

# WELDER

NSQF LEVEL - 6



**SECTOR- CAPITAL GOODS & MANUFACTURING**

**COMPETENCY BASED CURRICULUM**  
**CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**



GOVERNMENT OF INDIA

Ministry of Skill Development & Entrepreneurship  
Directorate General of Training

**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**

EN-81, Sector-V, Salt Lake City, Kolkata – 700091

# WELDER

**(Engineering Trade)**

Also applicable for “Welder (GMAW & GTAW)”, “Welder (Pipe)”, “Welder (Structural)”, “Welder (Fabrication & Fitting)” and “Welder (Welding & Inspection)” Trades

## SECTOR –CAPITAL GOODS & MANUFACTURING

**(Revised in 2019)**

**Version 1.1**

### **CRAFT INSTRUCTOR TRAINING SCHEME (CITS)**

**NSQF LEVEL - 6**

Developed By

Government of India  
Ministry of Skill Development and Entrepreneurship

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## 1. COURSE OVERVIEW

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The Craft Instructor Training Scheme is operational since inception of the Craftsmen Training Scheme. The first Craft Instructor Training Institute was established in 1948. Subsequently, 6 more institutes namely, Central Training Institute for Instructors (now called as National Skill Training Institute (NSTI)), NSTI at Ludhiana, Kanpur, Howrah, Mumbai, Chennai and Hyderabad were established in 1960 by DGT. Since then the CITS course is successfully running in all the NSTIs across India as well as in DGT affiliated institutes viz. Institutes for Training of Trainers (IToT). This is a competency based course for instructors of one year duration. “Welder” CITS trade is applicable for Instructors of “Welder”, “Welder (GMAW & GTAW)”, “Welder (Pipe)”, “Welder (Structural)”, “Welder (Fabrication & Fitting)” and “Welder (Welding & Inspection)” Trades under CTS.

The main objective of Craft Instructor training programme is to enable Instructors explore different aspects of the techniques in pedagogy and transferring of hands-on skills so as to develop a pool of skilled manpower for industries, also leading to their career growth & benefiting society at large. Thus promoting a holistic learning experience where trainee acquires specialized knowledge, skills & develops attitude towards learning & contributing in vocational training ecosystem.

This course also enables the instructors to develop instructional skills for mentoring the trainees, engaging all trainees in learning process and managing effective utilization of resources. It emphasizes on the importance of collaborative learning & innovative ways of doing things. All trainees will be able to understand and interpret the course content in right perspective, so that they are engaged in & empowered by their learning experiences and above all, ensure quality delivery.

## 2. TRAINING SYSTEM

### 2.1 GENERAL

CITS courses are delivered in National Skill Training Institutes (NSTIs) & DGT affiliated institutes viz., Institutes for Training of Trainers (IToT). For detailed guidelines regarding admission on CITS, instructions issued by DGT from time to time are to be observed. Further complete admission details are made available on NIMI web portal <http://www.nimionlineadmission.in>. The course is of one-year duration. It consists of Trade Technology (Professional skills and Professional knowledge), Training Methodology and Engineering Technology/ Soft skills. After successful completion of the training programme, the trainees appear in All India Trade Test for Craft Instructor. The successful trainee is awarded NCIC certificate by DGT.

### 2.2 COURSE STRUCTURE

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

S No.	Course Element	Notional Training Hours
1.	<b>Trade Technology</b>	
	Professional Skill (Trade Practical)	640
	Professional Knowledge (Trade Theory)	240
2.	<b>Engineering Technology</b>	
	Workshop Calculation & Science	80
	Engineering Drawing	120
3.	<b>Training Methodology</b>	
	TM Practical	320
	TM Theory	200
	<b>Total</b>	<b>1600</b>

### 2.3 PROGRESSION PATHWAYS

- Can join as an Instructor in a vocational training Institute/ technical Institute.
- Can join as a supervisor in Industries.

### 2.4 ASSESSMENT & CERTIFICATION

The CITS trainee will be assessed for his/her Instructional skills, knowledge and attitude towards learning throughout the course span and also at the end of the training program.

a) The Continuous Assessment (Internal) during the period of training will be done by **Formative Assessment Method** to test competency of instructor with respect to assessment criteria set against each learning outcomes. The training institute has to maintain an individual trainee portfolio in line with assessment guidelines. The marks of internal

assessment will be as per the formative assessment template provided on [www.bharatskills.gov.in](http://www.bharatskills.gov.in)

b) The **Final Assessment** will be in the form of **Summative Assessment Method**. The All India Trade Test for awarding National Craft Instructor Certificate will be conducted by DGT at the end of the year as per the guidelines of DGT. The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The external examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

### 2.4.1 PASS CRITERIA

S No.	Subject		Marks	Internal Assessment	Full Marks	Pass Marks	
						Exam	Internal Assessment
1.	Trade Technology	Trade Theory	100	40	140	40	24
		Trade Practical	200	60	260	120	36
2.	Engineering Technology	Workshop Cal. & Sc.	50	25	75	20	15
		Engineering Drawing	50	25	75	20	15
3.	Training Methodology	TM Practical	200	30	230	120	18
		TM Theory	100	20	120	40	12
Total Marks			<b>700</b>	<b>200</b>	<b>900</b>	<b>360</b>	<b>120</b>

The minimum pass percent for Trade Practical, TM practical Examinations and Formative assessment is 60% & for all other subjects is 40%. There will be no Grace marks.

### 2.4.2 ASSESSMENT GUIDELINE

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking the assessment. While assessing, the major factors to be considered are approaches to generate solutions to specific problems by involving standard/non-standard practices.

Due consideration should also be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising of the following:

- Demonstration of Instructional Skills (Lesson Plan, Demonstration Plan)
- Record book/daily diary

- Assessment Sheet
- Progress chart
- Video Recording
- Attendance and punctuality
- Viva-voce
- Practical work done/Models
- Assignments
- Project work

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

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of an <b>acceptable standard</b> of crafts instructorship with <b>occasional guidance</b> and engage students by demonstrating good attributes of a trainer.	<ul style="list-style-type: none"> <li>• Demonstration of <b>fairly good</b> skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Average engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A fairly good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.</li> <li>• Occasional support in imparting effective training.</li> </ul>
(b) Weightage in the range of 75%-90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a <b>reasonable standard</b> of crafts instructorship with <b>little guidance</b> and engage students by demonstrating good attributes of a trainer.	<ul style="list-style-type: none"> <li>• Demonstration of <b>good</b> skill to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Above average in engagement of students for learning and achievement of goals while undertaking the training on specific topic.</li> <li>• A good level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.</li> <li>• Little support in imparting effective training.</li> </ul>
(c) Weightage in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate should be well versed with instructional design, implement learning programme and assess learners which demonstrates attainment of a <b>high</b>	<ul style="list-style-type: none"> <li>• Demonstration of <b>high</b> skill level to establish a rapport with audience, presentation in orderly manner and establish as an expert in the field.</li> <li>• Good engagement of students for learning</li> </ul>

**standard** of crafts instructorship with **minimal or no support** and engage students by demonstrating good attributes of a trainer.

and achievement of goals while undertaking the training on specific topic.

- A high level of competency in expressing each concept in terms the student can relate, draw analogy and summarize the entire lesson.
- Minimal or no support in imparting effective training.



### 3. GENERAL INFORMATION

<b>Name of the Trade</b>	<b>WELDER - CITS</b>
<b>Trade Code</b>	<b>DGT/ 4005</b>
<b>Reference NCO 2015</b>	2356.0100, 7212.0100, 7212.0200, 7212.0700, 7212.0400, 7212.0500, 7212.0105, 7212.0303, 7212.0111, 7212.0402.
<b>NSQF Level</b>	Level-6
<b>Duration of Craft Instructor Training</b>	One Year
<b>Unit Strength (No. Of Student)</b>	25
<b>Entry Qualification</b>	<p>Degree in Mechanical/Production/ Metallurgy / Mechatronics Engineering from recognized University.</p> <p style="text-align: center;">OR</p> <p>Diploma in Mechanical/Production/Metallurgy/Mechatronics Engineering from recognized Board / University.</p> <p style="text-align: center;">OR</p> <p>National Trade Certificate in Welder or related trades.</p> <p style="text-align: center;">OR</p> <p>National Apprenticeship Certificate in Welder or related trades.</p>
<b>Minimum Age</b>	18 years as on first day of academic session.
<b>Space Norms</b>	120 Sq. m
<b>Power Norms</b>	20 KW
<b>Instructors Qualification for</b>	
<b>1. Welder -CITS Trade</b>	<p>B.Voc./Degree in Mechanical / Production Engineering from AICTE/UGC recognized Board / University with two years experience in relevant field.</p> <p style="text-align: center;">OR</p> <p>03 years Diploma in Mechanical / Production Engineering from AICTE/ recognized Board/ University or relevant Advanced Diploma (Vocational) from DGT with Five years experience respectively.</p> <p style="text-align: center;">OR</p> <p>NTC/ NAC in relevant trade with seven years experience.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in welder trade, in any of the variants under DGT.</p>
<b>2. Workshop Calculation &amp; Science</b>	<p>B.Voc/Degree in any Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field.</p> <p style="text-align: center;">OR</p> <p>3 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT</p>

	<p>with five years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any Engineering trade with seven years experience in relevant field.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;"><b>OR</b></p> <p>NCIC in RoDA or any of its variants under DGT.</p>					
<b>3. Engineering Drawing</b>	<p>B.Voc/Degree in Engineering from AICTE/ UGC recognized Engineering College/ university with two years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>03 years Diploma in Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with five years' experience in the relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any one of the 'Mechanical group (Gr-I) trades categorized under Engg. Drawing' / D'man Mechanical / D'man Civil' with seven years experience.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in relevant trade.</p> <p style="text-align: center;"><b>OR</b></p> <p>NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.</p>					
<b>4. Training Methodology</b>	<p>B.Voc./Degree in any discipline from AICTE/ UGC recognized College/ university with two years experience in training/ teaching field.</p> <p style="text-align: center;"><b>OR</b></p> <p>Diploma in any discipline from recognized board / University with five years experience in training/teaching field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC passed in any trade with seven years experience in training/ teaching field.</p> <p><b><u>Essential Qualification:</u></b> National Craft Instructor Certificate (NCIC) in any of the variants under DGT / B.Ed /ToT from NITTTR or equivalent.</p>					
<b>5. Minimum Age for Instructor</b>	21 years					
<b>Distribution of training on Hourly basis: (Indicative only)</b>						
<b>Total Hrs /week</b>	<b>Trade Practical</b>	<b>Trade Theory</b>	<b>Workshop Cal. &amp; Sc.</b>	<b>Engg. Drawing</b>	<b>TM Practical</b>	<b>TM Theory</b>
40 Hours	16 Hours	6Hours	2 Hours	3 Hours	8 Hours	5 Hours

## 4. JOB ROLE

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### Brief description of job roles:

**Manual Training Teacher/Craft Instructor;** instructs students in ITIs/Vocational Training Institutes in respective trades as per defined job role. Imparts theoretical instructions for the use of tools & equipments of related trades and related subjects. Demonstrate process and operations related to the trade in the workshop; supervises, assesses and evaluates students in their practical work. Ensures availability & proper functioning of equipment and tools in stores.

**Welder while doing gas welding;** fuses metal parts together using welding rod and oxygen acetylene flame. Examines parts to be welded, cleans portion to be joined, holds them together by some suitable device and if necessary makes narrow groove to direct flow of molten metal to strengthen joint. Selects correct type and size of welding rod, nozzle etc. and tests welding, torch. Wears dark glasses and other protective devices while welding. Releases and regulates valves of oxygen and acetylene cylinders to control their flow into torch. Ignites torch and regulates flame gradually. Guides flame along joint and heat it to melting point, simultaneously melting welding rod and spreading molten metal along joint shape, size etc. and rectifies defects if any.

**Welder, Electric;** fuses metals using arc-welding apparatus and electrodes (welding material). Examines parts to be welded, cleans them and sets joints together with clamps or any other suitable device. Starts generator or transformer (welding apparatus and regulates current according to material and thickness of welding. Clamps one lead (insulated wire carrying current from generator) to part to be welded, selects required type of electrode and clamps it to holder connected with other lead). Generates sparks between electrode and joint, simultaneously guiding and depositing melting electrode uniformly for welding. Takes precautionary measures such as wearing rubber gloves, holding welding screen of dark glass etc. May join parts first at various points for holding at specified angles, shape, form and dimension.

**Welder, Resistance;** sets up and operates resistance welding machine to join metal parts, according to blueprints, work orders, or oral instructions. Turns machine dials to set air and hydraulic pressure, amperage, and joining time, according to specified type of metal, weld, and assembly. May select, install, and adjust electrodes. Aligns work pieces, using square and rule. May hold pieces together manually, fasten into jigs, or secure with clamps to align in specified assembly position. Holds part between electrodes or positions on machine worktable. Depresses pedal or pulls trigger to close electrodes and form weld at point of contact. Releases pedal or trigger after specified welding time. Cleans electrodes, using file, tip dresser, emery cloth. May operate machine which automatically releases electrodes from metal after welding cycle. May devise and build fixtures to hold pieces. May inspect finished work. May operate machine equipped with two or more electrodes which weld at several points simultaneously. Important variations include types of joints welded (seam, spot, butt) and types of materials welded (aluminium, steel).

**Welder while doing gas cutting;** cuts metal to required shape and size by gas flame either manually or by machine. Examines material to be cut and marks it according to instruction of specification. Makes necessary connections and fits required size of nozzle in welding torch. Releases and regulates flow of gas in nozzle, ignites and adjusts flame. Guides flame by hand or machine along cutting line at required speed and cuts metal to required size.

**Welder while doing gas brazing;** joints metal parts by heating using flux and filler rods. Cleans and fastens parts to be joined face to face by wire brush. Apply flux on the joint and heats by torch to melt filler rods into joint. Allows it to cool down. Clean and examines the joint.

**Welder while doing Gas Tungsten Arc welding** also known as Tungsten Inert Gas (TIG) welding reads fabrication drawing, examines parts to be welded, cleans them and sets joints with clamps or any other suitable device. Selects suitable tungsten electrode, grinds the edges and fit in to the GTA welding torch. Selects gas nozzle and fit in to the GTA welding torch. Selects suitable filler rods and cleans them. Connects work piece with earth cable, Connects the machine with Inert gas Cylinder, regulator and flow meter. Starts the Constant current GTA welding machine, sets suitable welding current & polarity and inert gas flow. Establish arc through across a column of highly ionized inert gas between work piece and Tungsten electrode. Melts the metal and deposit weld beads on metal surfaces by passing the suitable filler rod in to the weld puddle. Joins metal pieces such as Steel, Stainless steel and Aluminium metals.

**Welder while doing Gas Metal Arc welding** also known as MIG/MAG Welding, reads fabrication drawing, examines parts to be welded, cleans them and sets joints with clamps or any other suitable device. Connects work piece with earth cable. Connects the machine with suitable gas Cylinder, regulator and flow meter. Connects pre-heater when CO<sub>2</sub> is used as shielding gas. Selects suitable wire electrode, feed it to welding GMA Welding torch through wire feeder. Selects contact tip gas nozzle and fit in to the GMA welding torch. Preheats joints as required. Starts the Constant Voltage GMA welding machine, sets suitable welding voltage & wire feed speed and shielding gas flow, produces arc between work piece and continuously fed wire electrode. Melts the metal and deposit weld beads on the surface of metals or joins metal pieces such as Steel, and Stainless steel metals.

**Repair Welder,** is responsible for maintaining and operating all welding related works. The individual must be able to use hand welding techniques or welding equipment and tools to join various metal components and also carry out repair work on machinery and equipment.

**Iron and Steel Plasma Cutter-Manual** cuts different materials (mild carbon steel, stainless steel, aluminium, high tensile and special steels, and other materials) in various profiles. This involves setting-up and preparing operations interpreting the right information from the specification documents, obtaining the right consumables and other materials, etc.

Welder while doing Arc welding, fuses metals using arc-welding power source and electrodes. Examines parts to be welded, cleans them and sets joints together with clamps or any other suitable device. Starts welding power source and regulates current according to material and thickness of welding. Connect one lead to part to be welded, selects required

type of electrode and clamps other lead to electrode holder. May join parts first at various points for holding at specified angles, shape, form and dimension by tack welding. Establish arc between electrode and joint and maintain it throughout the length of the joint.

**Reference NCO-2015:**

- a) 2356.0100 - Manual Training Teacher/Craft Instructor
- b) 7212.0100- Welder, Gas
- c) 7212.0200- Welder, Electric
- d) 7212.0700- Welder, Resistance
- e) 7212.0400- Gas Cutter
- f) 7212.0500-Brazer
- g) 7212.0105- Tungsten Inert Gas Welder
- h) 7212.0303 - Gas Metal Arc Welder/Metal Inert Gas/Metal Active Gas/Gas Metal Arc Welder (MIG/MAG/GMAW)
- i) 7212.0111- Repair Welder
- j) 7212.0402- Iron and Steel Plasma Cutter-Manual

## 5. LEARNING OUTCOME

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

### 5.1 TRADE TECHNOLOGY

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Monitor the oxy- acetylene cutting plant and perform different cutting operations on MS plate. [Different cutting operation – Straight, Bevel, circular].
3. Demonstrate the SMAW machine and perform different type of joints on M.S. And S.S. in different position observing standard procedure. [different types of joints- Fillet (Lap, T-joint, & Corner), Butt (Square butt & Single “V” butt); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G].
4. Monitor the gas welding plant and evaluate the joints in different metals (M.S., Aluminium, Copper, Brass, Stainless Steel sheet) and in different position. [Different position: - 1F, 2F, 3F, 1G, 2G, 3G.] by OAW.
5. Evaluate welding in different types of pipe joints [Butt Joint, Elbow, T- joint, angle (450) joint, flange joint] in 1G / DHP by OAW.
6. Demonstrate arc gouging operation to rectify the weld joints by SMAW and monitor hard facing of alloy steel components / MS rod by using hard facing electrode.
7. Analyze& perform brazing and Silver Brazing in different Joint (Square Butt Joint, Lap Joint, “T” joint, joint) on M.S. sheet and bell mouth joint on Tube (Brass & Copper) by OAW.
8. Assess welding in butt joint on MS pipe in different position (1G, 2G, 5G & 6G ) by SMAW using Liquid Penetrant Test during Root Pass & Cover Pass.
9. Demonstrate fusion Welding& Bronze Welding in Single “V” Butt joint on Cast Iron ( 6 mm thick) in 1G/ DHP by choosing appropriate welding process ( OAW & SMAW).
10. Demonstrate GMAW / FCAW machine and analyze welding in different types of joints [ Fillet Joints ( T-joint, lap, Corner), Butt Joints (Square & Single V) ] on different type of metals (M.S., S.S. sheet/plate by GMAW / FCAW in various positions [various positions- 1F, 2F, 3F,4F, 1G, 2G, 3G].
11. Monitor welding in T-joint, on M.S. Pipe in 1G / DHP by GMAW.
12. Demonstrate the GTAW machine and evaluate welding by GTAW in different types of joints on different metals in different position and check correctness of the weld. [different types of joints- Fillet (lap, T-joint, Corner), Butt (Square & V); different metals- Mild Steel., Aluminium, Stainless Steel; different position- 1F,2F, 3F, & 1G, 2G, 3G].
13. Monitor Tube Welding (M.S. to S.S. Tube) in Butt joint in 1G position by GTAW.
14. Plan & operate the Plasma Arc cutting machine and cut ferrous & non-ferrous metals.

15. Review and perform Resistance Spot welding, Seam welding and Submerged Arc Welding on different metals in different position and check correctness of the weld.].
16. Analyse& assess welded joints by different methods of testing.

## 6. COURSE CONTENT

SYLLABUS FOR WELDER - CITS TRADE			
TRADE TECHNOLOGY			
Duration	Reference Learning Outcome	Professional Skill (Trade Practical)	Professional Knowledge (Trade Theory)
Practical 16 Hrs  Theory 06 Hrs	Recognize & comply safe working practices, environment regulation and housekeeping.	<ol style="list-style-type: none"> <li>1. Familiarize with the Institute.</li> <li>2. Identify, select &amp; review machinery used in the trade.</li> <li>3. Implement &amp; monitor use of safety equipment and their applications etc.</li> </ol>	Importance of Welding in Industry Course objectives Safety precautions in Shielded Metal Arc Welding (SMAW), Oxy Acetylene Welding (OAW) and Oxy Acetylene Gas Cutting (OAGC) Fire and firefighting equipments.
Practical 16 Hrs  Theory 06 Hrs	Monitor the oxy-acetylene cutting plant and perform different cutting operations on MS plate. [Different cutting operation – Straight, Bevel, circular].	<ol style="list-style-type: none"> <li>4. Perform &amp; monitor Oxy-Acetylene gas cutting (manual) straight, bevel and circular cutting on Mild steel plate. (10 mm. thick).</li> <li>5. Assess weld joint preparation for fillet weld (Cutting to size, fit up, tack weld etc.).</li> </ol>	Introduction of Arc, Gas and other welding process and their applications. Oxy-Acetylene gas cutting of metals-cut ability, cutting parameters and faults in cutting
Practical 48Hrs  Theory 18Hrs	Demonstrate the SMAW machine and perform different type of joints on M.S. And S.S. in different position observing standard procedure. [different types of joints- Fillet (Lap, T-joint, & Corner), Butt (Square butt & Single "V" butt); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G].	<ol style="list-style-type: none"> <li>6. Review Lap, Tee and Corner joints on M.S. plate (10 mm. thick plate) in flat position by SMAW.</li> <li>7. Perform &amp; examine Single 'V butt joint on M.S. (10 mm. thick plate) in flat position by SMAW.</li> <li>8. Perform &amp; assess Lap, Tee and Corner joints on M.S. plate (10 mm. thick plate) in horizontal position by SMAW.</li> <li>9. Analyze &amp; construct Single 'V butt joint on M.S. (10 mm. thick plate) in horizontal position by SMAW.</li> <li>10. Practice &amp; review Lap, Tee and Corner joints on M.S. plate (10 mm. thick plate) in vertical position by SMAW.</li> <li>11. Make Single 'V butt joint on</li> </ol>	Basic electricity applicable to arc welding, Heat and temperature and its terms related to welding Principle of arc welding and characteristics of arc. Types of weld joints. Edge preparation.
			Arc welding power sources- AC welding Transformer -DC welding Motor generator set Welding Rectifier and inverter type welding machines. Advantages and disadvantages of A.C. and D.C. welding machines.
			Arc length - types - effects of arc length. Welding position - slope and rotation as per ASME and EURO standard.



		M.S. (10 mm. thick plate) in Vertical position by SMAW.	Polarity: Types and applications.
Practical 80Hrs	Monitor the gas welding plant and evaluate the joints in different metals (M.S., Aluminium, Copper, Brass, Stainless Steel sheet) and in different position. [Different position: - 1F, 2F, 3F, 1G, 2G, 3G.] by OAW.	12. Practice & review Lap, Tee and Corner joints on M.S. plate (10 mm. thick plate) in Overhead position by SMAW.	Arc blow and methods to control arc blow. Weld stresses, Distortion and methods of control.
Theory 30Hrs		13. Build & assess single 'V butt joint on M.S. (10 mm. thick plate) in overhead position by SMAW.	Arc Welding defects, causes and Remedies.
		14. Fabricate & evaluate square butt joint on M.S Sheet (2 mm. thick sheet) in flat position by OAW.	Common gases used for welding & cutting. Chemistry of Oxy-Acetylene flame. Types of Oxy-Acetylene flame and applications
		15. Analyze & make lap & Tee joint on M.S. Sheet (2 mm. thick sheet) in flat position by OAW.	
		16. Plan & make square butt joint on M.S Sheet (2 mm. thick sheet) in Horizontal position by OAW.	Production of calcium carbide. Acetylene gas properties, manufacturing methods Acetylene gas Purifier, Hydraulic back pressure valve and Flash back arrestor.
		17. Monitor & review Lap & Tee joint on M.S. Sheet (2 mm. thick sheet) in Horizontal position by OAW.	
		18. Construct & monitor Square butt joint on M.S Sheet (2 mm. thick sheet) in Vertical position by OAW.	Oxygen - properties - manufacturing methods. Oxygen and Acetylene gas cylinders-charging methods- Colour coding for different gas cylinders, safe handling and storage Gas pressure regulator, Gas welding and cutting blow pipe.
		19. Plan & make Lap & Tee joint on M.S. Sheet (2 mm. thick sheet) in Vertical position by OAW.	
		20. Make and examine Square But, Lap and Tee joints on M.S. Sheet 1.6 mm thick by brazing.	Gas welding techniques. Rightward and Leftward techniques. Gas welding filler rods, specifications and sizes. Gas welding fluxes - types and functions. Gas welding defects, causes and remedies.
		21. Plan & make square butt joint on Aluminium Sheet (3 mm. thick) in flat position by OAW.	Classification of steel. Welding of low, medium and high carbon steel and alloy steels
		22. Assess square butt joint on	

		copper Sheet (2 mm thick) in flat position by OAW.	Aluminium- properties and weldability, welding methods. Copper - types- properties and welding methods.
		23. Monitor Square butt joint on Brass Sheet (2 thick sheet) in flat position by OAW. 24. Evaluate square butt joint on Stainless steel (2 mm. thick sheet) in flat position by OAW Pipe butt joint on M.S. pipe outer dia. 50 mm x 3 mm. wall thickness in down hand position by OAW.	Brass - types - properties and welding methods. Stainless steel - types- weld decay and weldability
Practical 16 Hrs  Theory 06 Hrs	Evaluate welding in different types of pipe joints [Butt Joint, Elbow, T- joint, angle (45°) joint, flange joint] in 1G / DHP by OAW.	25. Assess pipe elbow and "T" joint on M.S. pipe outer dia. 50 mm x 3 mm wall thickness in down hand position by OAW. 26. Monitor Pipe welding 45 ° angle joint on MS pipe 0.50 and 3mm WT by OAW.	Development drawings for pipe Elbow joint. Development drawings for pipe 'T' Joint. Development drawings for pipe Branch 'Y' Joints.
Practical 16 Hrs  Theory 06 Hrs	Demonstrate arc gouging operation to rectify the weld joints by SMAW and Monitor hard facing of alloy steel components / MS rod by using hard facing electrode.	27. Analyze & construct Square Butt joint on S.S. Sheet 3 mm thick in flat position by SMAW. 28. Repair and review welds by Arc gouging and re-welding by SMAW. 29. Assess single 'V' butt joint on cast iron (6 mm. thick) in flat position by SMAW. 30. Analyze & perform hard surfacing practice on M.S. round rod 0. 25 mm by using Hard facing electrode.	Electrode - types - functions of flux, types of flux, coating factor, sizes of electrode. Coding of electrode as per IS and AWS. Criteria for selection of electrode. Effects of moisture pickup and backing of Electrodes.
Practical 16 Hrs  Theory 06 Hrs	Analyze & Perform Brazeing and Silver Brazeing in different Joint (Square Butt Joint, Lap Joint, "T" joint, joint) on M.S. sheet and bell mouth joint on Tube (Brass & Copper) by OAW.	31. Monitor Silver brazeing on S.S Sheet with copper sheet "T" joint. 32. Monitor Silver brazeing on copper tube to tube Bronze welding of cast iron (6mm. thick) in flat position By OAW.	Brazeing-principles, types of brazeing, applications, filler rods and fluxes, necessity of cleaning, brazeing parameters, brazeing techniques and cleaning.
Practical 80Hrs  Theory 30Hrs	Assess welding in butt joint on MS pipe in different position (1G, 2G, 5G & 6G ) by SMAW using Liquid Penetrant Test during Root Pass & Cover	33. Analyze Pipe butt joint on M.S. pipe outer dia. 50 mm x 3 mm. wall thickness in down hand position by SMAW. 34. Evaluate Pipe elbow & 'T' joint on M.S. pipe outer dia. 50 mm x 3 mm. wall thickness in	Introduction to pipe welding Difference between plate and pipe welding. Types of pipes and pipe schedule Preparation work before

	Pass.	down hand position by SMAW.	welding
		35. Assess Pipe welding 45 ° angle joint on MS pipe 0 50 and 3mm WT. by SMAW. 36. Construct Single "V" butt joint on M.S pipe in (schedule 40) in 1G position by SMAW. 37. Inspect and clear using LPI testing during Root pass and cover pass.	Basic pipe welding procedure uphill welding, downhill welding and horizontal welding Pipe welding position 1G, 2G, 5G & 6G
		38. Make Single "V" butt joint on M.S pipe (schedule 60) in 2G position by SMAW. 39. Inspect and clear using LPI testing during Root pass and cover pass.	Procedure for welding heavy wall pipes in 5G & 6G position welding
		40. Weld pipes (schedule 80) in 5G position by SMAW. 41. Inspect and clear using LPI testing during Root pass and cover pass.	Importance of pre heating, post heating and maintenance of inter pass temperature. Use of temperature indicating crayons
		42. Weld of pipes (schedule 80) in 6G position by SMAW. 43. Inspect and clear using LPI testing during Root pass and cover pass.	Welding symbols as per BIS & AWS. Reading of assembly drawings
Practical 32Hrs  Theory 12Hrs	Demonstrate fusion Welding & Bronze Welding in Single "V" Butt joint on Cast Iron (6 mm thick) in 1G/ DHP by choosing appropriate welding process (OAW & SMAW).	44. Monitor Fusion welding Single 'V butt joint on cast iron (6 mm. thick) in flat position by OAW. 45. Perform Bronze welding Single 'V butt joint on cast iron (6 mm. thick) in flat position by OAW.	Cast iron -types- properties and uses. Welding methods of cast iron.
		46. Weld joint preparation for pipe fillet welding pipe to pipe fillet weld on MS pipes by SMAW, position. 47. Illustrate study of Welding drawings. 48. Illustrate study of welding codes & standards.	Requirement for qualification in different codes Qualification procedure under various codes Different tests and inspection involved in qualification Pressure welding codes and standards (IBR,ASME etc.) Writing procedure for WPS and PQR
Practical 96Hrs  Theory	Demonstrate GMAW / FCAW machine and analyze welding in	49. Set up and monitor GMAW welding machine & accessories.	Safety precautions pertaining to GTAW & GMAW.

36Hrs	different types of joints [ Fillet Joints ( T-joint, lap, Corner), Butt Joints (Square & Single V) ] on different type of metals (M.S., S.S. sheet/plate by GMAW / FCAW in various positions [various positions- 1F, 2F, 3F,4F, 1G, 2G, 3G]	50. Perform & check Lap, Tee and Corner joints on M.S. plate (10 mm. thick plate) in flat position by GMAW.	Introduction to CO2 welding - equipment -accessories. Description of CO2 welding set with diagram Constant Voltage Power source for CO2 welding - working principle Advantages & Limitations of GMAW over other welding processes
		51. Construct & evaluate Single 'V' butt joint on M.S. (10 mm. thick plate) in flat position by GMAW.	
		52. Construct Lap, Tee and Corner joints on M.S. sheet (3 mm. thick plate) in Horizontal position by GMAW.	Power source & accessories Wire feed units - types - applications, limitations care and maintenance.
		53. Make Single 'V' butt joint on M.S. (10 mm. thick plate) in Horizontal position by GMAW.	
		54. Demonstrate fabrication of Lap, Tee and Corner joints on M.S. plate (sheet 6 mm. thick plate) in Vertical downward progression by GMAW.	Welding Gun-types, description of parts functions and maintenance. Modes of metal transfer - Dip or Short circuiting transfer, Spray transfer (free flight transfer) and Globular transfer (intermittent transfer) and applications. Welding parameters for GMAW M.S and Alloy steels-related Tables / data
		55. Make single 'V' butt joint on M.S. (10 mm. thick plate) in Vertical position by GMAW.	
56. Analyze & make Tee joint on M.S plate 10 mm thick plate by Vertical upward progression Lap, Tee and Corner joints on M.S. plate (10 mm. thick plate) in Overhead position by GMAW.	Welding wires used in CO2 welding -diameter - specification as per AWS and applications. Shielding gases & Gas mixtures, and its applications in GMAW Edge preparation and fit up of various thicknesses of metals for GMAW. Types of weld defects, causes and remedy in GMAW process		
57. Review Single 'V' butt joint on M.S. (10 mm. thick plate) in Over head position by GMAW.			
58. Monitor Single "V" joint by Flux cored Arc welding (on 12 mm thick plate) Lap & Square butt and T joint on S.S sheet. 2 mm thick by GMAW.	Flux cored arc welding - description, advantage Welding wire for Flux cored Arc Welding, types coding as per AWS and specification - Trouble shooting in MIG welding		
59. Evaluate Single "V" and fillet	Introduction to GTAW (TIG)		

		Tee joint on Aluminium plate (thickness 6 mm) by GMAW.	welding) equipment - advantages over SMAW and oxy-acetylene welding. GTAW: Power sources - high frequency unit, D.C. suppressor unit and uses.
Practical 16 Hrs  Theory 06 Hrs	Monitor welding in T-joint, on M.S. Pipe in 1G / DHP by GMAW.	60. Monitor & assess Tee Joints on MS Pipe 0 60 mm OD x 3 mm WT in flat position - Arc constant (Rolling) by GMAW.	Effect of polarity in DC TIG Welding and application of straight and reversed polarity. GTAW torches, types, parts and functions Edge preparation and fit up for TIG welding sheets, plates and pipes
Practical 80Hrs  Theory 30Hrs	Demonstrate the GTAW machine and evaluate welding by GTAW in different types of joints on different metals in different position and check correctness of the weld. [different types of joints- Fillet (lap, T-joint, Corner), Butt (Square & V) ; different metals- Mild Steel., Aluminium, Stainless Steel; different position- 1F,2F, 3F, & 1G, 2G, 3G].	61. Set and check GTAW welding machine & accessories. 62. Make Lap, Tee and Corner joint on MS sheet in down hand position by GTAW. 63. Assess the Square butt joint on MS in down hand position by GTAW.	Welding parameters and Tables & data relating to TIG welding. - Tungsten electrode, Types, sizes, and uses. coding as per AWS
		64. Construct Lap, Tee and Corner joint on MS sheet 1.6 mm in Vertical position by GTAW. 65. Make Square butt joint on MS sheet 2 mm in Vertical position by GTAW.	Filler metals for GTAW Types & Specifications as per BIS & AWS and applications Argon / Helium gas properties and application.
		66. Monitor Square butt joint on Aluminium sheet 3 mm thick in Flat position by GTAW. 67. Assess Lap, "T" and Corner joint on Aluminium sheet 2 mm thick in down hand position by GTAW.	Pulsed TIG welding and application Different type of weld joints- plates & pipes
		68. Construct Square butt joint on Aluminium sheet 2 mm thick in Horizontal & vertical positions by GTAW. 69. Make Lap, Tee and Corner joint on Aluminium sheet 2 mm thick in down Horizontal & vertical positions by GTAW.	Advantages of root pass welding of pipes by TIG welding Square wave concept and Wave balancing.
		70. Monitor the fabrication of Square butt joint on S.S sheet 1.6 mm thick in Flat position by GTAW. 71. Lap, Tee and Corner joint on	Types of weld defects, causes and remedy in GTAW process Purging : Importance, Method of purging

		S.S sheet 1.6 mm thick in Flat position by GTAW.	
		72. Plan & make Square butt joint on S.S sheet 1.6 mm thick in Vertical position by GTAW. 73. Make Lap, Tee and Corner joint on S.S sheet 1.6 mm thick in Vertical position by GTAW. 74. Monitor the formation of Single V butt joint on Aluminum sheet 6 mm thick by GTAW in down hand position.	Submerged Arc welding - Principles, application-Types of fluxes, welding head, power source and Parameter setting
Practical 32Hrs  Theory 12Hrs	Monitor Tube Welding (M.S. to S.S. Tube) in Butt joint in 1G position by GTAW.	75. Make Square butt joint on Tube welding on M.S. & S.S tube metals in rolled position by GTAW and monitor the same.	Micro plasma welding principles, Equipment, power source, parameter settings, Advantages & limitations Plasma cutting principles and advantages
		76. Plan & perform Root pass welding of M. S schedule 40pipes by GTA Welding up to 6G Positions.	Friction welding process: principles, application, advantages, Principles and applications of Friction Stir welding
Practical 16 Hrs  Theory 06 Hrs	Plan & operate the Plasma Arc cutting machine and cut ferrous & non-ferrous metals.	77. Plan & monitor Plasma cutting of SS sheets & Aluminum plates. 78. CNC profile cutting practice using air plasma torch.	Principles and applications of Laser welding, Electron beam welding, Electro slag welding, Electro gas welding, Thermit welding etc. Principles and application of Water jet cutting & laser cutting
Practical 32Hrs  Theory 12Hrs	Review and perform Resistance Spot welding, Seam welding and Submerged Arc Welding on different metals in different position and check correctness of the weld.	79. Make Lap joint on Stainless steel sheet by Resistance Spot welding MS sheets joining by Resistance Spot welding. 80. Practice on Seam welding machine.	Resistance welding processes: Principles, application, advantages, Elements, Control parameters, Various types viz. Spot, seam projection , Flash butt etc,
		81. Practice on Automatic Submerged Arc Welding machine 82. Demonstrate butt joint Robot Welding.	Robot Welding - principles, applications and advantages. Programming concept. Mechanical Testing of Metals. Principles, Applications of - Hardness testing ( Rockwell and Brinell ) - Impact testing (Izod and Charpy ) - Tensile testing and Bend Test

Practical 48Hrs  Theory 18Hrs	Analyze & assess welded joints by different methods of testing.	83. Perform & review Hardness Testing. 84. Plan Bend Testing of Weldments. 85. Perform Tensile testing. 86. Conduct Impact Testing.	Non destructive Testing of Metals. Visual inspection Dye penetrant test - Principles - Advantages Limitations - Types of Penetrants - Cleaners - Dwelling time etc. Magnetic Particle Test (MPT)- Principles - Advantages - Limitations - Types of Magnetation - Current requirements - Testing equipments - Indication and Interpretations Eddy current testing - Principles, advantages & limitations
		87. Inspect Dimensional weldments using weld gauge. 88. Plan & prepare Weld test specimen. 89. Conduct Visual inspection of weldments. 90. Evaluate welding defects using Dye penetrant. 91. Evaluate welding defects using cleaners and perform Magnetic Particle Testing. 92. Evaluation of defects Eddy current testing.	Ultrasonic Testing (UT)- Principles - Advantage - Limitations Measuring Techniques - Standard reference blocks - Contact Testing procedure - Indications and interpretations Radiographic testing (RT) - Principles - Advantages - Limitations - Basic Radiation Physics - X-Rays - Gama Rays - Radiographic Techniques - Radiographic Interpretation and Evaluation
		93. Set & Calibrate Ultrasonic Flaw detector. 94. Assess Ultrasonic Flaw detector- application on weldments. 95. Illustrate Study of IIW / ASTM reference Radiograph. 96. Interpret Radiographic films. 97. Analyze & Prepare welding inspection reports.	Certification methods for welding inspectors Codes and standards for welding inspection

**SYLLABUS FOR CORE SKILLS**

- |   |
|---|
| 1. Workshop Calculation & Science (Common for all Engineering CITS trades) (80 Hrs) |
| 2. Engineering Drawing (Group I) (120Hrs)   |
| 3. Training Methodology (Common for all trades) (320Hrs + 200Hrs)                   |

Learning outcomes, assessment criteria, syllabus and Tool List of above Core Skills subjects which is common for a group of trades, provided separately in [www.bharatskills.gov.in](http://www.bharatskills.gov.in)



## 7. ASSESSMENT CRITERIA

LEARNING OUTCOME	ASSESSMENT CRITERIA
<b>TRADE TECHNOLOGY</b>	
1. Recognize & comply safe working practices, environment regulation and housekeeping.	Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	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 off dangerous/unsalvageable 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 details correctly according to site accident/injury procedures.
	Identify and observe site evacuation procedures according to site policy.
	Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	Identify basic first aid and use them under different circumstances.
	Identify different fire extinguisher and use the same as per requirement.
	Identify environmental pollution & contribute to avoidance of same.
	Take opportunities to use energy and materials in an environmentally friendly manner
	Avoid waste and dispose waste as per procedure
2. Monitor the oxy-acetylene cutting plant and perform different cutting operations on MS plate. [Different cutting operation – Straight, Bevel, circular].	Plan and mark on MS plate surface for straight/bevel/circular cutting.
	Select the nozzle size and working pressure of gases as per requirement.
	Set the marked plate properly on cutting table.
	Set the cutting plant & perform the cutting operation maintaining proper techniques and all safety aspects.
	Clean the cutting burrs and inspect the cut surface for soundness of cutting.

3. Demonstrate the SMAW machine and perform different type of joints on M.S. And S.S. in different position observing standard procedure. [different types of joints- Fillet (Lap, T-joint, & Corner), Butt (Square butt & Single "V" butt); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G].	Plan and select the type & size of electrode, welding current.
	Prepare edge as per requirement
	Prepare, set SMAW machine and tack the pieces as per drawing.
	Set up the tacked pieces in specific position.
	Deposit the weld maintaining appropriate arc length, electrode angle, welding speed, weaving technique and safety aspects.
	Clean the welded joint thoroughly.
	Carry out visual inspection for appropriate weld joint & check by
	Carry out visual inspection for appropriate weld joint & check by gauges.
4. Monitor the gas welding plant and evaluate the joints in different metals (M.S., Aluminium, Copper, Brass, Stainless Steel sheet) and in different position. [Different position: - 1F, 2F, 3F, 1G, 2G, 3G.] by OAW.	Plan and select the nozzle size, working pressure, type of flame, filler rod as per requirement.
	Prepare, set and tack the pieces as per drawing.
	Set up the tacked joint in specific position.
	Deposit the weld following proper welding technique and safety aspect.
	Carry out visual inspection to ascertain quality weld joint.
5. Evaluate welding in different types of pipe joints [Butt Joint, Elbow, T- joint, angle (45°) joint, flange joint] in 1G / DHP by OAW.	Plan and prepare the development for a specific type of pipe joint.
	Mark and cut the MS pipe as per development.
	Select the size of filler rod, size of nozzle, working pressure etc.
	Set and tack the pieces as per drawing.
	Deposit the weld bead maintaining proper technique and safety aspects.
	Inspect the welded joint visually for poor penetration, uniformity of bead and surface defects.
6. Demonstrate arc gouging operation to rectify the weld joints by SMAW and monitor hard facing of alloy steel components / MS rod by using hard facing electrode.	Plan and select the size of electrode for Arc gouging.
	Select the polarity and current as per requirement.
	Perform gouging adapting proper gouging technique.
	Clean and check to ascertain the required stock removed.
	Plan and prepare the component by cleaning the surface thoroughly.
	Select the type & size of electrode, power source, welding current as per requirement.
	Deposit the weld observing standard practice and safety.
	Clean the welded surface thoroughly

	Carryout visual inspection to ascertain quality of weld.
7. Analyze & Perform Brazing and Silver Brazing in different Joint (Square Butt Joint, Lap Joint, "T" joint, joint) on M.S. sheet and bell mouth joint on Tube (Brass & Copper) by OAW.	<p>Plan and select the nozzle size, working pressure, type of flame, filler rod as per requirement.</p> <p>Prepare, set and tack the pieces as per drawing.</p> <p>Set up the tacked joint in specific position.</p> <p>Braze the joint by following proper welding technique and safety aspect.</p> <p>Carry out visual inspection to ascertain quality weld joint.</p>
8. Assess welding in butt joint on MS pipe in different position (1G, 2G, 5G & 6G) by SMAW using Liquid Penetrant Test during Root Pass & Cover Pass.	<p>Plan and prepare the development for a specific type of pipe joint.</p> <p>Mark and cut the MS pipe as per development.</p> <p>Select the electrode size and welding current for welding.</p> <p>Set and tack the pieces as per drawing.</p> <p>Deposit the weld bead maintaining proper technique and safety aspects.</p> <p>Plan and select the job and clean the surface thoroughly</p> <p>Select the appropriate testing methods.</p> <p>Perform testing of welded joints adapting standard operating procedure.</p> <p>Record the test result &amp; compare with standard parameter/ result value.</p> <p>Accept/reject the job based on test result.</p> <p>Inspect the welded joint visually for root penetration, uniformity of bead and surface defects.</p>
9. Demonstrate fusion Welding & Bronze Welding in Single "V" Butt joint on Cast Iron (6 mm thick) in 1G/ DHP by choosing appropriate welding process (OAW & SMAW).	<p>Plan and prepare the job as per requirement.</p> <p>Select the type &amp; size of Filler rod OR electrode., size of nozzle, working pressure etc.for OAW And power source, polarity, welding current for SMAW as per requirement</p> <p>Set the part properly.</p> <p>Deposit the weld adapting appropriate welding technique and safety aspects.</p> <p>Clean the welded joint thoroughly.</p> <p>Carry out visual inspection to ascertain quality of weld joint.</p>
10. Demonstrate GMAW / FCAW machine and perform welding in different types of joints [ Fillet Joints ( T-joint, lap, Corner), Butt Joints	<p>Select size of electrode wire, welding voltage, gas flow rate, wire feed rate as per requirement.</p> <p>Prepare, set (machine &amp; Job) and tack the pieces as per drawing and type of joints.</p> <p>Set up the tacked joint in specific position.</p> <p>Deposit the weld adapting proper welding technique and safety aspects.</p>

(Square & Single V) Joint on different type of metals (M.S., S.S. sheet/plate) by GMAW / FCAW in various positions [various positions- 1F, 2F, 3F, 4F, 1G, 2G, 3G].	Carry out visual inspection to ensure quality of welded joint.
	Inspect the weld using Dye-penetration Test (DPT)/Magnetic particle Test (MPT).
11. Monitor welding in T-joint, on M.S. Pipe in 1G / DHP by GMAW.	Select size of electrode wire, welding voltage, gas flow rate, wire feed rate as per requirement.
	Prepare, set (machine & Job) and tack the pieces as per drawing and type of joints.
	Arrange tacked joint in specific position.
	Deposit the weld adapting proper welding technique and safety aspects.
	Carry out visual inspection to ensure quality of welded joint.
	Inspect the weld using Dye-penetration Test (DPT)/Magnetic particle Test (MPT).
12. Demonstrate the GTAW machine and perform welding by GTAW in different types of joints on different metals in different position and check correctness of the weld. [different types of joints- Fillet (lap, T-joint, Corner), Butt (Square & V) ; different metals- Mild Steel., Aluminium, Stainless Steel; different position- 1F, 2F, 3F, & 1G, 2G, 3G].	Select power source as per material, size and type of Tungsten electrode, welding current, gas nozzle size, gas flow rate and filler rod size as per requirement.
	Prepare, set (machine & Job) and tack the pieces as per drawing and type of joints.
	Set up the tacked joint in specific position.
	Deposit the weld by adapting proper welding technique and safety aspects.
	Carry out visual inspection to ensure quality of welded joint.
	Inspect the weld using Dye-penetration Test (DPT)/Magnetic particle Test (MPT).
13. Monitor Tube Welding (M.S. to S.S. Tube) in Butt joint in 1G position by GTAW.	Demonstrate the making of Square butt joint on Tube welding on M.S. tube metals in rolled position by GTAW.
	Demonstrate the making of Square butt joint on Tube welding on S.S tube metals in rolled position by GTAW.
	Assess the joint as per given the specifications.
14. Plan & operate the Plasma Arc cutting machine and cut ferrous & non-ferrous	Demonstrate Plasma cutting of given SS sheets plates.
	Demonstrate Plasma cutting of given Aluminum plates.
	Demonstrate CNC profile cutting practice using air plasma torch.

metals.	
15. Review and perform Resistance Spot welding, Seam welding and Submerged Arc Welding on different metals in different position and check correctness of the weld.	Operate Seam welding machine.
	Demonstrate construction of lap joint on Stainless steel sheet by Resistance Spot welding MS sheets joining by Resistance Spot welding.
	Perform welding on Automatic Submerged Arc Welding.
	Demonstrate butt joint Robot Welding.
16. Analyze& assess welded joints by different methods of testing.	Plan and select the job and clean the surface thoroughly.
	Analyze& select the appropriate testing methods.
	Perform & monitor testing of welded joints adapting standard operating procedure.
	Record & evaluate the test result & compare with standard parameter/ result value.
	Accept/reject the job based on test result.

## 8. INFRASTRUCTURE

LIST OF TOOLS AND EQUIPMENT FOR WELDER (CITS)			
For Batch Of 25 Candidates			
S No.	Name of the Tool & Equipment	Specification	Quantity
<b>A. Consumable</b>			
1.	Leather Hand Gloves	14"	26 pairs
2.	Cotton hand Gloves	8"	26 pairs
3.	Leather Apron leather		26 nos.
4.	S.S Wire brush	5 rows and 3 rows	26 nos. each
5.	Leather hand sleeves	16"	26 pairs
6.	Safety boots for welders		26 pairs
7.	Leg guards leather		26 pairs
8.	Rubber hose clips	1/2"	26 nos.
9.	Rubber hose oxygen	8 mm dia X 10 Mts long as per BIS	2 nos.
10.	Rubber hose acetylene	8 mm dia X 10 Mts long as per BIS	2 nos.
11.	Arc welding cables multi cored copper	400/ 600 amp as per BIS	45 mts. each
12.	Arc welding single coloured glasses	108 mm x 82 mm x 3 mm. DIN 11A &12A	34 nos.
13.	Arc welding plain glass	108 mm x 82 mm x 3 mm.	68 nos.
14.	Gas welding Goggles with Colour glass	3 or 4A DIN	34 nos.
15.	Safety goggles plain		34 nos.
16.	Spark lighter		6 nos.
17.	AG 4 Grinding wheels		10 nos.
<b>B. Trainees Tools Kit</b>			
18.	Welding helmet fiber		26 nos.
19.	Welding hand shield fiber		26 nos.
20.	Chipping hammer with metal handle	250 Grams	26 nos.
21.	Chisel cold flat	19 mm x 150 mm	26 nos.
22.	Centre punch	9 mm x 127 mm	26 nos.
23.	Dividers	200 mm	26 nos.
24.	Stainless steel rule	300mm	26 nos.
25.	Scriber	150 mm double point	26 nos.
26.	Flat Tongs	350mm long	26 nos.
27.	Hack saw frame fixed	300 mm	26 nos.
28.	File half round bastard	300 mm	26 nos.
29.	File flat	350 mm bastard	26 nos.
30.	Hammer ball pane	1 kg with handle	26 nos.
31.	Tip Cleaner		26 nos.
32.	Try square	6"	26 nos.

C. GENERAL SHOP OUTFIT:			
33.	Spindle key		4
34.	Screw Driver	300mm blade and 250 mm blade	1 each
35.	Number punch	6 mm	2 set
36.	Letter punch	6 mm	2 set
37.	Magnifying glass	100 mm .dia	2
38.	Universal Weld measuring gauge		2
39.	Earth clamp	600A	6
40.	Spanner D.E.	6 mm to 32mm	2 sets
41.	C-Clamps	10 cm and 15 cm	2 each
42.	Hammer sledge double faced	4 kg	1
43.	S.S tape	5 meters flexible in case	1
44.	Electrode holder	600 amps	6
45.	H.P. Welding torch with 5 nozzles		2 sets
46.	Oxygen Gas Pressure regulator double stage		2
47.	Acetylene Gas Pressure regulator double stage		2
48.	CO <sub>2</sub> Gas pressure regulator, with flow meter		2 set
49.	Argon Gas pressure regulator with flow meter		2 set
50.	Metal rack	182 cm x 152 cm x 45 cm	1
51.	First Aid box		1
52.	Steel lockers with 8 Pigeon holes		3
53.	Steel almirah / cupboard		3
54.	Black board and easel with stand		1
55.	Flash back arrester (torch mounted)		4 pairs
56.	Flash back arrester (cylinder mounted)		4 pairs
57.	Welding Transformer with all accessories	( 400A,OCV 60-100 V, 60% duty cycle)	2 sets
58.	Welding Transformer with all accessories	(300A , OCV 60 - 100 V, 60% duty cycle)	2 sets
59.	Inverter based welding Power source	(300A)	1 No
60.	D.C Arc welding rectifiers set with all accessories	(400 A. OCV 60 -100 V, 60% duty cycle )	2 sets
61.	GMAW welding machine	400A capacity with air cooled torch, Regulator, Gas preheater, Gas hose and Standard accessories	3 set
62.	AC/DC GTAW welding machine	With water cooled torch 300 A, Argon regulator, Gas hose, water circulating system and standard accessories.	3 set
63.	Air Plasma cutting equipment with all accessories, capacity to cut	25 mm clear cut	1 set
64.	Air compressor suitable for air		1

	plasma cutting system		
65.	Auto Darkening Welding Helmet		2
66.	Spot welding machine to 15 KVA with all accessories	15 KVA with all accessories	1 set
67.	Portable gas cutting machine capable of cutting Straight & Circular with all accessories		1 set
68.	Pedestal grinder fitted with coarse and medium grain size grinding wheels	dia. 300 mm	1
69.	Bench grinder fitted with fine grain size silicon carbide green grinding wheel	dia. 150 mm	1
70.	AG 4 Grinder		2
71.	Suitable gas welding table with fire bricks		2
72.	Suitable Arc welding table with positioner		14
73.	Trolley for cylinder (H.P. Unit)		2
74.	Hand shearing machine capacity to cut 6 mm sheets and flats		1
75.	Power saw machine	18"	1
76.	Portable drilling machine	(Cap. 6 mm)	1
77.	Oven, electrode drying	0 to 350°C, 10 kg capacity	1
78.	Work bench	340x120x75 cm with 4 bench vices of 150 mm jaw opening	4 sets
79.	Oxy Acetylene Gas cutting blow pipe		2 sets
80.	Oxygen, Acetylene Cylinders		2 each
81.	CO <sub>2</sub> cylinder		3 Nos.
82.	Argon gas cylinder		3 Nos.
83.	Anvil 12 sq. inches working area with stand		
84.	Swage block		
85.	Die penetrant testing kit		5 set
86.	Magnetic particle testing Machine Prode Type with all standard accessories		1 set
87.	Fire extinguishers (foam type and CO <sub>2</sub> type)		
88.	Fire buckets with stand		
89.	Portable abrasive cut-off machine		
90.	Suitable Gas cutting table		
91.	Welding Simulators for SMAW/GTAW/GMAW		1 each*
92.	Seam welding Machine( longitudinal) 75 KVA with accessories		1*
93.	Potable CNC profile cutting system with all standard accessories		1*



94.	Ultrasonic flaw detector with accessories		
95.	Submerged arc welding machine with accessories (1000 amps)		
96.	Radiographic reference standard		
97.	Eddy current tester		1*
98.	Friction welding machine		
99.	Welding motor generator	(300 Amps)	1 No
100.	X-ray film illuminator		
101.	Electric pipe cutting and beveling machine, cutting capacity 15 mm wall thickness M.S. pipes		
102.	Fume extractor system connecting all the Welding booths		1 set
103.	Pressure vessel codes (Book or CD) IBR & ASME sec IX		
104.	Structural welding codes D1.1 (Book or CD)		
105.	Universal Testing Machine 20T		1 set*
106.	Rockwell hardness Testing machine		
107.	Impact testing Machine (Charpy & Izod Combined)		
108.	MAG welding Robot with all standard accessories		1 set*
<b>D. List of Furniture, Accessories and Audio Visual Aids</b>			
109.	Class Room Chairs (armless) / Dual desk may also be allowed		25 nos.
110.	Class Room Tables	( 3 ft X 2ft) / Dual desk may also be allowed	25 nos.
111.	Chair for Trainer (armed) movable		01no.
112.	Table for Trainer	(4ft X 2ft) with Drawer and cupboard	01no.
113.	LCD Projector		01 no.
114.	Computer System with latest configuration with	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. Cache Memory: - Minimum 3 MB or better. RAM:-8 GB DDR-III or Higher. Hard Disk Drive: 500GB or Higher, 7200 rpm (minimum) or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet (10/100/1000) - Wi-Fi, USB Mouse, USB Keyboard and Monitor (Min. 17 Inch), Standard Ports and connectors. DVD Writer, Speakers And Mic. Licensed Windows Operating System / OEM Pack(Preloaded),	01 set

		Antivirus / Total Security	
115.	UPS		As required
116.	Computer Table		01 no.
117.	White Board	(6ft X 4 ft.)	01 no.
118.	LCD Projector Screen		01 no.
119.	Air Conditioner (OPTIONAL)	1.5Ton	As required
120.	Wall Clock		01 no.
121.	Wall charts, Transparencies and DVDs related to the trade		As required
122.	Document Camera / Visualizer		01 no.
123.	Smart Board / Inter Active Board		01 no.
124.	Over Head Projector		01 no.
125.	Video Camera with stand		01 no.
126.	Printer cum Scanner		01 no.
127.	Laptop with all latest OS		01 no.

## ANNEXURE – I

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts and all others who contributed in revising the curriculum. Special acknowledgement is extended by DGT to the expert members who had contributed immensely in this curriculum.

<b>List of Expert members participated for finalizing the course curricula of Welder-CITS held on at CSTARI, Kolkata</b>			
<b>S No.</b>	<b>Name &amp; Designation Sh/Mr/Ms</b>	<b>Organization</b>	<b>Remarks</b>
<b>Members of Sector Mentor council</b>			
1.	Dr. G. Buvanashakaran	AGM, WRI, Trichy	Chairman
2.	Dr. K. Ashokkumar	AGM, BHEL, Trichy	Member
3.	Prof. Jyothi Mukhopadhyaya	IIT, Ahmedabad	Member
4.	B. Pattabhiraman	MD, GB Engineering, Trichy	Member
5.	Dr. Rajeevkumar	IIT, Mandi	Member
6.	Dr. Vishalchauhan	IIT, Mandi	Member
7.	D.K. Singh	ITI, Kanpur	Member
8.	Navneet Arora	IIT, Roorkee	Member
9.	R. K. Sharma	Head, SDC, JBM Group, Faridabad	Member
10.	Puneet Sinha	Deputy Director, MSME, New Delhi	Member
<b>Mentor</b>			
11.	Deepankar Mallick	Director of Training, DGE&T Hq,	Member
<b>Members of Core Group</b>			
12.	M Thamizharasan	JDT, CSTARI, Kolkata	Member
13.	M Kumaravel	DDT, FTI , Bangalore	Team Leader
14.	Sushi IKumar	DDT, DGE&T Hq,	Member
15.	S.P. Khatokar	T.O. ATI, Mumbai	Member
16.	V.L. Ponmozhi	TO, CTI, Chennai	Member
17.	D. Pani	TO, ATI, Howrah	Member
18.	Amar Singh	TO, ATI, Ludhiyana	Member
19.	Gopala krishnan	TO, NIMI, Chennai	Member

