support of IMPs developed by NIMI, DGT.

4. Distribution of training duration into theory/practical/OJT component: Indicated in the curriculum.
2. Curriculum for Core Skills (Workshop Calculation & Science, Engineering Drawing and Employability Skills).

NSQC Approved

**5. SUMMARY**

<b>1</b>	<b>Qualification Title</b>	<b>'INSTRUMENT MECHANIC'</b>
<b>2</b>	<b>Qualification Code, if any</b>	<b>DGT/1024</b>
<b>3</b>	<b>NCO code and occupation</b>	7311.0100- Mechanic Precision Instrument, General 7311.0101- Technician Instrumentation 7311.0400- Mechanic Precision Instrument, Mechanical 7543.0801- Functional Tester
<b>4</b>	<b>Nature and purpose of the qualification (Please specify whether qualification is short term or long term)</b>	Prepare skilled Technician to undertake the job roles of Instrument Mechanic and will enable the trainee to tests, repairs, overhauls and assembles various precision instruments and their parts for efficient performance  It is long term qualification.
<b>5</b>	<b>Body/bodies which will award the qualification</b>	Directorate General of Training (DGT).
<b>6</b>	<b>Body which will accredit providers to offer courses leading to the qualification</b>	Directorate General of Training (DGT) accredits the Training providers (ITIs/ NSTIs/ MSTIs/ BTCs/ BTPs / Industries / Establishments).
<b>7</b>	<b>Whether accreditation/affiliation norms are already in place or not, if applicable (if yes, attach a copy)</b>	Yes. The accreditation/ affiliation norms and any amendments made from time to time are available on DGT web portal.
<b>8</b>	<b>Occupation(s) to which the qualification gives access</b>	<ul style="list-style-type: none"> <li>• 7311.0100- Mechanic Precision Instrument, General</li> <li>• 7311.0101- Technician Instrumentation</li> <li>• 7311.0400- Mechanic Precision Instrument, Mechanical</li> <li>• 7543.0801- Functional Tester</li> </ul>
<b>9</b>	<b>Job description of the occupation</b>	The individual examines, repairs, overhauls, assembles, calibrates various precision instruments and their parts for efficient performance conforming to prescribed efficiency, preparing service reports &

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

### Instrument Mechanic

		documenting. Removes minor defects of parts by grinding, filing, drilling, etc. and replaces worn out and damaged parts. Adjusts position of various parts using screwdriver, spanner etc. and assembles instrument to form complete unit etc.		
10	<b>Licensing requirements</b>	NOT REQUIRED		
11	<b>Statutory and Regulatory requirement of the relevant sector (documentary evidence to be provided)</b>	NOT APPLICABLE		
12	<b>Level of the qualification in the NSQF</b>	Level 5		
13	<b>Anticipated volume of training/learning required to complete the qualification</b>	<b>Sl. No.</b>	<b>Course Element</b>	<b>Notional Training Hours</b>
		1	Professional Skill (Trade Practical)	2000
		2	Professional Knowledge (Trade Theory)	640
		3	Workshop Calculation & Science	160
		4	Engineering Drawing	160
		5	Employability Skills	240
			Total	3200
14	<b>Indicative list of training tools required to deliver this qualification</b>	As per Annexure I of curriculum.		
15	<b>Entry requirements and/or recommendations and minimum age</b>	Passed 10 <sup>th</sup> class examination with Science and Mathematics or its equivalent. Minimum age 14 years as on first day of academic session.		
16	<b>Progression from the qualification (Please show</b>	An Individual can proceed for:		

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

### Instrument Mechanic

	<b>Professional and academic progression)</b>	Professional <ul style="list-style-type: none"> <li>• Technician</li> <li>• Senior Technician</li> <li>• Supervisor</li> <li>• Manager</li> <li>• Entrepreneur</li> </ul>	Technical / Academic [ ] ATS          Diploma/ CITS        Advance Diploma (Vocational)	
17	<b>Arrangements for the Recognition of Prior learning (RPL)</b>	<ul style="list-style-type: none"> <li>• Yes (For more details refer “Guidelines for Private candidate” in DGT website MIS portal).</li> </ul>		
18	<b>International comparability where known (research evidence to be provided)</b>	-		
19	<b>Date of planned review of the qualification.</b>	5 Yrs. from the Date of Approval		
20	<b>Formal structure of the qualification</b>			
	<b>Mandatory components</b>			
	<b>Title of component and identification code/NOSs/ Learning Outcomes</b>	<b>Estimated size (learning hours)</b>		<b>Level</b>
		<b>Skills</b>	<b>Knowledge</b>	
<b>TRADE SPECIFIC</b>				
(i)	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check dimensional accuracy using precision instruments following safety precaution. [Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.5mm]	100	28	4
(ii)	Apply a range of skills to execute tube joints, dismantle and assembles tubes and fittings of PI arc & ferrule and test for leakage. [range of skills- cutting,	25	7	4

**NSQF QUALIFICATION FILE****Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020****Instrument Mechanic**

	threading, flaring, bending and joining]			
(iii)	Identify, test the cable and measure the electrical parameters.	25	7	4
(iv)	Test various electrical passive and active components using proper measuring instruments and compare the data using standard parameter.	50	14	4
(v)	Identify, test and use of various types of switches, E.M. relays, Circuit breaker and construct electrical circuits.	25	7	5
(vi)	Estimate, Assemble, install and test wiring system.	25	7	5
(vii)	Verify characteristics of resonance circuits.	25	7	5
(viii)	Plan, execute commissioning, testing and evaluate performance of AC & DC motors and generators.	50	14	5
(ix)	Execute testing, evaluate performance and maintenance of transformer.	25	7	5
(x)	Plan, select, and carry out measurement, extension of range, overhauling, testing and calibration of D'Arsonval meter, PMMC meter.	50	14	5
(xi)	Select, perform electrical/electronic measurement, earthing installation service and calibrate MI instruments, electro dynamometer instruments, Induction type and Special instruments- voltage tester, continuity tester, rotation tester, phase sequence indicator, synchronising, synchroscope, frequency meter, thermocouple type ammeter.	75	21	5
(xii)	Identify, Test various analog and power electronics components, Construct, test and analyze the circuit functioning.	125	35	5
(xiii)	Detect the faults and troubleshoot SMPS, UPS, inverter, converter and Thyristor family.	25	7	5
(xiv)	Identify, place, solder and de-solder and test different SMD, discrete components	25	7	5

**NSQF QUALIFICATION FILE****Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020****Instrument Mechanic**

	with due care and following safety norms using proper tools/setup.			
(xv)	Construct and test different circuits using operational amplifiers circuits and execute the result.	50	14	5
(xvi)	Identify, test and verify all digital ICs. Assemble, test and troubleshoot various digital circuits and digital instruments.	150	42	5
(xvii)	Measure the various parameters by CRO and execute the result with standard one.	25	7	5
(xviii)	Install and setup operating system and related software in a computer & Practice with MS office and application software related to instruments.	75	21	5
(xix)	Identify various functional blocks of a microprocessor system, identify various I/O Ports, write and executive simple program and Interface a model application with the microprocessor kit and run the application.	50	14	5
(xx)	Identify the parameters of measurement systems. Identify, select, test, wire & execute the operation of different process sensors by selecting appropriate signal conditioning for stress, strain, load displacement and Thickness.	75	27	5
(xxi)	Select, Installs, services, and calibrate instruments for motion, speed, acceleration and vibration.	50	18	5
(xxii)	Identify different unit of pressure, terms and operation of basic instruments. Perform maintenance, Servicing calibration and installation of field pressure gauges, switches, electronic pressure indicators and transmitters for absolute, atmospheric, gauge, vacuum and differential pressure measurement.	150	54	5
(xxiii)	Recognise the fundamental of fluid flow, terms, different unit of flow, read specification of flow meters. And fluid pump. Perform the maintenance, Servicing	100	36	5

**NSQF QUALIFICATION FILE****Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020****Instrument Mechanic**

	and calibration and installation of variable DP flow meters / head flow meters, variable area flow meters, positive displacement meters, Electronic type flow meters and mass flow meters for fluids flow measurement.			
(xxiv)	Identify, operate, maintain, troubleshoot and calibrate the devices for solid flow measuring system & verify the result within standard.	25	9	5
(xxv)	Identify, select, wire & execute the operation of different types of level instruments use for liquid level and solid level. Carry out maintenance, Servicing, calibration and Installation.	75	27	5
(xxvi)	List out different unit of temperature, terms and read specification of temperature instruments. Perform measurement, maintenance, Servicing and calibration of Bimetallic and filled system thermometers & thermo switches.	25	9	5
(xxvii)	Identify, select, Evaluate performance, install, service and calibrate temperature Indicators, Transmitters (RTD'S, Thermistors and Thermocouples types); various type of pyrometers and instruments for humidity.	50	18	5
(xxviii)	Identify, select, Operate, maintain, Service and calibrate different types of recorders.	25	9	5
(xxix)	Identify different types of Final control elements and role. Identify different valve body, constructional feature, Dismantle, Inspect parts, replace parts, recondition, check, and resetting of control valves with actuators, convertors & positioners. Install and test the performance.	50	18	5
(xxx)	Identify fundamental of automatic control system and various functional elements in control loop. Identify, select, Install, wire, configure, test the performance, maintain, and service various types of ON-OFF and	50	18	5

**NSQF QUALIFICATION FILE****Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020****Instrument Mechanic**

	PID controllers (electronic and pneumatic).			
(xxxix)	Tune controller mode and evaluate performance of control loops as per specification and system application.	25	9	5
(xxxii)	Identify modules of PLC, its function, Wire and connect the digital I/O field devices to the I/O Module of PLC, install Software, Hardware and configure plc for operation. Write and execute simple logic and real application programs.	75	27	5
(xxxiii)	Operate, maintain, service, configure, install, wire and test HART transmitters / devices (I/O). And Net-working system for instrumentation.	50	18	5
(xxxiv)	Identify the different modules of DCS, function, Wire and connect I/O field devices to the I/O Modules, install Software, Hardware and configure DCS for operation with HMI. Write and execute DCS AND SCADA programs FOR real application.	50	18	5
(xxxv)	Identify, check constructional Feature and function of hydraulic pump and hydraulic power system, accumulator, hydraulic hoses and fitting, Hydraulic components. Build and test hydraulic control circuit.	50	18	5
(xxxvi)	Lay out construction feature, operate, maintain of air compressor, air Distribution system, pneumatic associate components, piping, tubing and fitting. Build and test pneumatic control circuit.	50	18	5
(xxxvii)	Identify constructional feature, operate, maintain, service and calibrate of analytical instruments.	25	9	5
<b>CORE SKILL</b>				
<b>EMPLOYABILITY SKILLS</b>				
(i)	Apply safe working practices.	-	30	5
(ii)	Comply with environment regulation and housekeeping.		30	5

**NSQF QUALIFICATION FILE****Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020****Instrument Mechanic**

(iii)	Interpret & use formal and technical communication.		30	5
(iv)	Apply the concept in productivity & quality management in day to day work to improve productivity & quality.		30	5
(v)	List and interpret various acts of labour welfare legislation.		30	5
(vi)	Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.		30	5
(vii)	Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.		30	5
(viii)	Utilize computer applications and internet to take benefit of IT developments in the industry.		30	5
<b>WORKSHOP CALCULATION &amp; SCIENCE</b>				
(i)	Demonstrate mathematical concept and principles to perform practical operations.	-	80	5
(ii)	Explain science in the field of study including simple machine.		80	5
<b>ENGINEERING DRAWING</b>				
(i)	Read and apply engineering drawing for different application in the field of work.	-	160	5
	<b>Total</b>		<b>3200</b>	

**SECTION 1**  
**ASSESSMENT**

21	<p><b>Body/Bodies which will carry out assessment:</b> Controller of Examinations, DGT</p>
22	<p>DGT will carry out the RPL assessment following the below mentioned eligibility criteria for Trainee:</p> <p>Applicants aspiring to appear as Private Candidates in the AITT under CTS for award of NTC, have been categorized based on their educational background and experience. Subsequently 'Private Candidates' may be admitted under one of the following categories. Category wise 'eligibility criteria' for appearing as 'Private Candidate' in AITT under CTS has been listed below:</p> <p>Category I: Ex-trainees (successful pass-outs) of ITI</p> <p>A. Ex-trainees of ITI who already possess NTC in one of the trades under CTS, are eligible for applying as Private candidate for an allied trade, provided he/ she fulfils all the conditions regarding educational qualification etc. prescribed for that allied trade.</p> <p>B. In addition, the applicant should possess minimum of 1 year experience (as on date of submission of application) post the date of AITT result declaration in the desired allied trade in establishments implementing Apprenticeship Training Scheme (ATS)/ establishments registered under the Apprenticeship portal or registered MSMEs or Entities registered with any government/local authorities / shops covered under Factories Act 1948 and Shops and Establishments Act applicable for the concerned State.</p> <p>Category II: 'Ex-trainees (successful pass-outs) and current trainees under CoE scheme</p> <p>A. The applicant should have the minimum prescribed entry qualification and should fulfil eligibility criteria for the desired trade under CTS, in which he/she intends to appear for AITT as Private Candidate. CoE candidates must register as 'Private Candidate' under CTS in the relevant/mapped CTS trade only.</p> <p>B. There should be a minimum gap of 1 year between successful completions of CoE training i.e. from the date of result declaration to the date of submission of application for 'Private Candidate' certification.</p> <p>C. During this gap of 1 year, the candidate must have undergone Industry training or gained experience in desired trade in establishments implementing Apprenticeship Training Scheme (ATS)/ establishments registered under the Apprenticeship portal or registered MSMEs or Entities registered with any government/local authorities / shops covered under</p>

	<p>Factories Act 1948 and Shops and Establishments Act applicable for the concerned State.</p> <p>Category III: SCVT Candidates (admitted till August 2018 session)</p> <p>A. No special provisions have been made for SCVT Trainees to enrol as 'Private Candidate'. Going forward, SCVT trainees have been granted equivalence vide G.S.R 186(E) dated 2nd March 2017 for undergoing apprenticeship training under the Apprentices Act 1961 to obtain 'NAC'.</p> <p>B. Only for SCVT trainees admitted till August 2018 batch, provision has been made for obtaining NTC by appearing in AITT under 'Private Candidate'. Such trainees will continue to be governed by old guidelines for 'Private Candidate'.</p> <p>Category IV: Other Candidates (candidate not falling in any of the above 3 categories, including SCVT trainees enrolled from admission session 2019 onwards)</p> <p>A. The applicant should have the minimum prescribed entry qualification and should fulfil eligibility criteria for the relevant trade under CTS, in which he/she desires to appear for AITT as Private Candidate.</p> <p>B. Applicant should be minimum 21 years of age on the date of submission of application. There is no upper age limit.</p> <p>C. The applicant should possess minimum of 3 years' experience (on the date of submission of application) in the relevant trade in establishments implementing Apprenticeship Training Scheme (ATS)/ establishments registered under the Apprenticeship portal or registered MSMEs or Entities registered with any government/local authorities / shops covered under Factories Act 1948 and Shops and Establishments Act applicable for the concerned State.</p> <p>For detail and updated information please refer to DGT web portal.</p>
23	<p><b>Describe the overall assessment strategy and specific arrangements which have been put in place to ensure that assessment is always valid, reliable and fair and show that these are in line with the requirements of the NSQF.</b></p> <p><b>(1) Assessment process:</b></p> <p>The assessment for the qualification is carried out by conducting formative assessments, and end of year examinations (Summative). The formative assessments in respect of each Learning Outcome for practical and related theory are conducted by the concerned instructors for evaluating the knowledge and skill acquired by trainees and the behavioural transformation of the trainees. This formative assessment is primarily</p>

carried out by collecting evidence of competence gained by the trainees by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports. Summative assessment is carried out by All India Trade Test on Trade Theory, Trade practical, Workshop Calculation & Science, Engineering Drawing and Employability Skills. The question papers for the theory Examinations contain objective type questions.

The marking pattern and distribution of marks for the qualification are as under:

Marking Pattern				
Sl. No.	Type of Assessment	Subject for the Trade Test	Marks for the 1st Year	Marks for the 2nd Year
1	Summative Assessment	Practical	250	250
2		Trade Theory	100	100
3		Employability Skills	50	50
4		Workshop Calculation and Science.	50	50
5		Engineering Drawing	50	50
6	Formative assessment based on Learning Outcomes		200	200
TOTAL:			700	700

**(2) Minimum pass marks:**

The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%. There will be no Grace marks.

**Testing and certifications for the course:**

Controller of examinations, DGT carries out the assessment and issues National Trade Certificate (NTC) following the norms and guidelines issued by the Directorate from time to time.

**Overall assessment strategy:**

Assessment of the qualification evaluates trainees to show that they can integrate knowledge, skills and values for carrying out relevant tasks as per the defined learning outcomes and assessment criteria. The trainees may choose the preferred language for assessment. The underlying principle of assessment is fairness and transparency. While assessing the trainee, assessor is directed to assess as per the defined assessment criteria against the learning outcomes. The evidence of the competence acquired by the trainees can be obtained by conducting theory and practical examinations, observing the trainees at work, asking questions and initiating discussions to assess, understand and evaluate records and reports. The ultimate objective of the assessment is to assess the candidates as per the defined assessment criteria for the learning outcomes.

**Specific Arrangements for assessment:**

- Assessment is outcome-based.
- There are formative and summative assessments in Theory and Practical.
- Assessment is carried out in Trade theory, Trade Practical, Workshop

Calculation and Science, Engineering Drawing and Employability Skills.

- While Trade Theory and Trade Practical are used for assessing Trade-related jobs, Workshop Calculation and Science is used to test trainee's numerical and logical skills, Drawing is used to test the ability of the trainee to draw and read sketches and Employability skills is used to test the communication, professional language, leadership, entrepreneurship and team-work abilities of the trainee.
- In addition to demonstration of theory and practical knowledge, trainees get a chance to present total personality.

**Quality assurance activities:**

Question papers are set by external paper setters/ software generated.

Evaluation of Theory Examinations in Trade, Workshop Calculation & Science, Engineering Drawing and Employability Skill is done by third-party agency.

Trade Practical is examined by External Examiner.

**24. Assessment evidences**

**Title of Component: Formative Assessment Breakup**

(on half yearly average of the learning assessment covered)

**Means of assessment**

Assessment will be evidence based comprising the following for each Learning Outcome:

Serial No.	Terminal Competency	Maximum Weightage (%)
1	Safety consciousness	15
2	Workplace hygiene	5
3	Attendance/ Punctuality	10
4	Ability to follow Manuals/ Written instructions	5
5	Application of Knowledge	10
6	Skills to handle tools / equipment/ Instruments/ Devices	10
7	Economical use of materials	5
8	Working Strategy	10
9	Quality in workmanship/ Performance	15
10	VIVA	15
	Total Maximum Weightage (%)	100

**Pass/Fail**

The minimum pass percentage is 60% marks for formative assessment.

**LEARNING OUTCOME WITH ASSESSMENT CRITERIA:**

LEARNING OUTCOMES (TRADE SPECIFIC)	
LEARNING OUTCOME	ASSESSMENT CRITERIA
<b>FIRST YEAR</b>	
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check dimensional accuracy using precision instruments following safety precaution. <i>[Basic fitting operation – marking,</i>	Plan & Identify tools, instruments and equipments for marking and make this available for use in a timely manner.
	Select raw material and visually inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.

<p><i>Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.5mm]</i></p>	<p>Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.</p>
	<p>Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.</p>
	<p>Observe safety procedure during above operation as per standard norms and company guidelines.</p>
	<p>Use and care non precision instruments such as different types of callipers, gauges, and making tools.</p>
	<p>Mark the job as per blueprint.</p>
	<p>Perform operation, maintenance, and use Precision Measuring Instruments.</p>
	<p>Quality check for dimensional accuracy as per standard procedure.</p>
	<p>Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.</p>
<p>2. Apply a range of skills to execute tube joints, dismantle and assemble tubes and <i>fittings</i> of PI arc &amp; ferrule and test for leakage. [range of skills-cutting, threading, flaring, bending and joining]</p>	<p>Ascertain and select tools and materials for the job and make this available for use in a timely manner.</p>
	<p>Plan to dismantle and assemble tube and ferrule fittings.</p>
	<p>Dismantle PI arc, ferrule and fittings in tube applying range of skills and check for defect as per standard procedure.</p>
	<p>Demonstrate possible solution in case of defect and agree task within the team for repair or replacement.</p>
	<p>PI arc, ferrule and various tubes fitting using range of skills and observing standard procedure.</p>
	<p>Test for leakage and appropriate functioning of PI arc, ferrule.</p>
	<p>Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.</p>
<p>3. Identify, test the cable and measure <i>the</i> electrical parameters.</p>	<p>Plan work in compliance with standard safety norms.</p>
	<p>Identify the Phase, Neutral and Earth on power socket, use a tester to monitor AC power</p>
	<p>Construct a test lamp and use it to check mains healthiness.</p>
	<p>Identify the different types of single range electrical meter for measuring AC &amp; DC parameters</p>

	Measure the voltage between phase and ground and rectify Earthing.
	Identify and test different AC mains cables.
	Prepare terminations, skin the electrical wires /cables using wire stripper and cutter,
	Identify types of wires and verify their specification.
	Measure the gauge of the wire using SWG and outside micrometre. Refer table and find current carrying capacity of wires.
	Identify the type of single range meters and electronic instruments for electrical measurement.
	Measure the value of resistance, voltage and current using Analog/ digital multimeter
4. Test various electrical passive and active <i>components</i> 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.
	Ascertain and select tools and materials for the job and make this available for use in.
5. Identify, test and use of various types of switches, E.M. relays, Circuit breaker and construct electrical circuits.	Plan work in compliance with standard safety norms.
	Identify different types of switches and test.
	Identify the types of switches their rating and applications.
	Identify the types of E.M. relays & Circuit breaker their rating and applications.
	Dismantle, identify parts, service and test the different parts of a relay& Circuit breaker
	Build electrical control circuit and test its working.
	Wind a solenoid and determine the magnetic effect of electric current
	Solder the given components.

	Avoid waste, ascertain unused material and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
6. Estimate, Assemble, install and test wiring system.	Comply with safety & IE rules when performing the wiring.
	Prepare and mount the energy meter board.
	Draw and wire up the consumers main board with ICDP switch and distribution fuse box.
	Draw and wire up a bank/hostel/jail in PVC conduit.
	Identify the types of fuses their ratings and applications.
	Identify the parts of a relay, MCB & ELCB and check its operation.
	Estimate the cost of material for wiring in PVC channel for an office room having 2 lamps, 1 Fan, one 6A socket outlet and wire up.
	Estimate the requirement for conduit wiring (3 phase) and wire up.
	Estimate the materials and wire up the lighting circuit for a godown.
	Estimate the materials and wire up a lighting circuit for a corridor in conduit.
Test, locate the fault and repair a domestic wiring installation.	
7. Verify characteristics of resonance circuits.	Verify the characteristics of series, parallel and its combination circuit.
	Analyze the effect of the short and open in series and parallel circuits.
	Verify the relation of voltage components of RLC series circuit in AC.
	Determine the power factor by direct and indirect methods in an AC single phase RLC parallel circuit.
	Identify the phase sequence of a 3 $\phi$ supply using a phase-sequence meter.
	Prepare / connect a lamp load in star and delta and determine relationship between line and phase values with precaution.
	Connect balanced and unbalanced loads in 3 phase star system and measure the power of 3 phase loads.
	Make the solenoid and determine its polarity for the given direction of current.

	Group the given capacitors to get the required capacity and voltage rating.
8. Plan, execute commissioning, testing and evaluate performance of AC & DC motors and generators.	Plan work in compliance with standard safety norms related with AC motors.
	Draw circuit diagram and connect forward & reverse a 3-phase squirrel cage induction motor.
	Start, run and reverse an AC 3 phase squirrel cage induction motor by different type of starters.
	Measure the slip of 3 phase squirrel cage induction motor by tachometer for different output. Draw slip / load characteristics of the motor.
	Determine the efficiency of 3 phase squirrel cage induction motor by no load test/ blocked rotor test and brake test.
	Plot the speed torque (Slip/Torque) characteristics of slip ring induction motor.
	Speed control of 3 phase induction motor.
	Connect, start and run a 3-phase synchronous motor.
	Connect start, run, control speed and reverse the DOR of different type of single-phase motors.
	Install a single-phase AC motor.
	Plan work in compliance with standard safety norms related with DC machines.
	Determine the load performance of a different type of DC generator on load.
	Connect, start, run and reverse direction of rotation of different types of DC motors.
	Conduct the load performance tests on different type of DC motor.
Control the speed of a DC motor by different method.	
9. Execute testing, evaluate performance and maintenance of transformer.	Plan work in compliance with standard safety norms related with transformer.
	Identify the types of transformers and their specifications.
	Identify the terminals; verify the transformation ratio of a single-phase transformer.
	Connect and test a single-phase auto- transformer.
	Determine the losses (iron loss and copper loss) and the regulation of a single-phase transformer at different loads.
Measure the current and voltage using CT and PT.	

	Carry out winding for small transformer of 1KVA rating.
	Connect the given two single phase transformers a) parallel b) series (secondary only) and measure voltage.
10. Plan, select, and carry out measurement, extension of range, overhauling, testing and calibration of 'D'Arsonval meter, PMMC meter.	Identify the types of electrical instruments, types of scale dials, symbols of the instruments with respect to functions.
	Disassemble electrical meters, Identify different parts and Familiar with the internal Construction and operation of 'D' Arsonval meter, PMMC meter for current and voltage measurement.
	Identify types of deflecting torque, controlling torque, & damping torque arrangement in meter and adjustment for correct functioning
	Extend the range of voltmeter, ammeter. And ohm meters.
	Determine the types of measurement errors and correction procedure.
	Overhaul, check, fault find, repair, calibrate of Electrical PMMC instruments for current, voltage and resistance.
11. Select, perform electrical/electronic measurement, earthing installation service and calibrate MI instruments, electro dynamometer instruments, Induction type and Special instruments- voltage tester, continuity tester, rotation tester, phase sequence indicator, synchronising, synchronous cope, frequency meter, thermocouple type ammeter.	Plan work in compliance with standard safety norms related with electrical instruments& earthing installation.
	Familiar with construction and operation of Megger, insulation tester and earth-tester
	Test open circuit / short circuit / continuity of cable using megger/ insulation tester.
	Measure the insulation resistance between conductors of an armoured cable and insulation resistance between earth and conductors of an armoured cable.
	Prepare, Install the plate earthing/ pipe earthing and measure earth resistance by earth tester / megger.
	Service, calibrate and test Megger/insulation tester and earth tester.
	Identify and select MI type, electro dynamometer type , Induction type and Special instruments for ac / dc voltage, current, frequency, power, power factors and energy etc. Measurement.
	Study with the construction and operation of MI type, electro dynamometer type, Induction type and Special instruments for the measurement of electrical variables
Connect MI type, electro dynamometer type, Induction type and Special instruments to electrical circuit. Record	

	<p>the results, Draw the response curve, identify deviation and error.</p> <p>Disassemble, Identify different parts, Overhaul, check and fault find , test and calibrate MI type meters, electro-dynamometer type instruments, Induction type meter,</p> <p>Measure the power and energy in a single &amp; three phase circuit using wattmeter and energy meter.</p> <p>Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.</p> <p>Measure the frequency by frequency meter.</p> <p>Test single phase energy meter for its errors</p> <p>Measure the power factor in poly-phase circuit and verify the same with voltmeter, ammeter, watt-meter readings.</p> <p>Identify Special instruments and practice electrical measurements.</p>
<p>12. Identify, Test various analog and power electronics components, Construct, test and analyze the circuit functioning.</p>	<p>Practice on soldering components on lug board with safety.</p> <p>Identify the passive /active components by visual appearance, Code number and test for their condition.</p> <p>Identify the control and functional switches in CRO and measure the D.C. &amp; A.C. voltage, frequency and time period.</p> <p>Construct and test a half, full wave and bridge rectifiers with and without filter circuits.</p> <p>Construct and test a Zener based voltage regulator circuit.</p> <p>Ascertain and select tools and instruments for carrying out the jobs.</p> <p>Construct and test the transistor-based switching circuit</p> <p>Construct and test CB, CE&amp; CC amplifier circuit</p> <p>Ascertain the performance of different oscillator circuits.</p> <p>Construct and test Clipper, Clamper and Schmitt trigger circuit.</p> <p>Construct and test of Transistor and JFET amplifiers, oscillators and multi vibrators.</p> <p>Construct and test a UJT as relaxation oscillator.</p> <p>Construct and test lamp dimmer using TRIAC/DIAC with safety.</p> <p>Construct and test MOSFET, IGBT test circuit and apply for suitable operation with proper safety.</p> <p>Construct and test the universal motor speed controller</p>

	using SCR with safety.
	Construct and test switching circuits using optical devices.
13. Detect the faults and troubleshoot SMPS, UPS, inverter, converter and Thyristor family.	<p>Identify the tools and equipments to perform the job with due care and safety.</p> <p>Dismantle the given stabilizer and find major sections/ ICs components.</p> <p>Identify various input and output sockets/ connectors of the given SMPS.</p> <p>Identify major sections/ ICs/components of SMPS.</p> <p>Identify and replace the faulty components and construct and test IC Based DC-DC converter for different voltages.</p> <p>Identify front panel control &amp; indicators of UPS.</p> <p>Identify various circuit boards in UPS and monitor voltages at various test points.</p> <p>Test UPS under Fault condition &amp; rectify fault.</p>
14. Identify, place, solder and desolder and test different SMD, discrete components with due care and following safety norms using proper tools/setup.	<p>Identify the various crimping tools for various IC packages.</p> <p>Identify different types of soldering guns and choose the suitable tip for the application.</p> <p>Practice the soldering and de-soldering the different active and passive components, IC base on GPCBs using solder, flux, pump and wick.</p> <p>Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety norms.</p> <p>Identify SMD components, de-solder and solder the SMD components on the PCB.</p> <p>Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects.</p> <p>Avoid waste, ascertain unused materials and components for safe disposal.</p>
15. Construct and test different circuits using operational amplifiers circuits and execute the result.	<p>Demonstrate analog trainer kit with safety precautions.</p> <p>Identify various ICs, differentiate by code No. and test for their condition.</p> <p>Construct and test various OPAMP circuits.</p> <p>Construct and test R-2R ladder type digital to analog converter circuit.</p>

16. Identify, test and verify all digital ICs. Assemble, test and troubleshoot various digital circuits and digital instruments.	Illustrate to practice the digital trainer kit with safety.
	Identify various digital ICs, test IC using digital IC tester and verify the truth table
	Construct and verify the truth table of all gates using NOR and NAND gates
	Construct an adder/subtractor circuits and verify the truth table
	Construct and verify the truth table of various flipflops, counters and shift register circuits
	Construct a decoder and encoder, multiplexer and demultiplexer circuits and verify the truth table
	Identify LCD/LED Display module and its decoder/driver ICs and display a word on a two-line LCD/LED.
	Construct and test D/A and A/D circuits
	Measure the current flowing through a resistor and display it. Measure current flowing through a sensor and display it on a LCD/LED module (DPM).
	Service and test digital instruments
	Avoid waste and dispose the waste as per the procedures.
17. Measure the various parameters by CRO and execute the result with standard one.	Identify and demonstrate various control elements on front panel of a CRO.
	Measure different parameters of electronic signals using CRO.
	Store the waveform of a signal in CRO.
	Connect CRO with a printer and take printout of signal waveforms.
18. Install and setup operating system and related software in a computer & Practice with MSoffice and application software related to instruments.	Assemble computer and configuring the CMOS setup.
	Install and configure windows OS and application software.
	Install the printer and other peripheral devices.
	Burn CD/DVD
	Troubleshoot the PC
19. Identify various functional blocks of a microprocessor system, identify various I/O Ports, write and execute simple program and Interface a model	Understand and interpret the procedure as per manual of Microprocessor.
	Identify various ICs & their functions on the given Microprocessor Kit.
	Identify the address range of RAM & ROM.
	Write data into RAM & observe its volatility.

<p>application with the microprocessor kit and run the application.</p>	<p>Identify the port pins of the controller &amp; configure the ports for Input &amp; Output operation.</p> <p>Demonstrate entering of simple programs, execute &amp; monitor the results.</p>
<p><b>SECOND YEAR</b></p>	
<p>20. Identify the parameters of measurement systems. Identify, select, test, wire &amp; Execute the operation of different process sensors by selecting appropriate signal conditioning for stress, strain, load displacement and Thickness.</p>	<p>Identify various types of instrument constructions, various parts and section</p> <p>Identify units for Fundamental and Derived physical variable, in different system of measurements, multiplying factor.</p> <p>Measure the voltage and current using analog/ digital standard voltmeter and ammeter.</p> <p>Check the repeatability, reproducibility, drift, dead band, back clash, hysteresis speed of response and lag etc. of analog and digital instruments.</p> <p>Identify instrument specification and types of error.</p> <p>Identify types of sensors and transducers used in process industries for stress, strain, load, displacement and Thickness based on resistive, capacitive, inductive and photoelectric etc. such as strain gauge, load cells, LVDT and proximity transducers.</p> <p>Verify the characteristics of different types of resistive, capacitive, inductive, strain gauge, load cells, LVDT, RVDT, photoelectric, proximity Transducers.</p> <p>Detect different objectives using capacitive, inductive and photoelectric proximity sensors</p> <p>Identify and study the instrument specification and the circuit operation of analog/ digital instruments for stress, strain, load, displacement and Thickness referring to instrument manual.</p> <p>Measure stress, strain, load, displacement and Thickness variable. Record the readings and verify the performances for various factors by observing std condition referring to data chart.</p> <p>Carry out maintenance, Servicing and calibration Of instruments for stress, strain, load, displacement and Thickness measurements.</p>
<p>21. Select, Installs, services, and calibrate instruments for motion, speed,</p>	<p>Identify sensors used for motion, speed, and acceleration and vibration measurement and verify the characteristics.</p> <p>Identify different parts, its function, construction and</p>

acceleration and vibration.	operation of vibrometers and accelerometer.
	Measure the acceleration and vibration and verify the performances for various factors by observing std. condition referring to data chart.
	Identify different parts, its function and operation of mechanical tachometer and study construction.
	Measure the speed of motor using tachometers.
	Identify different parts its function and operation of eddy current type, AC and DC tachometer.
	Carry out maintenance, Servicing and calibration Of vibrometers, accelerometer and speedometers
	Identify different parts/section, its function, operation and use of stroboscope and find motion of object.
22. Identify different unit of pressure, terms and operation of basic instruments. Perform maintenance, Servicing calibration and installation of field pressure gauges, switches, electronic pressure indicators and transmitters for absolute, atmospheric, gauge, vacuum and differential pressure measurement.	Select, operate and measure the atmospheric pressure using different types of barometers
	Select, operate and measure the gauge, vacuum, & differential pressure using manometers.
	Maintenance, servicing and calibration of analog & digital barometers and manometers.
	Measure the line and vessel pressure and vacuum using different types of pressure gauges. Record results and find deviation.
	Dismantle, Identify different parts, its function, construction and operation of bourdon tube, diaphragms capsules and bellows types pressure gauges and switches.
	Service, Assemble and calibrate bourdon tube types, diaphragms types, capsules types, and bellows types. Pressure gauges and switches.
	Study the construction, circuit operation of Different types electronic pressure indicators and transmitters: (potentiometric pr. transducers, Capacitive pr. transducers, strain gauge pressure transducers, piezoelectric pressure transducer types).
	Wire and Measure the pressure using different indicating transmitters and verify the performances for various factors by observing std condition referring to data chart.
	Familiar with construction, Operation of Standard pressure Calibrator, Dead weight Tester and vacuum tester.
	Study the construction, circuit operation adjustments for correct functioning and test of indicators and transmitters

	for line and vessel pressure.
	Study construction, operation of different types of McLeod gauge.
	Study construction, operation and use of thermal conductivity gauges pirani gauges, thermocouple gauges, slack diaphragm, ionization gauge, and measure the vacuum.
	Test and calibrate of pressure gauges, indicators, transmitters with standard calibrator/dead weight tester.
	Service and calibrate electronic vacuum gauges/ indicators and transmitters
	Identify pressure installation component, impulse line, safety guideline and accessories and installation procedure of pressure instruments as per guidelines.
	Practice installation of gauges, transmitters and pressure switches on the fluid line and vessel.
	Identify and carry out preventive and break down maintenance of pressure and vacuum gauges, transmitters, impulse line etc. As per guidelines.
23. Recognise the fundamental of fluid flow, terms, different unit of flow, read specification of flow meters. And fluid pump. Perform the maintenance, Servicing and calibration and installation of variable DP flow meters / head flow meters, variable area flow meters, positive displacement meters, Electronic type flow meters and mass flow meters for fluids flow measurement.	Identify nature of fluid flow and factor affecting flow rate.
	Study operation of different types fluid pump.
	Identify different types of flow metres with their function. & Read specifications of flow meters.
	Select and check constructional feature and use of various types of flow meters (orifice, venturi, flow nozzle, pitot tube) and tapings
	Installation and test of DP flow transmitter, primary flow elements, pressure taps, piping and fitting valve, electrical hook-up.
	Measure the flow rates using manometer and DP transmitters
	Identify constructional feature of weirs, notches and flumes their shape and connections and measure the Open channel flow rates using manometer and DP Transmitters
	Dismantling, checking overhauling and calibration of D.P.cell/ transmitter. (pneumatic & electronic)
	Study of construction of Rotameter and measure fluid flow rate by Rota meters.
	Dismantling, checking, overhauling and calibration of Rota meters

	<p>Read the specification of various types of positive displacement meters and identify deferent parts, its function, and operation of various type of positive displacement meters.</p> <p>Practice the flow measurement using positive displacement meters.</p> <p>Dismantle, Repair, assemble and calibration of oscillating piston type rotating vane meter, nutating disc meter. Lobed impeller and oval flow meter.</p> <p>Install and test of positive displacement flow meters for fluid flow.</p> <p>Identify the construction feature of flow meter body, study circuit operation of turbine flow meter, vortex flow meters, ultrasonic flow meters, electromagnetic flow meters, mass flow meter, carioles mass flow meters and read the specification.</p>
	<p>Measure fluid flow using electrical type flow meter and Mass flow meters.</p> <p>Service and calibrate electrical type and mass flow meters</p> <p>Identify and carry out preventive maintenance of all types flow meters.</p> <p>Perform the installation of flow meters as per guidelines and verify the performance</p>
24. Identify, operate, maintain, troubleshoot and calibrate the devices for solid flow measuring system & verify the result within standard.	<p>Study Construction and operation volumetric solids flow meter and mass flow meter for solids, belt type solid meters, belt speed sensing and signal conditioner and constant weight feeders.</p> <p>Measure the solid flow rates.</p> <p>Identify and carry out maintenance and preventive maintenance of solid flow measuring system.</p> <p>Service and calibrate solid flow meter.</p>
25. Identify, select, wire & Execute the operation of different types of level instruments use for liquid level and solid level. Carry out maintenance, Servicing, calibration and Installation.	<p>Construction and operation of various type sight glasses.</p> <p>Install, test and measure the performance of sight glasses for liquid level.</p> <p>Identify different parts, its function and operation of various types of floats and displacers liquid level indicators, transmitters and different types of level switches for liquid vessel.</p> <p>Construction and operation of various types of liquid level</p>

	traps, air purge, liquid purge, flash diaphragm, liquid level gauges and differential pressure indicating and transmitters.
	Install, wire, test and measure the liquid level by different types of floats displacers and hydrostatics level indicators and transmitters
	. Study the constructional feature, identify different parts, its function, and circuit operation of various types of electrical level indicators and transmitters i.e. capacitance probes, ultrasonic, microwave and nuclear types for liquid and solid level measurements.
	Install, wire, test and measure the liquid level/ solid level by different types of electrical level indicators and transmitters
	Service and calibrate electrical type's level indicators and transmitters.
	Identify and carry out maintenance of level indicators and transmitters and switches for liquid and solid level.
26. List out different unit of temperature, terms and read specification of temperature instruments. Perform measurement, maintenance, Servicing and calibration of Bimetallic and filled system thermometers & thermo switches.	Identify different types of heating sources, transfer of heat and change of physical state.
	Identify different types of primary and secondary standards for calibration of temperature scales.
	Construction, operation and use of temperature-controlled oil bath/furnace for low and high temperature.
	Identify different types of thermometers and thermo switches for temperature with their function, Read its specifications and use.
	Dismantle, identify different parts, its function, adjustment, assemble and operation of bimetallic and liquid field system thermometers and thermo switches.
	Service and calibrate various types of thermometers and switches.
	Identify and carry out maintenance and preventive maintenance of thermometers and switches.
	Install and test various types of thermometers and switches as per guidelines.
27. Identify, select, evaluate performance, install, service and calibrate	Identify and check different types of RTD's, Thermistors, Thermocouples, Ex-tension wires. and protecting wells for temperature measurement.

<p>temperature Indicators, Transmitters (RTD'S, Thermistors and Thermocouples types); various type of pyrometers.</p>	<p>Verify the characteristic of different types of RTD's, Thermistors and Thermocouples sensors.</p>
	<p>Study circuit operation of analog/ digital indicators and transmitters design for RTD's, and Thermistors and Thermocouples sensors.</p>
	<p>Install, WIRE and test various types RTDS, Thermistor&amp; Thermocouples with Indicators/ Transmitters as per guide lines.</p>
	<p>Measure the temperature using RTD'S, Thermistors &amp; Thermocouples base instruments and verify the performance as per field requirements.</p>
	<p>Maintain, service, trouble shoot and calibrate various types of electronic indicators and transmitters(analog and digital version)</p>
	<p>Identify parts/ section and its function, circuit operation of analog/ digital type Optical and Radiation pyrometer.</p>
	<p>Install, WIRE and test Optical and Radiation pyrometer as per guide lines.</p>
	<p>Measure high temperature using optical and Radiation pyrometer.</p>
	<p>Identify and check different types of humidity sensors.</p>
	<p>Measure the relative humidity using humidity sensors.</p>
<p>Install, wire, test, service, trouble shoots and calibrates various types' humidity sensors with Indicators/ Transmitters as per guidelines.</p>	
<p>28. Identify, select, Operate, maintain, Service and calibrate different types of recorders.</p>	<p>Identify different types of recorders.</p>
	<p>Practice recording of variable signal.</p>
	<p>Construction, operation and use of circular chart recorder for temperature and pressure.</p>
	<p>Construction, operation and use strip chart pneumatic and electronics recorders.</p>
	<p>Study of paperless LCD/LED recorder.</p>
	<p>Carry out maintenance and preventive maintenance, fault find, repair, test and calibrate of various types of pneumatic, electronics recorders.</p>
	<p>Install and the check the performances of recorders as per guides lines.</p>
<p>29. Identify different types of Final control elements</p>	<p>Identify final control element in process control loop and types of electric and fluidic control signals for operation of</p>

<p>and role. Identify different valve body, constructional feature, Dismantle, inspect parts, replace parts, recondition, check, and resetting of control valves with actuators, convertors &amp; positioners. Install and test the performance.</p>	<p>final control elements.</p>
	<p>Identify parts, its function, operation, service, and calibrate various types of convertors.</p>
	<p>Construction, operation and use of various types of pneumatic and electrical actuators.</p>
	<p>Study, operation and use of various types of control valve positioners.</p>
	<p>Dismantle, fault finding, repair and install actuators and positioners on valve body.</p>
	<p>Examine, Operation and applications of various types of basic control elements viz. Valves body globe, gate, weir, rotary plug, split body, butterfly, louver etc.</p>
	<p>Identify characteristics of control valve.</p>
	<p>Dismantling, reconditioning, checking, replace parts and resetting of control valve.</p>
	<p>Examine operation and application of various types of electrical final control elements.</p>
	<p>Install, wire, test and verify the performance of various electrical type final control elements respect to control signal</p>
	<p>Maintain and service electrical type final control elements</p>
	<p>Remove and install control valves with service line.</p>
	<p>Carry out maintenance of final control elements.</p>
	<p>Construction and operation of capacitive, inductive type valve, proximity switch, IR switch, micro switch, limit switch.</p>
	<p>Identify final control elements in system and manually control feed water rate at desire value.</p>
<p>Construction and operation of sequential control and block valves.</p>	
<p>Operation of electromechanical and solid-state relay.</p>	
<p>Design and test sequential logic operation using relay and turbine control system operation.</p>	
<p> </p>	
<p>30. Identify fundamental of automatic control system and various functional elements in control loop. Identify, select, Install, wire, configure, test the performance, maintain,</p>	<p>Basic Process control system and identify various functional elements.</p>
	<p>Study construction and operation of thermostatic, pressure and humidity switches.</p>
	<p>Install, wire up and test the control operation using auto /smart switches.</p>
	<p>Study construction and operation of ON-OFF electronic</p>

and service various types of ON-OFF and PID controllers (electronic and pneumatic).	and pneumatic controllers.
	Study construction and operation of PID electronic/ digital controller.
	Install, wire up, configure, test the control operation using ON-OFF &PID electronic/digital controller
	Verify the steady state and transient responses of PID electronic/digital controllers in P, PI, PD, PID.
	Study construction & operation of PID pneumatic Controllers.
	Install, connect pneumatic signal, align and test the control operation using PID pneumatic controller.
31. Tune controller mode and evaluate performance of control loops as per specification and system application	Familiar with feed forward, and feedback process control system, check loop and identify various functional elements.
	Familiar with cascade and ratio process control system.
	Check loop and identify various functional elements.
	Perform the control operation in manual and automatic mode.
	Set optimum setting for unit process in PID controller. (Electronic and pneumatic).
32. Identify modules of PLC, its function, Wire and connect the digital I/O field devices to the I/O Module of PLC, install Software, Hardware and configure plc for operation. Write and execute simple logic and real application programs.	Identify each module in a rack and mount in the specified slot.
	Wire and connect the digital I/O field devices to the I/O modules of PLC.
	Install PLC Programming software and establish communication with PC and PLC.
	Hardware configuration and prepare the input output addresses for each slot.
	Prepare and download ladder programmes for various switching gates.
	Write and execute programme logic control operation, sequence control using timers and counters.
	Develop programme using arithmetic/data copy operation, shift bit operation and execute.
	Interface analog I/P module of PLC with sensor, O/P module of PLC with actuator, relay.
	Prepare programmes based on ON-delay and OFF-delay timers making ON and OFF of a single LED taking one input and one output.

	<p>Sequencer task using three LEDs as output and two input push buttons one as input (No) for start and other for stop (No).</p> <p>Development of the ladder logic for the running a traffic control with the different display indicator.</p> <p>Write and execute real application programs.</p>
33. Operate, maintain, service, configure, install, WIRE and test HART transmitters /devices (I/O). And Net-working system for instrumentation.	<p>Familiar with facilities, functions, operation and use HART communicators.</p> <p>Installing and operating HART transmitters and devices I/O.</p> <p>Configure and calibration of HART devices.</p> <p>Identify the cable and network component.</p> <p>Study various network lines.</p> <p>Preparation of network cables and connectors. Testing network cable.</p> <p>Preparation of network cable serial (RS 232/485 standard or equivalent) and Ethernet.</p> <p>Connect network connectivity hardware and check for its functioning.</p> <p>Construct and design pulse code modulation and demodulation.</p> <p>Identify and adjust the frequency of the sampling pulse generator and level of modulating signal to obtain the PWM waveform on CRO.</p>
34. Identify the different modules of DCS, function, Wire and connect I/Os field devices to the I/O Modules, install Software, Hardware and configure DCS for operation with HMI. Write and execute DCS AND SCADA programs FOR real application.	<p>Familiar with different facilities and function of DCS system.</p> <p>Identify the different modules of DCS and different process instruments in process plant.</p> <p>Install DCS programming software and establish communication with PC and DCS.</p> <p>DCS programming for sequence and safety operation.</p> <p>Programming of DCS to measure and control the flow&amp;level loop with PID.</p> <p>Set the communication between DCS and SCADA system.</p> <p>Create the alpha numeric display.</p> <p>Setup and configure HMI with PLC.</p> <p>Animate objects on a HMI screen to monitor motor starters.</p>

	Use security features to do tag logging and command execution.
35. Identify, check constructional Feature and function of hydraulic pump, and hydraulic power system, accumulator, hydraulic hoses and fitting, Hydraulic components. Build and test hydraulic control circuit	<p>Familiar with hydraulic trainer and safety measure to handle hydraulic system.</p> <p>Practice symbolic representation of hydraulic components.</p> <p>Familiar with hydraulic hoses and fitting.</p> <p>Study Constructional Feature Function of hydraulic pump and hydraulic power system.</p> <p>Study Features and function of hydraulic accumulator.</p> <p>Identify hydraulic component and check its function.</p> <p>Service and test different types valves.</p> <p>Build a hydraulic circuit for single acting, double acting cylinder actuation, and hydraulic rotary actuation using pilot operated check valve, pressure reducing valve, pressure relive and pressure regulating valve, pressure sequencing circuit, pressure compensated flow control etc.</p>
36. Lay out construction feature, operate, maintain of air compressor, air Distribution system, pneumatic associate components, piping, tubing and fitting. Build and test pneumatic control circuit.	<p>Study construction operation and use of air compressor.</p> <p>Identify different device in air distribution system, air filters, regulators and lubricators.</p> <p>Practice and use of pneumatic piping, tubing and fitting. . (Metallic and non-metallic.)</p> <p>Setup a system to provide pneumatic (Air) supply of 20 psi output from the available compressor.</p> <p>Draw Symbolic representation of different Pneumatic components, various supply elements such as Compressors, pressure regulating valve, service unit directional control valves etc.</p> <p>Build a pneumatic simple/sequential logic circuit to control actuation of a single acting cylinder &amp; double acting cylinder Using various types of directional control valves</p> <p>Maintain and service pneumatic system and associate components.</p>
37. Identify constructional feature, operate, maintain, service and calibrate of Analytical instruments.	<p>Study the circuit operation of PH meter conductivity meter and dissolved oxygen meter.</p> <p>Wire up PH meter electrode to PH meter.</p> <p>Calibrate PH meter using buffer solution.</p> <p>Determination of PH value of solution.</p>

	Wire up conductivity meter to electrode and find the electrolytic conductivity of solution.
	Maintain, Service and calibrate the conductivity meter & dissolved oxygen meter.

<b>LEARNING OUTCOME (CORE SKILL)</b>	
<b>LEARNING OUTCOME</b>	<b>ASSESSMENT CRITERIA</b>
<b>EMPLOYABILITY SKILLS</b>	
1. Apply safe working practices	Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
	Recognize and report all unsafe situations according to site policy.
	Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	Identify, handle and store / dispose of dangerous goods and substances according to site policy and procedures following safety regulations and requirements.
	Identify and observe site policies and procedures in regard to illness or accident.
	Identify safety alarms accurately.
	Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident

	<p>details correctly according to site accident/injury procedures.</p> <p>Identify and observe site evacuation procedures according to site policy.</p> <p>Identify Personal Protective Equipment (PPE) and use the same as per related working environment.</p> <p>Identify basic first aid and use them under different circumstances.</p> <p>Identify different fire extinguisher and use the same as per requirement.</p>
2. Comply with environment regulation and housekeeping	<p>Identify environmental pollution &amp; contribute to the avoidance of instances of environmental pollution.</p> <p>Deploy environmental protection legislation &amp; regulations</p> <p>Take opportunities to use energy and materials in an environmentally friendly manner.</p> <p>Avoid waste and dispose waste as per procedure</p> <p>Recognize different components of 5S and apply the same in the working environment.</p>
3. Interpret & use formal and technical communication.	<p>Obtain sources of information and recognize information.</p> <p>Use and draw up technical drawings and documents.</p> <p>Use documents and technical regulations and occupationally related provisions.</p> <p>Conduct appropriate and target oriented discussions with higher authority and within the team.</p> <p>Present facts and circumstances, possible solutions &amp; use English special terminology.</p> <p>Resolve disputes within the team.</p> <p>Conduct written communication.</p>
4. Apply the concept in productivity & quality management in day to day work to improve productivity & quality.	<p>Explain the concept of productivity and apply during execution of job.</p> <p>Explain the concept of quality tools and apply during execution of job.</p>
5. List and interpret various acts of labour welfare legislation.	<p>Explain basic concept of labour welfare legislation, adhere to responsibilities and remain sensitive towards such laws.</p> <p>Knows benefits guaranteed under various acts.</p>

6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	Explain the concept of energy conservation, global warming, pollution and utilize the available resources optimally & remain sensitive to avoid environment pollution.
	Explain standard procedure for disposal of waste.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	Explain personnel finance and entrepreneurship.
	Explain role of various schemes and institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarize with the policies/ programmes, procedure & the available scheme.
	Prepare a report to become an entrepreneur for submission to financial institutions.
8. Utilize computer applications and internet to take benefit of IT developments in the industry.	Explain the basic hardware of personal computer.
	Use common application software viz., word, excel, power point etc., in day to day work.
	Awareness about useful internet websites, search relevant information pertaining to the assigned tasks.
<b>WORKSHOP CALCULATION &amp; SCIENCE</b>	
1. Demonstrate mathematical concept and principles to perform practical operations.	Solve different problems like phase angle, etc. with the help of a calculator.
	Demonstrate conversion of Fraction to Decimal and vice versa.
	Explain BCD code, conversion from decimal to binary and vice-versa, all other conversions.
2. Explain science in the field of study including simple machine.	Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.
	Explain levers and its types.
	Explain relationship between Efficiency, velocity ratio and Mechanical Advantage.
	Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	Solve simple problems on lifting tackles like crane-

	Solution of problems with the aid of vectors.
<b>ENGINEERING DRAWING</b>	
1. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read & analyse the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

NSQC Approved

**SECTION 2**

**25. EVIDENCE OF LEVEL**

**OPTION A**

Title/Name of qualification/component: Instrument Mechanic			Level: 5
NSQF Domain	Outcomes of the Qualification/Component	How the outcomes relate to the NSQF level descriptors	NSQF Level
Process	<p><b>Requires Well Developed Skill with Clear choice of procedures in familiar context</b></p> <ul style="list-style-type: none"> <li>Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check dimensional accuracy using precision instruments. <i>[Basic fitting operation – marking, Hacksawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.5mm].</i></li> <li>Identify, Test various analog and power electronics components, Construct, test and analyze the circuit functioning.</li> <li>Measure the various parameters by CRO and execute the result with standard one.</li> </ul>	<p>The learner requires to demonstrate a well-developed skill for example ‘Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check dimensional accuracy using precision instruments.’, as indicated in the learning outcome to achieve the tolerance levels and accuracy demanded as per the job requirement. The learner requires to apply clear choice of procedures in familiar context as indicated in the learning outcomes, ‘Identify, Test various analog and power electronics components, Construct, test and analyze the circuit functioning.’ “Measure the various parameters by CRO and execute the result with standard one”</p>	5

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

Instrument Mechanic

Title/Name of qualification/component: Instrument Mechanic			Level: 5
NSQF Domain	Outcomes of the Qualification/Component	How the outcomes relate to the NSQF level descriptors	NSQF Level
		<p>In all these learning outcomes the learner has to apply one's knowledge and decide what needs to be done to either meet the client's requirement or identify a fault and decide how to rectify it or plan and take action as per requirements and resources available.</p> <p>Hence NSQF Level is 5 for this descriptor.</p>	
Professional knowledge	<p><b>Knowledge of facts in the field of work or study</b></p> <ul style="list-style-type: none"> <li>• Measurement &amp; measuring instruments, marking tools, Fasteners &amp; Fastening devices.</li> <li>• Element &amp; types of screw threads used in instruments, Calculation of drill size for tapping.</li> </ul> <p><b>Knowledge of Principles and general concepts in the field of work or study</b></p> <ul style="list-style-type: none"> <li>• Half wave rectifier, full wave (bridge &amp; center tapped) rectifier.</li> <li>• General characteristics of an amplifier,</li> </ul>	<p>The learner requires to demonstrate knowledge of facts, principles, processes and general concepts, in a field of work or study like measurement &amp; measuring instruments, precision measuring Instruments, elements &amp; types of screw threads used in instruments, Electrical components, Uses of multimeter, Switches and types, Principles of alternating current, Inductor and Inductance etc.</p> <p>The learner also requires to demonstrate knowledge of transistors, half wave rectifier, full wave (bridge &amp; center tapped) rectifier, UPS and SMPS, Differential amplifier, ideal op-amp etc.</p>	5

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

Instrument Mechanic

Title/Name of qualification/component: Instrument Mechanic			Level: 5
NSQF Domain	Outcomes of the Qualification/Component	How the outcomes relate to the NSQF level descriptors	NSQF Level
	<p>Concept of amplification.</p> <p><b>Knowledge of processes in the field of work or study</b></p> <ul style="list-style-type: none"> <li>Introduction, purpose &amp; use. UPS and SMPS, inverters and converters and their applications.</li> </ul>	Hence NSQF Level is 5 for this descriptor	
Professional skill	<ul style="list-style-type: none"> <li>Test various electrical passive and active components using proper measuring instruments and compare the data using standard parameter.</li> <li>Operate, maintain, service, configure, install, WIRE and test HART transmitters / devices (I/O). And Net-working system for instrumentation.</li> <li>Lay out construction feature, operate, maintain of air compressor, air Distribution system, pneumatic associate components, piping, tubing and fitting. Build and test pneumatic control circuit.</li> </ul>	The learning outcomes for example 'Test various electrical passive and active components using proper measuring instruments and compare the data using standard parameter', 'Operate, maintain, service, configure, install, WIRE and test HART transmitters / devices (I/O). And Net-working system for instrumentation.' require cognitive and practical skills to accomplish tasks that involve understanding requirements; then as per requirements deciding which operations/procedure/tools will achieve desired result; planning the sequence of operations to maximum effectiveness; constantly checking and reviewing plan, etc., all of which involve problem solving and decision making.	5

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

Instrument Mechanic

Title/Name of qualification/component: Instrument Mechanic			Level: 5
NSQF Domain	Outcomes of the Qualification/Component	How the outcomes relate to the NSQF level descriptors	NSQF Level
		Hence NSQF Level is 5 for this descriptor.	
Core skill	<p><b>Desired Mathematical Skills</b></p> <ul style="list-style-type: none"> <li>• Explain science in the field of study including simple machine.</li> </ul> <p><b>Understanding of social/political</b></p> <ul style="list-style-type: none"> <li>• Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal &amp; societal growth.</li> </ul> <p><b>Organizing information and communication</b></p> <ul style="list-style-type: none"> <li>• Interpret &amp; use formal and technical communication.</li> </ul>	<p>The learning outcomes for example 'Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal &amp; societal growth ' and 'Interpret &amp; use formal and technical communication' are the learning outcomes where the learner needs to display desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.</p> <p>Hence NSQF Level is 5 for this descriptor.</p>	5

## NSQF QUALIFICATION FILE

Approved in 24<sup>th</sup> NSQC, dated: 27<sup>th</sup> Feb, 2020

Instrument Mechanic

Title/Name of qualification/component: Instrument Mechanic			Level: 5
NSQF Domain	Outcomes of the Qualification/Component	How the outcomes relate to the NSQF level descriptors	NSQF Level
Responsibility	<ul style="list-style-type: none"><li>• Test various electrical passive and active components using proper measuring instruments and compare the data using standard parameter.</li><li>• Estimate, Assemble, install and test wiring system.</li><li>• Verify characteristics of resonance circuits.</li><li>• Plan, execute commissioning, testing and evaluate performance of AC &amp; DC motors and generators.</li></ul>	<p>The role of Instrument Mechanic is independently responsible to perform the work as per specifications followed by analysis of what needs to be done based on their understanding of various Electrical and Electronic Testing, Equipments, selection of best processes, principles and standards to achieve desired outcome. Here the trainee is expected to take responsibility for own work &amp; learning and some responsibility for other's works and learning</p> <p>Hence NSQF Level is 5 for this descriptor.</p>	5

**SECTION 3**

**EVIDENCE OF NEED**

<p><b>26</b></p>	<p><b>What evidence is there that the qualification is needed? What is the estimated uptake of this qualification and what is the basis of this estimate?</b></p> <table border="1" data-bbox="339 566 1390 1715"> <thead> <tr> <th data-bbox="339 566 627 712"> <p><b>Basis</b></p> </th> <th data-bbox="627 566 1390 712"> <p><b>In case of other Awarding Bodies (Institutes under Central Ministries and states departments)</b></p> </th> </tr> </thead> <tbody> <tr> <td data-bbox="339 712 627 1093"> <p>Need of the qualification</p> </td> <td data-bbox="627 712 1390 1093"> <p>Electronics and Hardware Sector has a significant presence of organized as well as unorganized skilled manpower requirement. This sector is poised to grow exponentially in the years to come and is highly labor intensive and there are many emerging trends in this sector. Hence the qualification has been designed keeping in view to cater to the ever-increasing demand of skilled manpower in consultation with stakeholders.</p> </td> </tr> <tr> <td data-bbox="339 1093 627 1518"> <p>Industry Relevance</p> </td> <td data-bbox="627 1093 1390 1518"> <p>The job role defined for the qualification is as per the National Classification of Occupations 2015 which is developed by Employment Directorate under the ministry of Labour and Employment in collaboration with different industry partners and as per ILO guidelines. Moreover, the training is imparted in ITIs/ NSTIs/ MSTIs/ BTC/ BTPs/ Industries / Establishments etc. where such requirement is available. This justifies the qualification is very much relevant for industry.</p> </td> </tr> <tr> <td data-bbox="339 1518 627 1641"> <p>Usage of the qualification</p> </td> <td data-bbox="627 1518 1390 1641"> <p>The Proposed qualification will create skilled Technician for various establishments in different Sectors.</p> </td> </tr> <tr> <td data-bbox="339 1641 627 1715"> <p>Estimated uptake</p> </td> <td data-bbox="627 1641 1390 1715"> <p>The present seating capacity is 11388.</p> </td> </tr> </tbody> </table>	<p><b>Basis</b></p>	<p><b>In case of other Awarding Bodies (Institutes under Central Ministries and states departments)</b></p>	<p>Need of the qualification</p>	<p>Electronics and Hardware Sector has a significant presence of organized as well as unorganized skilled manpower requirement. This sector is poised to grow exponentially in the years to come and is highly labor intensive and there are many emerging trends in this sector. Hence the qualification has been designed keeping in view to cater to the ever-increasing demand of skilled manpower in consultation with stakeholders.</p>	<p>Industry Relevance</p>	<p>The job role defined for the qualification is as per the National Classification of Occupations 2015 which is developed by Employment Directorate under the ministry of Labour and Employment in collaboration with different industry partners and as per ILO guidelines. Moreover, the training is imparted in ITIs/ NSTIs/ MSTIs/ BTC/ BTPs/ Industries / Establishments etc. where such requirement is available. This justifies the qualification is very much relevant for industry.</p>	<p>Usage of the qualification</p>	<p>The Proposed qualification will create skilled Technician for various establishments in different Sectors.</p>	<p>Estimated uptake</p>	<p>The present seating capacity is 11388.</p>
<p><b>Basis</b></p>	<p><b>In case of other Awarding Bodies (Institutes under Central Ministries and states departments)</b></p>										
<p>Need of the qualification</p>	<p>Electronics and Hardware Sector has a significant presence of organized as well as unorganized skilled manpower requirement. This sector is poised to grow exponentially in the years to come and is highly labor intensive and there are many emerging trends in this sector. Hence the qualification has been designed keeping in view to cater to the ever-increasing demand of skilled manpower in consultation with stakeholders.</p>										
<p>Industry Relevance</p>	<p>The job role defined for the qualification is as per the National Classification of Occupations 2015 which is developed by Employment Directorate under the ministry of Labour and Employment in collaboration with different industry partners and as per ILO guidelines. Moreover, the training is imparted in ITIs/ NSTIs/ MSTIs/ BTC/ BTPs/ Industries / Establishments etc. where such requirement is available. This justifies the qualification is very much relevant for industry.</p>										
<p>Usage of the qualification</p>	<p>The Proposed qualification will create skilled Technician for various establishments in different Sectors.</p>										
<p>Estimated uptake</p>	<p>The present seating capacity is 11388.</p>										
<p><b>27</b></p>	<p><b>Recommendation from the concerned Line Ministry of the Government/Regulatory Body. To be supported by documentary evidences.</b></p> <p>The qualification originally designed for Craftsman Training Scheme is in existence for many years and approved by DGT (Regulatory Body) under</p>										

	Ministry of Skill Development and Entrepreneurship, Govt. of India.
28	<p><b>What steps were taken to ensure that the qualification(s) does (do) not duplicate already existing or planned qualifications in the NSQF? Give justification for presenting a duplicate qualification</b></p> <p>The qualification is originally designed and approved by DGT for the Craftsman Training Scheme and is in existence for many years. No such duplicate qualification of same duration and competencies exists.</p>
29	<p><b>What arrangements are in place to monitor and review the qualification(s)? What data will be used and at what point will the qualification(s) be revised or updated? Specify the review process here</b></p> <ul style="list-style-type: none"> <li>• The research wing of CSTARI &amp; DGT reviews and updates the qualification, in consultation with industries and other stakeholders, on a regular basis by conducting trade committee meetings.</li> <li>• DGT will monitor any duplicity by comparing existing qualifications with upcoming ones in the National Qualifications Register (NQR) and relevant sectors.</li> </ul>

**SECTION 4**

**EVIDENCE OF PROGRESSION**

30 **What steps have been taken in the design of this or other qualifications to ensure that there is a clear path to other qualifications in this sector? Show the career map here to reflect the clear progression**

On completion of the training the trainee will have an opportunity to move in vertical/horizontal pathways to promote to higher designations. The learner can further undergo other specialised courses to excel in the relevant field.

```

    graph LR
      A[Technician] --> B[Senior Technician]
      B --> C[Supervisor]
      C --> D[Manager]
      B --> E[Entrepreneur]
  
```