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

COMPETENCY BASED CURRICULUM

SMALL HYDRO POWER PLANT TECHNICIAN

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR–POWER

Directorate General of Training

SMALL HYDRO POWER PLANT TECHNICIAN

(Engineering Trade)

(Revised in March 2023)

Version: 2.0

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

The two-year specialized course is jointly developed by Indian Institute of technology Roorkee, Ministry of New and Renewable Energy with Sectoral Trade Course Committee on Power Sector formed by Directorate General of Training, MSDE.

During the Two-year duration of Small Hydro Power Plant Techniciantrade, a candidate is trained on technical skill, technical knowledge, technical drawing, basic of mathematics and workshop calculation. In addition, a candidate is entrusted to undertake project workand extracurricular activities to build up confidence. The course will be implemented in Dual System of Training (DST) mode for which ITI needs to sign an MoU with industry as per the guidelines available on https://dgt.gov.in/sites/default/files/PolicyGuidelinesforDSTV.18.5_.pdf. The trainee needs to spend minimum 6 months in industry/industries.

To impart training and empowering the trainees on the knowledge of sequential layout of structures and various components of small hydroelectric power project and the utility and functioning of each component. The course includes specialization in Electrical, Mechanical and Civil sector. This course includes exposure to Diversion weir, trash rakes, fish ladder, Gates, Channels, De-settling chambers, Tunnels, penstock, Tailrace, Power-shed, Hydro turbines, Governor, Generator, transformers, Power evacuation, Display and Metering, Sensors, Electrical transmission, and work and Health Safety and Hygiene and the course schedule like hours for Classroom lectures, laboratory work and hands on training at SHP stations.

Main components of SHP are Electrical equipment, Civil works and Hydro mechanical equipment.

Under this course different sector will be covered as follows:

(I) Electrical

a. Stator and stator winding, rotor and rotor windings, excitation system
b. Control relays, fuses/ protection.
c. Measuring devices; energy, current, voltage, frequency etc.
d. Electrical components of governors.
e. Transformer and switch yard component.
f. Repair of Generator/ Transformer/ Fuses etc.
g. Adopt safe practices at workplace
h. Follow emergencies, rescue and first aid procedures
i. Follow good housekeeping practices and infection control guidelines.

(II) Civil

a. Discharge and head measurement; techniques and methods.
b. Functions and scope of maintenance of civil structure.
c. Measurement of sediments.
d. Flow/ Head measurement/ maintenance of Civil structure.
e. Trash rack cleaning

(III) Mechanical

a. Types and Functions of various mechanical equipment;
b. Types of hydro turbines and maintenance of
    - Casing
    - Nozzle/ Guide vanes/ Wicket gates.
    - Runner buckets/ runner blades/runner vanes.
    - Shaft and bearings.
c. Mechanical components of governor: linkage, oil pressure unit, Servomotor and oil piping fitting.
d. Types of gear box and their maintenance.
e. Types of gates, valves and their maintenance.
f. Penstock repairing

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 variantsand Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Small Hydro Power Plant Technician trade under CTS courses in renewable energy field will be delivered nationwide through network of ITIs.The course is of Two-year duration. It mainly consists of Domain area and Core area. 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 of the training Program, the trainee would be awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates broadly need to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and machining work.
- Check the job/components as per drawing for functioning identify and rectify errors in job/components.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join in Small Hydro industry as technician and will progress further as senior technician, supervisor and can rise up the level ofTeam Leader/Manager.
- Can become Entrepreneur in the related field.
- Can take admission in the diploma course in notified branches of Engineering bylateral entry as applicable.
- Can join Apprenticeship programs in different types of industries leading to aNational Apprenticeship Certificate (NAC)

- Can join and become an instructor in ITIs.
- Can undertake small business in small hydro power projects and grow up to Project Developer
- Can perform trade activities in small hydro power projects and commercial merchandise.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

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

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

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

2.4 ASSESSMENT & CERTIFICATION

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

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain 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 by controller of examinations, DGT as per the guideline. The pattern and marking structure is being notified by DGT India from time to time. The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

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

2.4.2 ASSESSMENT GUIDELINE

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

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

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

Performance Level	Evidence
(a) Marks in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish. • Occasional support in completing the project/job.
(b) Marksin 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 in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracyachieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish. • Little support in completing the project/job.
(c) Marksin the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracy achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Operation and maintenance of components/equipment, assembling and minor repair of components at site is the major industry in different sectors (civil, mechanical and electrical) of Small Hydro Power.

Electrical Fitter; fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., Studies drawing sand wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and checks them with gauges, megger etc. to ensure proper function and accuracy. Fits mechanical components, resistance, insulators, etc., as per specifications, doing supplementary tooling where necessary. Follows wiring diagrams, makes electrical connections and solders points as specified. Checks for continuity, resistance, circuit shorting, leakage, earthing, etc. at each stage of assembly using megger, ammeter, voltmeter and other appliances and ensures stipulated performance of both mechanical and electrical components filled in assembly. Erects various equipment such as bus bars, panel boards, electrical posts, fuse boxes switch gears, meters, relays etc. using non-conductors, insulation hoisting equipment as necessary for receipt and distribution of electrical current to feeder lines. Installs motors, generators, transformer etc. as per drawings using lifting and hoisting equipment as necessary, does prescribed electrical wiring, and connects to supply line. Locates faults in case of breakdown and replaces blown out fuse, burnt coils, switches, conductors etc. as required. Checks, dismantles, repairs and overhauls electrical units periodically or as required according to scheduled procedure. May test coils. May specialize in repairs of particular equipment manufacturing, installation or power house work and be designated accordingly.

Electrical and Electronic Equipment Mechanics and Fitters and Related Workers, Other; include all other workers engaged in fitting, assembling, repairing and maintaining electronic and electrical equipment, machinery, appliances, etc., not elsewhere classified.

Electrical Engineering, Technician; Overseer, Electrical Engineering receives instructions from senior engineer, studies blue print and working details and directs workers for proper execution of duties allotted. Receives instructions verbally or from duty chart, studies blueprints and working instructions as necessary and determines method of work to be adopted. Instructs workers such as Electricians, Electrical Fitters, Turbine Operator, Switch Board Operators, Lines Men etc. and supervises their work. Ensures correct manufacture and stipulated performance of equipment, or scheduled generation and supply of electricity, etc. according to nature of work in which employed. Checks production, alterations or repairs using instruments such as voltmeter, ammeter, megger, etc. and has any defects corrected. Maintains prescribed records. May undertake complicated installation, maintenance and allied work personally to avoid mistakes and to train workers under him. May be designated as Shift Engineer, Power House; Maintenance Engineer, instructs workers such as Electricians, Electrical Fitters, Turbine Operator, Switch Board Operators, Lines Men etc. and supervises their work. Ensures correct manufacture and stipulated performance of equipment, or scheduled generation and supply of electricity, etc. according to nature of work in which employed. Checks production, alterations or repairs using instruments

such as voltmeter, ammeter, megger, etc. and has any defects corrected. Maintains prescribed records. May undertake complicated installation, maintenance and allied work personally to avoid mistakes and to train workers under him. May be designated as Shift Engineer, Power House; Maintenance Engineer, Electrical etc., according to nature of duties performed.

Maintenance Technician Electrical; is responsible for providing assistance to the maintenance technicians in maintaining the Electrical/electronic systems of equipment and machinery.

Power-Plant Operator; operates boilers, turbines, generators, and auxiliary equipment at generating plant to produce electricity: Monitors control board and regulates equipment, according to procedures and information obtained from recording and indicating instruments. Adjusts controls of water and cold feed systems, blowers, and igniters to start up or shut down boilers. Controls operation of boiler auxiliary equipment, such as water and vacuum pumps, coal driers and pulverisers, steam condensers and soot blowers, to ensure efficient operation of boilers. Adjusts boiler controls to provide steam at specified temperature and pressure for turbine loads according to power demands. Adjusts controls to regulate speed, voltage, and phase of incoming turbines to coincide with voltage and phase of power being generated. Synchronizes incoming generating units with units in operation and closes circuit breaker at exact instant of coincidence. Monitors gauges to determine effect of generator load on related equipment, such as bus bars and voltage regulators. Adjusts transformer controls to regulate flow of power between generating stations and substations. Operates switchgear to regulate and transfer power loads to protect maintenance workers engaged in repairing or cleaning equipment. Record small functions of equipment, instruments, or controls on log sheet.

Electrical Switch Board Operator; Switch Board Assistant; Switch Board Attendant; Sub-Station Attendant (Power Station) operates and attends switches and switch gear on switch boards to regulate flow of electric current from power house or substation to different feeding units. Synchronises generators and motor connectors to bus bar (conductor forming common junction between two or more electrical circuits) receiving electrical current from other generating units by operating switches on panel board. Operates various controls to switch on and off current supply to different feeder units depending on load-requirements and as per instructions of superiors. Controls and regulates voltage, frequency and power factor according to demand and system condition. Disconnects generator from bus bar to decrease power output or to cut out faulty units and equalises load among remaining operating generators. Maintains records of switching operations and generator output at regular intervals and submits daily reports to superiors. Reports to superiors of major breakdown, power failure and malfunctioning of switch board equipment, instrument or relays. Isolates feeding units in case of break-down and fixes danger notices. May clean panel board periodically. May overhaul and repair panel equipment. May supervise working and cleaning of static or rotary electrical plants. May check voltage and specific gravity of stand by storage batteries, maintain them and keep them fully charged.

Power Production Plant Operators, Other include operators who operate, monitor and maintain switchboards and related equipment in electrical control centres which control the production and distribution of electric or other power in transmission networks not elsewhere classified.

3115.9900 Mechanical Engineering Technicians, Other Mechanical Engineering Technicians, other include all other Mechanical Engineering Technicians engaged in manufacture, research, testing and other fields of mechanical engineering, not elsewhere classified

3112.9900 Civil Engineering Technicians, Other includes all other Civil Engineering Technicians engaged in construction, survey, and related fields of civil engineering, not elsewhere classified.

Reference NCO-2015:

a) 7412.0200 – Electrical Fitter
b) 7419.9900 –Electrical and Electronic Equipment Mechanics and Fitters and Related Workers.
c) 3113.0101 - Electrical Engineering, Technician/Maintenance Technician Electrical
d) 3113.0102 - Maintenance Technician Electrical
e) 3131.0500 - Power Plant Operator
f) 3131.0600 - Electrical Switch Board Operator
g) 3131.9900 - Power Production Plant Operators, Other
h) 3115.9900 - Mechanical Engineering Technicians, Other
i) 3112.9900 - Civil Engineering Technicians, Other

Reference NOS:

a) PSS/N2001
b) PSS/N0108
c) PSS/N6001
d) PSS/N6003
e) CON/N0144
f) PSS/N9437
g) PSS/N9435
h) PSS/N9438
i) PSS/N9439
j) PSS/N9401
k) PSS/N9402
l) PSS/N6002
m) PSS/N9403
n) PSS/N1707
o) PSS/N2406
p) PSS/N2407
q) PSS/N1709
r) PSS/N9405
s) PSS/N9440
t) PSS/N9441
u) PSS/N9442
v) PSS/N9443

4. GENERAL INFORMATION

Name of the Trade	**SMALL HYDRO POWER PLANT TECHNICIAN**
Trade Code	DGT/2028
NCO - 2015	7412.0200, 7419.9900, 3113.0101, 3113.0102, 3131.0500, 3131.0600, 3131.9900, 3115.9900, 3112.9900
NOS Covered	PSS/N2001, PSS/N0108, PSS/N6001, PSS/N6003, CON/N0144, PSS/N9437, PSS/N9438, PSS/N9435, PSS/N9439, PSS/N9401, PSS/N9402, PSS/N6002, PSS/N9403, PSS/N1707, PSS/N2406, PSS/N2407, PSS/N1709, PSS/N9405, PSS/N9440, PSS/N9441, PSS/N9442, PSS/N9443
NSQF Level	Level – 4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th Class examination
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	This course requires technicians to work at heights and hence it is not desirable for PwD
Unit Strength (No. Of Students)	20 (There is no separate provision of supernumerary seats)
Space Norms	100 Sq. m
Power Norms	5 KW, 3 Phase
Instructors Qualification for	
1. Small Hydro Power Plant Technician Trade	B.Voc/Degree Degree in Electrical Engineering from recognized Engineering College/university with one-year experience in the relevant field. **OR** Diploma in Electrical Engineering from recognized board of technical education with two years' experience in the relevant field. **OR** NTC/NAC passed in the Trade of "Small Hydro Power Plant Technician" With three years' experience in the relevant field. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade. ***For first 5 years after roll out of this course, guest faculties from Industries or other esteemed institutions where such course is running for engineering/ diploma/ CTS can be invited.***

	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. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering 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 in any one of the engineering trades with three years' experience. **<u>Essential Qualification:</u>** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering 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 in any one of the engineering/ Draughtsman group of trades with three years' experience. **<u>Essential Qualification:</u>** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade OR Regular/RPL variants NCIC in RoDA or any of its variants under DGT
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic

	Computer at 12th / Diploma level and above) **OR** Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills.
5. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1LEARNING OUTCOMES

FIRST YEAR:

1. Prepare profile with an appropriate accuracy as per drawing following safety precautions.(NOS: PSS/N2001)
2. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.(NOS: PSS/N0108)
3. Verify characteristics of electrical and magnetic circuits.(NOS: PSS/N6001, PSS/N6003)
4. Select and handle proper tools and operate machineries following safety precautions.(NOS: PSS/N2001)
5. Apply the knowledge about basic components used in civil structure like sand, cement, concrete, steel, bricks etc. and perform Masonry works. (NOS: CON/N0144)
6. Apply the knowledge of anchor blocks, foundation lines and desilting tank, check behaviour/ nature of the soil, analyse and apply the surveying methodologies, visual inspection of different civil structure of Powerhouse and operate heavy construction machineries. (NOS: PSS/N9437)
7. Select & handle proper tools and operate machineries following safety precautions. (NOS: PSS/N9435)
8. Perform installation and dismounting of turbines, checking against deterioration etc., perform welding of joints, identify leakage in joints, use Lubricants and apply the knowledge of abrasion, pitting, bearing of AC generators etc. (NOS: PSS/N9438)
9. Operate gates valves, penstocks, joints, flanges, servomotor gear devices etc. and repair/ maintenance of penstocks, HOT, gates etc. (NOS: PSS/N9439)
10. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

SECOND YEAR:

12. Assemble, install and test wiring system. (NOS: PSS/N6001)
13. Plan and prepare Earthing installation. (NOS: PSS/N6002)
14. Plan and execute electrical illumination system and test. (NOS: PSS/N9403)
15. Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. (NOS: PSS/N1707)

16. Execute testing; evaluate performance and maintenance of transformer. (NOS: PSS/N2406, PSS/N2407)
17. Plan, execute commissioning and evaluate performance of AC motors, Execute testing, and maintenance of AC motors and starters. (NOS: PSS/N1709)
18. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set, Execute parallel operation of alternators. (NOS: PSS/N9405)
19. Analyse, design and check foundation using discharge measurement techniques and knowledge of different types of construction materials. (NOS: PSS/N9440)
20. Identify drawing equipment and apply the knowledge of projection methods and construct engineering drawings using technical drawing rules. (NOS: PSS/N9441)
21. Perform installation as well as maintenance of intake gates, operate power plant including starting & shutting down and emergency operations. (NOS: PSS/N9442)
22. Perform Servicing, repairing, adjusting, moving parts, and equipment that operate primarily on the basis of mechanical principles, Apply the detail knowledge of dewatering pumps and governing system. (NOS: PSS/N9443)
23. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)
24. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)

6. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
FIRST YEAR	
1. Prepare profile with an appropriate accuracy as per drawing following safety precautions. (NOS: PSS/N2001)	Identify safety symbols/ hazards.
	Preventive measures for electrical accidents.
	Show steps to be taken in electrical accidents.
	Apply artificial respiration.
	Identify trade tools / machineries.
	Illustrate maintenance of trade tools.
	Perform filing and hacksawing and prepare T joint, straight joint and dovetail joint on wooden blocks.
	Demonstrate sawing, planning, drilling and assembling.
	Make wooden switchboard.
	Perform marking and cutting of straight and curved pieces in metal sheets.
	Demonstrate drilling, chipping, internal and external threading of different sizes.
	Make square and round holes, securing by screw and riveting.
	Make an open box from metal sheet.
2. Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable. (NOS: PSS/N0108)	Illustrate skinning/ twisting / crimping.
	Identify Different types of cables.
	Measure conductor size using SWG and micrometre.
	Make simple twist/ married/ Tee / western union joints.
	Make britannia straight/britannia Tee / rat tail joints.
	Demonstrate Soldering of joints / lugs.
	Make straight joint of different types of underground cable.
	Test underground cables for faults.
	Rectify faults of the underground cables.
3. Verify characteristics of electrical and magnetic circuits. (NOS: PSS/N6001, PSS/N6003)	Measure parameters in combinational electrical circuit by applying Ohm's Law for different resistor values / voltage sources.
	Measure current / voltage in electrical circuits to verify Kirchhoff's Law.
	Verify laws of series and parallel circuits with voltage source in

	different combinations.
	Measure resistance using wheat stone bridge/voltage drop method
	Determine the poles of a magnet bar.
	Plot the field of a magnet bar.
	Measure induced emf due to change in magnetic field/ Determine direction of induced emf.
	Determine the relationship between Line and Phase values for star and delta connections
	Identify various types of capacitors, charging / discharging and testing.
	Demonstrate improvement of PF by use of capacitor in three phase circuit.
	Measure current / voltage of two phases in case of one phase is short-circuited in three phase four wire system and compare with healthy system.
4. Select and handle proper tools and operate machineries following safety precautions. (NOS: PSS/N2001)	Identify trade tools and machineries.
	Apply safe methods of lifting, handling of tools / equipment.
	Select proper tools for operation.
	Apply precautions during operation.
	Demonstrate maintenance of trade tools.
	Visit various sections of the institutes and location of mechanical labs and machine installations.
	Identify power house / industry symbols and hazards.
	Apply preventive measures for accidents / steps to be taken in such accidents.
	Demonstrate use personal protective equipment.
	Show disposal procedure of mechanical waste materials.
	Practice on cleanliness and procedure to maintain it.
5. Apply the knowledge about basic components used in civil structure like sand, cement, concrete, steel, bricks etc. and perform Masonry works. (NOS: CON/N0144)	Identify different types of aggregate.
	Check different types of sand.
	Identify the grade of cements.
	Select different grade of cements according to its use.
	Identify &select different types of concrete as per ratio/ mixing/ RCC/ PCC.

	Identify & Select Chemicals/ Steel/ Bricks as per its applicability.
	Construct a masonry wall.
	Identify different types of tools and machinery used in civil work.
6. Apply the knowledge of anchor blocks, foundation lines and desilting tank, check behaviour/nature of the soil, analyse and apply the surveying methodologies, visual inspection of different civil structure of Powerhouse and operate heavy construction machineries. (NOS: PSS/N9437)	Check Anchor block / Saddle block.
	Identify Foundation of transmission line- 4poles/2poles/single pole structures and towers.
	Check Intake structure- different design as per site condition.
	Prepare different design of desilting tank as per project.
	Apply the knowledge of Physiographic conditions of landscape and general impact on water quality and flooding.
	Use of Maps/ GPS/ altimeter google imagery, identification on map.
	Check Basin area.
	Check General condition of catchment area: Ice fields/ Forest areas/ exposed rocks/ Loose soil/ Landslides.
7. Select & handle proper tools and operate machineries following safety precautions. (NOS: PSS/N9435)	Identify power house / industry symbols and hazards.
	Preventive measures for accidents and practice steps to be taken in such accidents.
	Use of personal protective equipment.
	Disposal procedure of mechanical waste materials.
	Practice on cleanliness and procedure to maintain it.
	Identify trade tools and machineries.
	Practice safe methods of lifting and handling of tools & equipment.
	Select proper tools for operation and precautions in operation.
	Care & maintenance of trade tools.
8. Perform installation and dismounting of turbines, checking against deterioration etc., perform welding of joints, identify leakage in joints, use Lubricants and apply the	Identify different types of Turbines:
	Select suitable turbines as per the Net head / available discharge.
	Identify different types of runner blades/ Shafts
	Identify various types of bearings.
	Demonstrate Foundations of turbines/ Alignment with

knowledge of abrasion, pitting, bearing of AC generators etc. (NOS: PSS/N9438)	Generators/ joints of penstock.
	Install / dismount turbines and other equipment.
	Demonstrate welding methods / Fabrication techniques used for the rolling of Feeder pipe/ power pipe /penstock pipe etc. and their testing.
	Show working of hydraulic system like Oil Pressure Unit (OPU) etc.
	Identify Various lubrication system used for AC Generator bearings etc.
9. Operate gates valves, penstocks, joints, flanges, servomotor gear devices etc. and repair/ maintenance of penstocks, HOT, gates etc. (NOS: PSS/N9439)	Identify Types of gates/ valves and their components.
	Identify Different type of Governors/ Mechanical parts of governor.
	Synchronize and adjust Servomotors/ Pressure pumps/ oil pipes connections and preventive leakages.
	Install HOT (Hoist One Track) Crane for lifting of heavy/light machineries.
	Maintenance Of HOT (Hoist One Track) Crane for lifting of heavy/light machineries.
10. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
11. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study
SECOND YEAR	
12. Assemble, install and test wiring system.	Identify different electrical accessories.
	Do cutting, threading of different sizes & laying Installations.

(NOS: PSS/N6001)	Prepare test boards / extension boards.
	Mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc.
	Conduit wiring with minimum to more number of points of minimum 15 mtr length by applying PVC Casing-capping.
	Wire up PVC conduit wiring to control one lamp from two different places/ one lamp from three different places.
	Control sockets and lamps in different combinations using switching concepts.
	Construct and mount the energy meter board.
	Prepare an estimate of the cost/bill of material for wiring of hostel/ residential building and workshop.
	Follow IE rules for wiring of institute and workshops.
	Test and detect faults of domestic and industrial wiring.
	Perform repair of the given fault.
13. Plan and prepare Earthing installation. (NOS: PSS/N6002)	Prepare pipe/Plate earthing.
	Measure earth resistance by earth tester / megger.
	Test earth leakage by ELCB / relay.
14. Plan and execute electrical illumination system and test. (NOS: PSS/N9403)	Identify various types of illumination system.
	Install light fitting with reflectors for direct / indirect lighting.
	Identify different types of lamp used in illumination system.
	Calculate lumens and efficiency.
15. Select and perform measurements using analog / digital instruments and install/ diagnose smart meters. (NOS: PSS/N1707)	Measure power in three phase circuit using two wattmeter methods.
	Measure power factor in three phase circuit by using power factor meter.
	Verify the power factor with voltmeter/ ammeter / wattmeter readings.
	Measure electrical parameters using tong tester in three phase circuits.
	Demonstrate physical components and Communication components of a Smart Meter.
	Perform meter readings/ installation/ diagnosis of smart meters.

16. Execute testing; evaluate performance and maintenance of transformer. (NOS: PSS/N2406, PSS/N2407)	Verify terminals/ identify components / calculate transformation ratio of single-phase transformers.
	Perform OC / SC test to determine and efficiency of single-phase transformer
	Perform series / parallel operation of two single phase transformers.
	Verify the terminals / accessories of three phase transformer HT / LT side.
	Perform 3 phase operation delta-delta/ delta-star/ star-star/ star-delta by use of three single phase transformers.
	Perform winding of small transformer.
17. Plan, execute commissioning and evaluate performance of AC motors, Execute testing, and maintenance of AC motors and starters. (NOS: PSS/N1709)	Install and connect a single-phase AC motors.
	Determine performance of a single-phase AC motors.
	Start, run and reverse the direction of rotation of a single-phase AC motor.
	Perform speed control of a single-phase AC motors.
	Run motor at various loads and measure the speed.
	Install and connect a three-phase AC motors.
	Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters.
	Perform measure slip of three phase induction motor.
	Check continuity and insulation resistance of three phase induction motors.
18. Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set, Execute parallel operation of alternators. (NOS: PSS/N9405)	Install an alternator and identify parts / terminals of an alternator.
	Check continuity and insulation resistance.
	Run an alternator to build up the voltage.
	Ascertain the load performance/ voltage regulation of three phase alternator.
	Demonstrate parallel operation and synchronization of three phase alternators.
	Perform maintenance of Alternator and synchronous motor.
19. Analyse, design and check	Install motors/ pumps/ DG sets/ switchboards/ relays/ switch

foundation using discharge measurement techniques and knowledge of different types of construction materials. (NOS: PSS/N9440)	gears/ meters/ hydraulic cranes / conduit channels.
	Perform Survey/ Contouring / levelling.
	Determine Flood and lean seasonal discharge/water level measurement on ground
	Apply techniques / methods for Head and discharge measurement.
	Identify leakages from structures.
	Perform maintenance of gates/ trash rakes/ tunnels/ penstock / flushing of silt from desilting chamber.
	Inspect Cracks, erosion, water leakage, clogging sedimentation and landslides near site.
	Construction work: Masonry, concrete, RCC, Construction materials, cement mixtures and compositions and strength, concrete block testing, sealants, repair of Power house, civil structures and machinery foundations, scaffolding work.
20. Identify drawing equipment and apply the knowledge of projection methods and construct engineering drawings using technical drawing rules. (NOS: PSS/N9441)	Explain flood precautions and Alert action during flooding.
	Draw IN 2D, 3D in with CAD,3D Max, STAAD software.
	Prepare of Inspection and maintenance schedules.
21. Perform installation as well as maintenance of intake gates, operate power plant including starting & shutting down and emergency operations. (NOS: PSS/N9442)	Apply various lifting tools like Chain Block, Pulley, slings etc.
	Operate gates in Normal condition/ during flood time.
	Check vibrations and preventive methods.
	Demonstrate Ventilation's and cooling system.
	Start Plant and shut down according to schedules.
	Care and maintain of Earth moving equipment.
	Identify various Types of gates, valves, their components.
22. Perform Servicing, repairing, adjusting, moving parts, and equipment that operate primarily on the basis of mechanical principles, Apply the detail knowledge of dewatering	Identify Different types of dewatering systems engaged during construction work / during running of plant.
	Carry out Maintenance of dewatering pumps.
	Apply Various laying method for Feeder pipe/ power pipe / penstock pipe in hilly / rocky areas.
	Perform general mechanical repair works such as welding,

pumps and governing system. (NOS: PSS/N9443)	metal cutting, machining and other tool room jobs.
	Carry out Servicing of mechanical equipment/ turbines/ gear boxes/ governing system.
	Apply Safety Measures in Hydro Power Plant.
23. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
24. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

7. TRADE SYLLABUS

SYLLABUS FORSMALL HYDRO POWER PLANT TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Electrical			
Professional Skill 140Hrs.; Professional Knowledge 30 Hrs.	Prepare profile with an appropriate accuracy as per drawing following safety precautions.	1. Visit various sections of the institutes and location of electrical installations. 2. Identify safety symbols and hazards. 3. Preventive measures for electrical accidents and practice steps to be taken in such accidents. 4. Practice safe methods of fire fighting in case of electrical fire. 5. Use of fire extinguishers. 6. Practice elementary first aid. 7. Rescue a person and practice artificial respiration. 8. Disposal procedure of waste materials. 9. Use of personal protective equipment. 10. Practice on cleanliness and procedure to maintain it. 11. Identify trade tools and machineries. 12. Practice safe methods of lifting and handling of tools & equipment. 13. Select proper tools for operation and precautions	Scope of the electrician trade. Safety rules and safety signs. Types and working of fire extinguishers. First aid safety practice. Hazard identification and prevention. Personal safety and factory safety. Response to emergencies e.g. power failure, system failure and fire etc. Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National Electrical Code-2011.

		in operation. 14. Care & maintenance of trade tools.	
		15. Operations of allied trade tools. 16. Workshop practice on filing and hacksawing. 17. Practice on preparing T joint, straight joint and dovetail joint on wooden blocks. 18. Practice sawing, planning, drilling and assembling for-making a wooden switchboard.	**Allied trades:** Introduction to carpentry Tools, safety precautions. Description of files, hammers, chisels, hacksaw frames, blades, their specification and grades Marking tools description and use. Types of drills, description & drilling machines. Various wooden joints.
		19. Practice in marking and cutting of straight and curved pieces in metal sheets. 20. Workshop practice on drilling, chipping, internal and external threading of different sizes. 21. Practice of making square and round holes, securing by screw and riveting. 22. Prepare an open box from metal sheet.	Marking tools; Introduction to fitting tools, calipers, Dividers, Surface plates, Angle plates, Scribers, punches, surface gauges Types, Uses, Care and maintenance. Sheet metal tools: Description of marking & cutting tools. Types of rivets and riveted joints. Use of thread gauge. Care and maintenance of tools. (30 hrs)
Professional Skill 120 Hrs.; Professional Knowledge 25Hrs.	Prepare electrical wire joints, carry out soldering, crimping and measure insulation resistance of underground cable.	23. Prepare terminations of cable ends 24. Practice on skinning, twisting and crimping. 25. Identify various types of cables and measure conductor size using SWG and micrometre.	Fundamentals of electricity, definitions, units & effects of electric current. Conductors and insulators. Conducting materials and their comparison. Joints in electrical

		26. Make simple twist, married, Tee and western union joints. 27. Make Britannia straight, Britannia Tee and rat tail joints. 28. Practice in Soldering of joints / lugs. 29. Identify various parts, skinning and dressing of underground cable. 30. Make straight joint of different types of underground cable. 31. Test insulation resistance of underground cable using megger. 32. Test underground cables for faults and remove the fault.	conductors. Techniques of soldering. Types of solders and flux. Underground cables: Description, types, various joints and testing procedure. Cable insulation & voltage grades Precautions in using various types of cables.
Professional Skill 180Hrs.; Professional Knowledge 35Hrs.	Verify characteristics of electrical and magnetic circuits.	33. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources and analyse by drawing graphs. 34. Measure current and voltage in electrical circuits to verify Kirchhoff's Law 35. Verify laws of series and parallel circuits with voltage source in different combinations. 36. Measure voltage and current against individual resistance in electrical	Ohm's Law; Simple electrical circuits and problems. Kirchoff's Laws and applications. Series and parallel circuits. Open and short circuits in series and parallel networks. Laws of Resistance and various types of resistors. Wheatstone bridge; principle and its applications. Effect of variation of temperature on resistance. Different methods of

		circuit 37. Measure current and voltage and analyse the effects of shorts and opens in series circuit. 38. Measure current and voltage and analyse the effects of shorts and opens in parallel circuit. 39. Measure resistance using voltage drop method. 40. Measure resistance using Wheatstone bridge. 41. Verify the characteristics of series parallel combination of resistors. 42. Determine the poles and plot the field of a magnet bar. 43. Wind a solenoid and determine the magnetic effect of electric current. 44. Measure induced emf due to change in magnetic field. 45. Determine direction of induced emf and current. 46. Practice on generation of mutually induced emf. 47. Measure the resistance, impedance and determine inductance of choke coils in different combinations. 48. Identify various types of capacitors, charging / discharging and testing. 49. Measure power, energy for lagging and leading power factors in single phase	measuring the values of resistance. Series and parallel combinations of resistors. Magnetic terms, magnetic materials and properties of magnet. Principles and laws of electro-magnetism. Self and mutually induced EMFs. Electrostatics: Capacitor-Different types, functions, grouping and uses. Inductive and capacitive reactance, their effect on AC circuit and related vector concepts. Comparison and Advantages of DC and AC systems. Related terms frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, power factor and Impedance etc. Sine wave, phase and phase difference. Active and Reactive power. Single Phase and three-phase system. Problems on A.C. circuits. Advantages of AC poly-phase system. Concept of three-phase Star and Delta connection.

		circuits and compare characteristic graphically. 50. Measure Current, voltage, power, energy and power factor in three phase circuits. 51. Practice improvement of PF by use of capacitor in three phase circuit. 52. Ascertain use of neutral by identifying wires of a 3-phase 4 wire system and find the phase sequence using phase sequence meter. 53. Determine effect of broken neutral wire in three phase four wire system. 54. Determine the relationship between Line and Phase values for star and delta connections. 55. Measure the Power of three phase circuit for balanced and unbalanced loads. 56. Measure current and voltage of two phases in case of one phase is short-circuited in three phase four wire system and compare with healthy system.	Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Phase sequence meter.
Civil			
Professional Skill 40Hrs.; Professional	Select and handle proper tools and operate machineries following safety	57. Visit various sections of the institutes and location of civil structures. 58. Identify trade tools and	Rules and regulation of institute and trade. List of subjects taught during the course.

Knowledge 08 Hrs.	precautions.	machineries. 59. Practice safe methods of lifting and handling of tools & equipment. 60. Select proper tools for operation and precautions in operation. 61. Care & maintenance of trade tools.	Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to civil engineering Code.
Professional Skill 70 Hrs.; Professional Knowledge 15Hrs.	Apply the knowledge about basic components used in civil structure like sand, cement, concrete, steel, bricks etc. and perform Masonry works.	62. Identify Aggregates, Types of aggregate. 63. Check Sand: Types of sand. 64. Cement- select the grade of cement, and where to use. 65. Concrete – select all types of concrete as per ratio, mixing, RCC, PCC. 66. Chemicals- identify chemicals used for quick setting, leakage proof etc. 67. Steel- identify all types of steel used in concrete, binding and spacing. 68. Select Bricks- Types of bricks. 69. Perform Masonry work- masonry wall. 70. Select Wire crates- types of wire crate (size of wire and spacing). 71. Identify Machinery and tools – All types of tools and machinery used in civil work as mixture m/c, vibrate, level measuring instruments etc.	Details of aggregate, sand, types of cement, concrete. Ratio of RCC, PCC and Concrete. Extraction of iron from its ore. Composition and types of steel. Constituents of Bricks. Manufacturing process of Bricks. Types of clay molding. Types of Level measurement.
Professional Skill 40Hrs.;	Apply the knowledge of	72. Check Anchor block - to hold the pipe, if your water	Civil structures in small hydropower plant.

Professional Knowledge 08Hrs.	anchor blocks, foundation lines and desilting tank,check behaviour/nature of the soil, analyse and apply the surveying methodologies, visual inspection of different civil structure of Powerhouse and operate heavy construction machineries.	supply system is based on M.S pipe. 73. Saddle block – to support the pipe. 74. Identify Foundation of transmission line- 4poles, 2poles, single pole structures and towers. 75. Check Intake structure- different design as per site condition. 76. Desilting tank- different design of desilting tank as per project. 77. Check Basin and catchment area, General condition of catchment area: Ice fields, Forest areas, exposed rocks, Loose soil, Landslides. 78. Check Physiographic conditions of landscape and general impact on water quality and flooding. 79. Use of Maps, GPS, altimeter google imagery, identification on map.	Details of Foundations. Different design of intake structures and desilting tank Types of soil, different types of basins and catchment area. Details of loose soils and landslides. Types of maps. Details of GPS. Symbols, identification on map.
Mechanical			
Professional Skill 70Hrs.; Professional Knowledge 15Hrs.	Select & handle proper tools and operate machineries following safety precautions.	80. Visit various sections of the institutes and location of mechanical labs and machine installations. 81. Identify power house / industry symbols and hazards. 82. Preventive measures for accidents and practice steps to be taken in such	Scope of the Small Hydro Plant trade. General discipline in the Institute Safety rules and safety signs. Preventive measures for accidents. First aid safety practice. Hazard identification and

		accidents. 83. Use of personal protective equipment. 84. Disposal procedure of mechanical waste materials. 85. Practice on cleanliness and procedure to maintain it. 86. Identify trade tools and machineries. 87. Practice safe methods of lifting and handling of tools & equipment. 88. Select proper tools for operation and precautions in operation. 89. Care & maintenance of trade tools.	prevention. Personal safety and Power house safety. Concept of Standards and advantages of BIS/ISI. Trade tools specifications. Introduction to National Mechanical Code-2021
Professional Skill 110 Hrs.; Professional Knowledge 20Hrs.	Perform installation and dismounting of turbines, checking against deterioration etc., perform welding of joints, identify leakage in joints, use Lubricants and apply the knowledge of abrasion, pitting, bearing of AC generators etc.	90. Identify types of turbines: Details of different types of turbines i.e. Pelton, Francis and Kaplan Turbines. 91. Check Suitability of turbines as per the Net head and available discharge. 92. Casings of turbines, Nozzle, Guide vanes, Wicket gates and their movements. 93. Types of runner blades, Shafts and types of bearings. Foundations of turbines, Alignment with Generators, joints of penstock. 94. Lubrication, cooling of	Fundamentals of turbines, definitions, units & effects of Net head and discharge. Different parts of turbines, their location etc. Basics of Lubrications and its importance. Basic procedure of installation and dismounting. Important observations after dismounting. Types of joints. Basics of Welding Techniques. Knowledge of types of pipes. Concept of density, mass, volume and pressure.

		bearings. 95. Practice Installations and dismounting of turbines and other equipment. 96. Checking of runner blades against abrasion and pitting. 97. Fabrication & Welding work: Type of Fabrication techniques used for the rolling of Feeder pipe, power pipe and penstock pipe etc and their testing. And the welding methods used. 98. Identifying and addressing leakages in turbine casings and leakage of oil. 99. Study and working of hydraulic system like OilPressure Unit (OPU) etc. for efficient working of Main Inlet Valve (MIV). 100. Different types of Valves used in OPU. 101. Various lubrication system used for AC Generator bearings etc. 102. Different bearings used in AC Generators.	Types of bearings and their maintenance.
Professional Skill 70 Hrs.; Professional Knowledge 14 Hrs.	Operate gates valves, penstocks, joints, flanges, servomotor gear devices etc. and repair/ maintenance of	103. Identify Types of gates, valves, their components and maintenance 104. Penstocks, expansion joints, flanges, seals and repairing of penstocks. 105. Different type of	Details about gate valves, its internal component and maintenance. Power transmission devices like gears belts etc. Understand the proper use of wire ropes, wire rope

	penstocks, HOT, gates etc.	Governors, Mechanical parts of governor. 106. Linkages, belts/gearing devices. 107. Servomotors, Pressure pumps, oil pipes connections and preventive leakages. Synchronization and adjustments. 108. Installation, working and maintenance Of HOT (Hoist One Track) Crane for lifting of heavy/light machineries.	fittings, end terminations, and tighteners. Types of valves, their components and maintenance of gate valves. Basic service of turbine, gears and governing system of power house.
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED: 40 hrs.	Read and apply engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instruments– • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Freehand drawing of– • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke Dimensioning Practice • Types of arrowhead Symbolic representation– • Different electrical symbols used in the related trades Reading of Electrical Circuit Diagram Reading of Electrical Layout drawing	
WORKSHOP CALCULATION & SCIENCE: 30 Hrs.			

Professional Knowledge WCS: 30 hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study	**Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentages - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non-ferrous metals Introduction of iron and cast iron **Mass, Weight, Volume and Density** Mass, volume, density, weight Related problems for mass, volume, density, weight Work, power, energy, HP, IHP, BHP and efficiency Potential energy, kinetic energy and related problems with assignment **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation. **Mensuration** Area and perimeter of square, rectangle and parallelogram

		Area and perimeter of Triangles Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
Project Work/ Industrial Visit: - **Broad Area:** a) Working of different types of turbines through working models. b) Test board with switches, plug socket, lamp holder etc. c) Temperature controlled system for switching 'ON' and 'OFF' of any circuit using bi-metallic strip. d) Series/ parallel combinational circuits. e) Protection of electrical equipment. f) Automatic control using relays. g) Fuse and power failure indicator using relays. h) Visit to Power station Control Panel Room (Components, Power distribution, etc.)		

SYLLABUS FORSMALL HYDRO POWER PLANT TECHNICIAN TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Electrical			
Professional Skill 150 Hrs.; Professional Knowledge 35 Hrs.	Assemble, install and test wiring system.	109. Identify various conduits and different electrical accessories. 110. Practice cutting, threading of different sizes & laying Installations. 111. Prepare test boards / extension boards and mount accessories like lamp holders, various switches, sockets, fuses, relays, MCB, ELCB, MCCB etc. 112. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to more number of points of minimum 15 mtr length. 113. Wire up PVC conduit wiring to control one lamp from two different places. 114. Wire up PVC conduit wiring to control one lamp from three different places. 115. Wire up PVC conduit wiring and practice	I.E. rules on electrical wiring. Types of domestic and industrial wirings. Study of wiring accessories e.g. switches, fuses, relays, MCB, ELCB, MCCB etc. Grading of cables and current ratings. Principle of laying out of domestic wiring. Voltage drop concept. PVC conduit and Casing-capping wiring system. Different types of wiring - Power, control, Communication and entertainment wiring. Wiring circuits planning, permissible load in sub-circuit and main circuit.

		control of sockets and lamps in different combinations using switching concepts. 116. Prepare and mount the energy meter board. 117. Estimate the cost/bill of material for wiring of hostel/ residential building and workshop. 118. Practice wiring of hostel and residential building as per IE rules. 119. Practice wiring of institute and workshop as per IE rules. 120. Practice testing / fault detection of domestic and industrial wiring installation and repair.	
Professional Skill 18 Hrs.; Professional Knowledge 08 Hrs.	Plan and prepare Earthing installation.	121. Prepare pipe earthing and measure earth resistance by earth tester / megger. 122. Prepare plate earthing and measure earth resistance by earth tester / megger. 123. Test earth leakage by ELCB and relay.	Importance of Earthing. Plate earthing and pipe earthing methods and IEE regulations. Earth resistance and earth leakage circuit breaker.
Professional Skill 18 Hrs.; Professional Knowledge 08Hrs.	Plan and execute electrical illumination system and test.	124. Install light fitting with reflectors for direct and indirect lighting.	Laws of Illuminations. Types of illumination system. Illumination factors, intensity of light. Type of lamps, advantages/ disadvantages and their

			applications. Calculations of lumens and efficiency.
Professional Skill 45 Hrs.; Professional Knowledge 12 Hrs.	Select and perform measurements using analog / digital instruments and install/ diagnose smart meters.	125. Practice on various analog and digital measuring Instruments. 126. Practice on measuring instruments in single and three phase circuits e.g. multi-meter, Wattmeter, Energy meter, Phase sequence meter and Frequency meter etc. 127. Measure power in three phase circuit using two wattmeter methods. 128. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. 129. Measure electrical parameters using tong tester in three phase circuits. 130. Demonstrate Smart Meter, its physical components and Communication components. 131. Perform meter readings, install and diagnose smart	Classification of electrical instruments and essential forces required in indicating instruments. PMMC and Moving iron instruments. Measurement of various electrical parameters using different analog and digital instruments. Measurement of energy in three phase circuit. Automatic meter reading infrastructures and Smart meter. Concept of Prosumer and distributed generation. Electrical supply requirements of smart meter, Detecting/clearing the tamper notifications of meter

		meters.	
Professional Skill 70 Hrs.; Professional Knowledge 22 Hrs.	Execute testing; evaluate performance and maintenance of transformer.	132. Verify terminals, identify components and calculate transformation ratio of single-phase transformers. 133. Perform OC and SC test to determine and efficiency of single-phase transformer. 134. Determine voltage regulation of single-phase transformer at different loads and power factors. 135. Perform series and parallel operation of two single phase transformers. 136. Verify the terminals and accessories of three phase transformer HT and LT side. 137. Perform 3 phase operation (i) delta-delta, (ii) delta-star, (iii) star-star, (iv) star-delta by use of three single phase transformers. 138. Perform testing of transformer oil. 139. Practice on winding of small transformer. 140. Practice of general maintenance of	Working principle, construction and classification of transformer. Single phase and three phase transformers. Turn ratio and e.m.f. equation. Series and parallel operation of transformer. Voltage Regulation and efficiency. Auto Transformer and instrument transformers (CT & PT). Method of connecting three single phase transformers for three phase operation. Types of Cooling, protective devices, bushings and termination etc. Testing of transformer oil. Materials used for winding and winding wires in small transformer.

		transformer.	
Professional Skill 45 Hrs.; Professional Knowledge 10 Hrs.	Plan, execute commissioning and evaluate performance of AC motors, Execute testing, and maintenance of AC motors and starters.	141. Identify parts and terminals of different types of single-phase AC motors. 142. Start, run and reverse the direction of rotation of single-phase AC motors. 143. Practice on speed control of single-phase AC motors. 144. Identify parts and terminals of three phase AC motors. 145. Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters. 146. Measure slip of three phase induction motor 147. Test for continuity and insulation resistance of three phase induction motors.	Working principle, different method of starting and running of various single-phase AC motors. Domestic and industrial applications of different single-phase AC motors. Characteristics, losses and efficiency. Working principle of three phase induction motor. Squirrel Cage Induction motor, Slip-ring induction motor; construction, characteristics, Slip and Torque. Different types of starters for three phase induction motors, its necessity, basic contactor circuit, parts and their functions. Single phasing prevention. Various methods of speedcontrol. Braking system of motor. Maintenance and repair.
Professional Skill 80Hrs.; Professional Knowledge 26 Hrs.	Plan, execute testing, evaluate performance and carry out maintenance of Alternator / MG set, Execute parallel operation of alternators.	148. Install an alternator, identify parts and terminals of alternator. 149. Test for continuity and insulation resistance of alternator. 150. Connect, start and run an alternator and build up the voltage. 151. Determine the load performance and	Principle of alternator, e.m.f. equation, relation between poles, speed and frequency. Types and construction. Efficiency, characteristics, regulation, phase sequence and parallel operation. Effect of changing the field excitation and power factor correction.

		voltage regulation of three phase alternator. 152. Parallel operation and synchronization of three phase alternators. 153. Carry out maintenance of Alternator and synchronous motor	
		Civil	
Professional Skill120 Hrs.; Professional Knowledge 30 Hrs.	Analyze, design and check foundation using discharge measurement techniques and knowledge of different types of construction materials.	154. Installations of foundations of electrical or mechanical equipment, such as motors/ pumps, DG sets, switchboards, relays, switch gears, meters, hydraulic cranes and conduit channels. 155. Carry out survey, Contouring and levelling. 156. Demonstrate causes of floods and likely impact, Quantity of Discharge of stream, water use. 157. Estimate flood and lean seasonal discharge. Measure water level on ground, Head and discharge measurement using appropriate techniques and methods.	Geographical Investigation, Characterization of ground, site investigations, method of drilling, sampling. Details of pile foundations, Caisson and Well Foundation and Machine foundations. General criteria for design of machine foundation Types of surveys. Different causes of flood and their impact. Different methods and techniques for measurement of water level, head and discharge measurement. Types of gates, operation and maintenance of gates, trash rakes, tunnels and penstock. Composition of concrete. Types of construction material. Details to testing procedures of RCC block. Types of foundations, machinery foundations. Hydraulic system, Pascal's law.

		158. Measurement of sediments. 159. Identification of leakages from structures, Operation and maintenance of gates, trash rakes, tunnels, penstock and flushing of silt from desilting chamber. 160. Carry out visual inspection of Power House shed, Yard, Diversion Weir, Trash rake, Gates, Waterways Channels, De-settling chamber, Penstock, Spillways, Tailrace, connecting paths to structures for damages, etc. 161. Carry out inspection for Cracks, erosion, water leakage, clogging sedimentation and landslides near site. 162. Ensure proper work at Construction site: Masonry, concrete, RCC, Construction materials, cement mixtures and compositions and strength, concrete block testing, sealants, repair of Power house, civil structures and	

		machinery foundations, scaffolding work. 163. Demonstrate Floats, pontoons, cables, ropeways, anchorage. Lift and move loads, using cranes, hoists, and rigging, to install or repair hydroelectric system equipment or infrastructure.	
Professional Skill 44Hrs.; Professional Knowledge 12 Hrs.	Identify drawing equipment and apply the knowledge of projection methods and construct engineering drawings using technical drawing rules.	164. Demonstrate precautions during floods and necessary actions. 165. Practice drawing in 2D, 3D with CAD,3D Max, STAAD software. 166. Prepare schedules for inspection and maintenance.	Basic concept of engineering drawing, lines, centerlines, circle etc. Concept of first angle projection and third angle projections. Auxiliary views, Isometric projections, section view, detailed view. Hatching, Scaling, trim, copy etc. Preparation of maintenance schedule.
MECHANICAL			
Professional Skill 140 Hrs.; Professional Knowledge 35 Hrs.	Perform installation as well as maintenance of intake gates, operate power plant including starting & shutting down and emergency operations.	167. Use of various lifting tools like Chain Block, Pulley, slings etc. 168. Operation of gates in Normal condition and during flood time. 169. Checking of vibrations and preventive methods. 170. Ventilation's and cooling system. 171. Plant starting and shutting down	Newton's law of motion, Pulley Vibration measurement techniques. Factor of safety, Understand the basic physics as they relate to mass, gravity, and centre of gravity. Efficiency of inclined planes. Types of ventilation like artificial ventilation, natural ventilation. Maintenance of earth moving equipment like cleaning and

		schedules. Emergency operations. 172. Earth moving equipment and their maintenance. 173. Types of gates, valves, their components and maintenance. 174. Maintenance of mechanical components.	storage, lubrication, inspection of wear and tear etc. Safety rules of hydro power stations.
Professional Skill 110 Hrs.; Professional Knowledge 30 Hrs.	Perform Servicing, repairing, adjusting, moving parts, and equipment that operate primarily on the basis of mechanical principles. Apply the detail knowledge of dewatering pumps and governing system.	175. Different types of dewatering systems engaged during construction work and during running of plant. 176. Maintenance of dewatering pumps. 177. Various laying method for water conductor pipes (Feeder pipe, power pipeand penstock pipe) in hilly / rocky areas. 178. Undertaking and performing general mechanical repair works such as welding, metal cutting, machining and other tool room jobs. 179. Servicing of mechanical equipment, turbines, gear boxes, governing system. 180. Safety Measures in	Dewatering systems, Types of maintenance. Different sizes and types of joints of penstock pipes. Different fabrication operations such as cutting, machining, welding. Basic about MMAW (manual metal arc welding), TIG (tungsten inert gas welding), MIG (metal inert gas welding). Knowledge of model space & layout space, how to create viewport & template. Managing drawing in page setup manager. Introduction to 3D, 3D primitives, Extrude, Revolve command. Setting User co-ordinate Systems, Rotating, Plotting, Print preview Preparation of maintenance schedule of equipment used in hydro power plants.

		Hydro Power Plant. 181. CAD: Practice using Creating templates, inserting drawings, Layers and Modify Layers. Viewing Drawing in viewports in layout space. Exposure of 3D modelling. 182. Preparation of Daily, weekly and monthly inspection and maintenance schedules of mechanical equipment.	
ENGINEERING DRAWING: 40 Hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work.	Reading of Electrical Sign and Symbols. Sketches of Electrical components. Reading of Electrical wiring diagram and Layout diagram. Reading of Electrical earthing diagram. Drawing the schematic diagram of plate and pipe earthing. Drawing of Electrical circuit diagram. Drawing of Block diagram of Instruments & equipment of trades.	
WORKSHOP CALCULATION & SCIENCE: 32 Hrs.			
Professional Knowledge WCS- 32 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Friction** Friction - Lubrication **Algebra** Algebra - Addition, subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems **Elasticity** Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus **Profit and Loss** Profit and loss - Simple problems on profit & loss	

		Profit and loss - Simple and compound interest **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade. Estimation and costing - Problems on estimation and costing
Project Work/ Industrial Visit: - **Broad Area:** a) Gates through working models including chain block, pulley and Gear box. b) Switching operations in power plants c) Monitoring requirements in power plants d) Maintenance of power plant e) Testing of power plant equipment f) Build models of power plant		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 hrs + 60 hrs)

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

ANNEXURE-I

List of Tools & Equipment			
Small Hydro Power Plant Technician (for batch of 20 candidates)			
Sl. No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Allen Key set of 12 pieces	2mm to 14mm	(20 +1) Nos.
2.	Box drawing instrument	containing one 1.5 cm compass with pin point, pin point & lengthening bar, one pair spring bows, rotating compass with interchangeable ink and pencil points, drawing pens with plain point & cross point, screw driver and box of leads. (0.2.0.3,0.4 mm).	(20 +1) Nos.
3.	Calliper inside with spring	15 cm	(20 +1) Nos.
4.	Calliper outside with spring	15 cm	(20 +1) Nos.
5.	Combination Plier Insulated	200 mm	(20 +1) Nos.
6.	Electrician screwdriver thin stem insulated handle	4mm X 100 mm, 4mm X 250 mm	(20 +1) Nos. each
7.	Hammer ball peen with handle	0.5 kg, 250 grams	(20 +1) Nos. each
8.	Hands file for Second cut flat	20 cm.	(20 +1) Nos.
9.	Heavy Duty Screwdriver insulated	5mm X 200 mm	(20 +1) Nos.
10.	Knife Double Bladed Electrician	100 mm	(20 +1) Nos.
11.	Measuring Steel Tape	5 meters	(20 +1) Nos.
12.	Neon Tester	500 V	(20 +1) Nos.
13.	Philips Screw Driver set of 5 pieces	100 mm to 300 mm	(20 +1) Nos.
14.	Pliers combination	20 cm.	(20 +1) Nos.
15.	Protractor celluloid	15 cm semi- circular.	(20 +1) Nos.
16.	Punch Centre	9mm X 150 mm	(20 +1) Nos.
17.	Scale card board	metric set of eight A to H in a box 1: 1, 1:2, 1:2.5, 1:5. 1:10, 1:20, 1:50. 1:100, 1:200, 1:500. 1:1000, 1:2000, 1:1250. 1:6000, 1:38 1/3; 1:66, 2/3	(20 +1) Nos.
18.	Scales plotting box wood 6 metric scales	30 cms long with offset scales.	(20 +1) Nos.
19.	Screw driver Blade	20cm. x 9mm.	(20 +1) Nos.
20.	Screw driver Blade	30 cm. x 9 mm.	(20 +1) Nos.

21.	Screwdriver Insulated	4mm X 150 mm, Diamond Head	(20 +1) Nos.
22.	Screwdriver Insulated	6mm X 150 mm	(20 +1) Nos.
23.	Scriber	15 cm	(20 +1) Nos.
24.	Set square celluloid	25 cm, 2mm thick with beveled edges 45 degrees.	(20 +1) Nos.
25.	Set square transparent	20 cm. 2 mm thick with beveled edges 45 degree	(20 +1) Nos.
26.	Spanner D.E. set of 12 pieces	6mm to 32mm	(20 +1) Nos.
27.	Spanner, ring set of 12	6 to 32 mm. (metric)	(20 +1) Nos.
28.	Steel rule	30 cm inch and metric	(20 +1) Nos.
29.	Steel Rule Graduated both in Metric and English Unit	300 mm with precision of 1/4th mm	(20 +1) Nos.
30.	Template -Architects and builders		(20 +1) Nos.
31.	T-Square.	1250mm/Mini drafter' Parallel Bar	(20 +1) Nos.
B. SHOP TOOLS & EQUIPMENT – For 2 (1+1) units no additional items are required			
(i) List of Tools & Accessories			
32.	Adjustable spanner (pipe wrench)	350 mm	2 Nos.
33.	Air ratchet with standard accessories		4 Nos.
34.	Allen Key alloy steel	1.5-10 mm (set of 9)	1 Set
35.	Angle plate adjustable	250x150x175mm	1 No.
36.	Angle plate size	200x100x200mm	2 Nos.
37.	Anvil with Stand	50 Kgs	1 No.
38.	Bearing Puller (inside and outside)	200 mm	1 No. each
39.	Blow lamp brass	0.5 ltr	1 No.
40.	Bradawl		2 Nos.
41.	Brake Test arrangement with two spring balance rating	0 to 25 kg	1 No.
42.	Bus bar with brackets	1 mtr each	3 Nos.
43.	C- Clamp	200 mm and 100 mm	2 Nos. each
44.	Capacitors	Electrolytic	2 Each
	Coaxial Cable		
	Direct-Buried Cable		
45.	Chisel Cold	25 mm X 200 mm	2 Nos.
46.	Chisel firmer with wooden Handle	6 mm X 200 mm	2 Nos.
47.	Chisels cross cut	200 mm x 6mm	4 Nos.
48.	Circlip pliers Expanding and contracting	15cm and 20cm	4 each

49.	Clamps C	100mm, 150mm, 200mm	2 Nos. each
50.	Contactor & auxiliary contacts	3 phase, 415 Volt, 25 Amp with 2 NO and 2 NC	2 Nos. each
51.	Crimping Tool	1.5 sq mm to 16 sq mm	2 Nos.
		16 sq mm to 95 sq mm	2 Nos.
52.	Copper bit soldering iron.	0.25 kg	2 Nos.
53.	D.E. metric Spanner Double Ended	6 - 32 mm	2 Set
54.	De soldering Gun	Heat proof nozzle, PVC type, 250mm	4 Nos.
55.	Dial gauge type 1 Gr. A	Complete with clamping devices and with magnetic stand	4 Nos.
56.	Divider	150 mm spring type	2 Nos.
57.	Dividers with Spring	15 cm	4 Nos.
58.	Drift Punch Copper	15 Cm	4 Nos.
59.	Drill hand brace	0-100mm	4 Nos.
60.	Drill point angle gauge		1 No.
61.	Drill S.S. Twist block	2 mm, 5 mm and 6 mm set of 3	4 Set
62.	Drill twist (various sizes)	1.5 mm to 15 mm by 0.5mm	4 Nos.
63.	ELCB and RCCB	25Amps, double pole and 25Amps, double pole, IΔn 30 mA	1 Each
64.	Electrician Helmet	Yellow Colour	2 Nos.
65.	Engineer's square	Blade size 15 cm	4 Nos.
66.	Feeler gauge 20 blades (metric)		4 Nos.
67.	File flat	200 mm 2nd cut with handle	8 Nos.
68.	File flat , bastard	20 cm	4 Nos.
69.	File flat bastard	250 mm with handle	4 Nos.
70.	File flat rough	150 mm with handle	4 Nos.
	File flat smooth	250 mm with handle	4 Nos.
71.	File half round	200 mm 2nd cut with handle	4 Nos.
72.	File Rasp, half round	200 mm bastard with handle	4 Nos.
73.	File round	200 mm 2nd cut with handle	4 Nos.
74.	File, half round, second cut	20 cm	4 Nos.
75.	File, Square round	30 cm	4 Nos.
76.	File, Square second cut	20 cm	4 Nos.
77.	File, triangular, second cut	15 cm	4 Nos.
78.	Files assorted sizes and types including safe edge file		(20 Nos)
79.	Flat File, bastard	35 cm	4 Nos.
80.	Flat File, second cut	25 cm	4 Nos.
81.	Fuses	HRC	4 Each
		Glass	
		Rewire Type	

82.	Gauge, wire imperial stainless steel marked in SWG & mm	Wire Gauge - Metric	4 Nos.
83.	Gloves for Welding	Leather and Asbestos	5 Sets
84.	Granite surface plate with stand and cover	1600 x 1000mm	1 No.
85.	Grease Gun	0.5 ltr. Capacity	1 No
86.	Geometrical models (wooden/plastic)	i) Cube 08 cm sides.	
		ii) Rectangular parallel piped 8cm x 15cm	
		iii) Sphere 8cm dia.	
87.	Hacksaw frame	Adjustable 20-30 cm	12 Nos.
88.	Hammer Ball Peen	0.75 Kg	4 Nos.
89.	Hammer Chipping	0.25 Kg	5 Nos.
90.	Hammer copper with handle	1 Kg	4 Nos.
91.	Hammer Extractor type	250 grams	4 Nos.
92.	Hammer Mallet		4 Nos.
93.	Hammer Plastic		4 Nos.
94.	Hand Drill Machine	0-6 mm capacity	2 Nos.
95.	Hand operated crimping tool	up to 4mm, up to 10mm	2 Each
96.	Hand reamers adjustable	10.5 to 11.25 mm, 11.25 to12.75 mm, 12.75 to 14.25 mm and 14.25 to 15.75 mm	2 Set
97.	Hand Shear Universal	250mm	2 Nos.
98.	Hand vice	Up to 37 mm	2 Nos.
99.	Hand Vice	50 mm jaw	4 Nos.
100.	Hollow Punch set of seven pieces	6mm to 15mm	2Set
101.	Hydrometer		2 Nos.
102.	Insulated Screw driver	20 cm x 9mm blade	4 Nos.
103.	Insulated Screw driver	30 cm x 9mm blade	4 Nos.
104.	Knife Switch DPDT fitted with fuse terminals	16 Amp	4 Nos.
105.	Knife Switch TPDT fitted with fuse terminals	16 Amp/ 440 V	4 Nos.
106.	Laboratory Type Induction Coil	1000 W	2 Nos.
107.	Left cut snips	250mm	4 Nos.
108.	Lifting jack screw	3 Ton, 5Ton & 20 Ton	1 Each
109.	Limit Switch	Limit Switch, Liver operated 2A 500v, 2-contacts	2 Nos.
110.	Load Bank (Lamp / heater Type)	6 KW, 3Ph	1 No.
111.	Magneto spanner set with 8 spanners		1Set

112.	Magnifying glass	75mm	2 Nos.
113.	Mallet hard wood	0.50 kg	4 Nos.
114.	Marking out table	90 x 60 x 90 cm.	1 No.
115.	MCCB	100Amps, Triple pole	1 No.
116.	Miniature Breaker	16 amp	2 Nos.
117.	Oil Can	250 ml	2 Nos.
118.	Oil pump for dismantling and assembling.		2 Nos.
119.	Out Side Micrometer	0 - 25 mm least count 0.01mm	2 Nos.
120.	Pin Type, shackle type, egg type & suspension type insulators including hardware fitting		2 Nos. each
121.	Pincer	150 mm	4 Nos.
122.	Pipe vice Cast Iron with hardened jaw open type	100 mm	2 Nos.
123.	Plane cutters	50 mm X 200mm	2 Nos.
124.	Pliers flat nose insulated	200 mm	4 Nos.
125.	Pliers long nose insulated	150 mm	4 Nos.
126.	Pliers round nose insulated	100 mm	4 Nos.
127.	Plug socket Piano Switch Lamp Holder	230 V, 5 A	2 Each
128.	Portable Electric Drill Machine	0-12 mm capacity 750w, 240v with chuck and key	1 No.
129.	Pully Puller with 3 legs	150 mm & 300mm	1 each
130.	Relay- a. Cut out Relays b. Reverse current c. Over current d. Under voltage	a. 16A, 440V b. 16A, 440V c. 16A, 440V d. 360V-440V	2 No. each
131.	Rheostat (Sliding type)	0 - 25 Ohm, 2 Amp 0 - 300 Ohm, 2 Amp 0 -1 Ohm, 10Amp 0 -10 Ohm, 5 Amp	1 No. each
132.	Rotary Switch	16 A/440v	2 Nos.
133.	Rubber mat	2’ x 4’ x 1”	2 Nos.
134.	Safety Belt	Standard quality	2 Nos.
135.	Scissors blade, SS	200mm, 150mm	4 Nos. each
136.	Series Test Lamp	230V, 60W	4 Nos.
137.	Smoothing cutters	50 mm X 200mm	2 Nos.
138.	Snip Straight and Bent heavy duty	250 mm	2 Nos. each

139.	Spanner Adjustable drop forged, SS	150 mm & 300mm	2 Nos. each
140.	Secondary Cu Strip 20x5mm		
141.	Table Vice	100 mm jaw	8 Nos.
142.	Thermometer Digital	0° C - 150° C	1 No.
143.	Try Square	150 mm blade	4 Nos.
144.	Tweezers	150 mm	4 Nos.
145.	Wire Cutter and Stripper	150 mm	4 Nos.
146.	Brass parallel rulers in a case		04 Nos.
147.	Calculator Scientific (Nonprogrammable)		04 Nos.
148.	Flexible curves	80 cm long	04 Nos.
149.	French curves	transparent plastic set of 12	04 Nos.
150.	Land measuring chain	30 meters with two handles	04 Nos..
151.	Proportional dividers	15 cm	04 Nos.
152.	Radius curve metric	3 mm to 15 mm	04 Nos.
153.	Steel tape 30 meters long in a leather case	Steel tape 30 meters long in a leather case	
154.	Ranging rod wooden fitted	2 mt. long	
155.	iron shoe		
156.	Steel arrow, wooden peg,		As required
157.	wooden mallet, hammer		
158.	Prismatic compass with stand	110 mm dia.	01 set
159.	Dumpy Level with all accessories		01 set
160.	Auto level with all accessories		02 Nos
161.	Levelling staff	4 mt. leading to 5 mt. telescopic type	01 telescopic and 02 straight pieces
162.	Instrument for Total Station	Graphic LCD display on both side. Multi-function key board on both sides. Able to interchange data between GPS and Total station without any data conversion. Minimum 8 hours rechargeable li-ion battery. Poles and Prism	02Nos. each
163.	Hand held GPS	(latest uncertainly model) with ±2mm specification	02 Nos.
164.	Chemical compound for fasteners		As required
165.	Different type gasket material		As required
166.	Different type of oil seal		As required
167.	Drill Twist (assorted)		As required

168.	Emery paper - 36–60 grit , 80–120		As required
169.	Engine oil & Engine coolant		As required
170.	Gear oils		As required
171.	Gloves for Welding (Leather and		
172.	Asbestos		As required
173.	Holders, lamp teakwood boards, plug sockets,		As required
174.	Ohm Meter; Series Type & Shunt Type, portable box type	50/2000-ohm analog	2 Nos. each
175.	Digital Multi Meter	DC 200mv -1000v,0 – 10A & AC 200mv-750v , 0-10A, resistance 0-20 MΩ and 3 1/2 digit	12 Nos.
176.	A.C. Voltmeter M.I. analog, portable box type housed in Bakelite case	Multi range 75 V - 150V - 300V - 600V	3 Nos.
177.	Milli Voltmeter centre zero analog, portable box type housed in Bakelite case	100 – 0 – 100 mV	2 Nos.
178.	Ammeter MC analog, portable box type housed in Bakelite case	0 - 500 mA, 0-5 A, 0-25 A	2 Nos. each
179.	AC Ammeter MI, analog, portable box type housed in Bakelite case	0 - 1 A, 0-5 A, 0-25 A	2 Nos. each
180.	Kilo Wattmeter Analog	0-1.5-3KW, pressure coil rating-240v/440v, current rating-5A/10A Analog, portable type Housed in Bakelite case	2 Nos.
181.	Digital Wattmeter	230 V, 1 KW, 50 Hz	2 Nos.
182.	A.C. Energy Meter	Single Phase, 10 A, 240 V induction type	2 Nos.
183.	A.C. Energy Meter	Three Phase, 15 A , 440 V induction type	2 Nos.
184.	Power Factor Meter Digital	440 V, 20 A, Three Phase portable box type	2 Nos.
185.	Frequency Meter	45 to 55 Hz	2 Nos.
186.	Magnetic Flux Meter	0-500 tesla	2 Nos.
187.	Lux meter	lux meter LCD read out 0.05 to 7000 lumens with battery.	2 Nos.
188.	Tachometer	Analog Type - 10000 RPM	1 No.
189.	Tachometer	Digital Photo Sensor Type - 10000 RPM	1 No.
190.	Tong Tester / Clamp Meter	0 - 100 A (Digital Type)	2 Nos.

191.	Megger	Analog - 500 V	2 Nos.
192.	Wheat Stone Bridge with galvanometer and battery		2 Nos.
193.	Single Phase Variable Auto Transformer	0 - 270 V, 10Amp (Air cooled)	2 Nos.
194.	Phase Sequence Indicator	3 Phase, 415 V	2 Nos.
195.	Growler	230 V, 50 Hz, Single Phase, Adjustable jaws, Testing armature with ampere meter and testing probes.	1 No.
196.	AC Starters: -	For A.C Motors of 2 to 5 H.P.	1 No. each
	a. Resistance type starter		
	b. Direct online Starter		
	c. Star Delta Starter- Manual		
	d. Star Delta Starter – Semi automatic		
	e. Star Delta Starter – Fully automatic		
	f. Star Delta Starter - Soft starter		
	g. Auto Transformer type		
197.	Soldering Iron	25-Watt, 65 Watt and 120-Watt, 230 Volt	2 Nos. each
198.	Temperature controlled Soldering Iron	50-Watt, 230 Volt	2 Nos.
199.	Oil Testing Kit	Oil Testing Kit 230 V, single phase 50 Hz 60 VA output 0-60 KV Variable	1 No.
200.	Voltage Stabilizer	AC Input - 150 - 250 V, 600 VA AC Output - 240 V, 10 A	1 No.
201.	DC Power Supply	0 - 30 V, 5 A	2 Nos.
202.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30amp	1 No.
203.	Current Transformer	415 V, 50Hz, CT Ratio 25 / 5 A, 5VA	2 Nos.
204.	Potential Transformer	415 V, 50Hz, PT Ratio, 440V/110V, 10VA	2 Nos.
205.	Desktop Computer or latest	2.8 GHz & above, 4 GB RAM, 500 GB HDD, DVD Combo Drive, 19/21" Monitor, optical scroll mouse, multimedia keyboard, LAN card with UPP port, necessary Drivers, etc. OR Latest Version	2 Nos.
206.	Ink jet/ laser printer		1 No.
C. Shop Machinery - For 2 (1+1) units no additional items are required			

207.	Motor Generator (DC to AC) set consisting of - Shunt Motor with starting compensator and switch directly coupled to AC generator with exciter and switch board mounted with regulator, breaker, ammeter, voltmeter frequency meter, knife blade switch and fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts and flexible coupling.	Shunt Motor rating: 5 HP, 440V AC Generator rating: 3-Phase, 4 wire, 3.5 KVA, 400/230 Volts, 0.8 pf, 50cycles	1 No.
208.	AC Squirrel Cage Motor with star delta starter and triple pole iron clad switch fuse with Mechanical Load.	5 HP, 3-Phase, 415 V, 50 Hz	1 No.
209.	AC phase-wound slip ring Motor with starter switch	5 HP, 440 V, 3 Phase, 50 Hz	1 No.
210.	Universal Motor with starter/switch	240 V, 50 Hz, 1 HP	1 No.
211.	Single phase Transformer, core type, air cooled	1 KVA, 240/415 V, 50 Hz	3 Nos.
212.	Three phase transformer, shell type oil cooled with Delta/ Star	3 KVA, 415/240 V, 50 Hz	2 Nos.
213.	Electrical Machine Trainer –	Suitable for demonstrating the construction and functioning of different types of AC machines (single phase and three phase). Should be fitted with friction brake arrangement, dynamo meter, instrument panel and power supply unit	1 for 8 , (4+4) Units
214.	Diesel Generator Set with changeover switch, over current breaker and water/ air-cooled with armature, star-delta connections AC 3 phase	7.5 KVA, 415 volt or higher rating	1 No. per institute
215.	Pillar Electric Drill Machine Motorized	12-20 mm Capacity, 1HP, 440V, 3 phase, Induction Motor with DOL starter, Bench Type	1 No.
216.	Motorized Bench Grinder	1 HP. 3 phase, 440V with DOL starter, Double side with smooth and rough wheel with Tool Base	1 No.

217.	A.C. Series type Motor	1 HP, 240 V, 50 Hz	1 No.
218.	Single Phase Capacitor Motor with starter switch	1 HP, 240 V, 50 Hz	1 No.
D. Shop Floor Furniture and Materials			
219.	Working Bench	2.5 m x 1.20 m x 0.75 m	4 Nos.
220.	Wiring Board	3-meter x1 meter with 0.5-meter projection on the top	1 No.
221.	Instructor's table		1 No.
222.	Instructor's chair		2 Nos.
223.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
224.	Lockers with drawers		1 for Each Trainee
225.	Almirah	2.5 m x 1.20 m x 0.5 m	1 No.
226.	Black board/white board	(minimum 4x6 feet)	1 No.
227.	Fire Extinguisher CO_2	2 KG	2 Nos.
228.	Fire Buckets	Standard size	2 Nos.

Note: -

1. All the tools and equipment are to be procured as per BIS specification.
2. Internet facility is desired to be provided in the class room.

ABBREVIATIONS

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


कौशलं बलम्