



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

**COMPETENCY BASED CURRICULUM**

# WELDER

(Duration: One Year)

**CRAFTSMEN TRAINING SCHEME (CTS)**

**NSQF LEVEL- 4**



**SECTOR – CAPITAL GOODS AND MANUFACTURING**



Directorate General of Training

# WELDER

(Engineering Trade)

(Revised in 2019)

Version: 1.2

**CRAFTSMEN TRAINING SCHEME (CTS)**

**NSQF LEVEL - 4**

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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## 1. COURSE INFORMATION

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During the one year duration a candidate is trained on subjects Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation and Employability Skills related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered under Professional Skill subject are as below:

The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The safety aspects covers components like OSH & E, PPE, Fire extinguisher, First Aid and in addition 5S being taught. The practical part starts with edge preparation by hacksawing, filing and fitting followed by Oxy Acetylene Welding & Brazing, Oxy Acetylene Cutting, Shielded Metal Arc Welding, Gas Metal Arc Welding, Gas Tungsten Arc Welding and Spot Welding, Plasma Cutting and Arc Gouging. These processes are widely used in Industries.

During the practice on Welding / Brazing process, the trainees will learn to read the job drawing, select the required base metal and filler metals, cut the metals by appropriate process, carry out edge preparation, setup the plant and do welding/Brazing on M.S, SS, Aluminium and Copper in different positions. On completion of each job the trainees will also evaluate their jobs by visual inspection, and identify the defects for further correction/improvement. They learn to adapt precautionary measures such as preheating; maintaining inter-pass temperature and post weld heat treatment for Welding Alloy steel, Cast Iron etc. The Work Shop calculation taught will help them to plan and cut the required jobs economically without wasting the material and also used in estimating the Electrodes, filler metals etc. The Workshop Science taught will help them to understand the materials and properties, effect of alloying elements etc. Engineering Drawing taught will be applied while reading the job drawings and will be useful in understanding the location, type and size of weld to be carried out.

The professional knowledge taught will be useful in understanding the principles of Welding, Brazing and Cutting process, use of jigs and Fixtures, distortion and methods of control, selection of consumables and to take precautionary measures for storage and handling and apply the same for executing the Cutting, Welding and Brazing.

The knowledge and practice imparted on Destructive and Non-destructive testing will be use in understanding the standard quality of welds and to carry out shop floor Inspection and test in laboratories.

One project need to be completed by the candidates in a group. In addition to above components the core skills components viz., Workshop calculation & science, Engineering drawing, employability skills are also covered. These core skills are essential skills which are necessary to perform the job in any given situation.

## 2. TRAINING SYSTEM

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### 2.1 GENERAL

The Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers a range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under the aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer schemes of DGT for strengthening vocational training.

Welder trade under CTS is one of the most popular courses delivered nationwide through a network of ITIs. The course is of one-year duration. It mainly consists of Domain area and Core area. In the Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while the core area (Workshop calculation & Science, Engg. Drawing and Employability Skill) imparts requisite core skills, knowledge, and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

#### **Trainee broadly needs to demonstrate that they are able to:**

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform tasks 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 repair & maintenance work.
- Check the job/ assembly as per drawing for functioning identify and rectify errors in job/ assembly.
- Document the technical parameters in tabulation sheet related to the task undertaken.

### 2.2 PROGRESSION PATHWAYS

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

## 2.3 COURSE STRUCTURE:

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

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	1000
2	Professional Knowledge (Trade Theory)	280
3	Workshop Calculation & Science	80
4	Engineering Drawing	80
5	Employability Skills	160
	<b>Total</b>	<b>1600</b>

## 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](http://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 guidelines. The pattern and marking structure is being notified by DGT 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%. 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 assessment. Due consideration should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/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 the following:

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

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



Performance Level	Evidence
<b>(a) Weightage in the range of 60 -75% to be allotted during assessment</b>	
<p>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.</p>	<ul style="list-style-type: none"> <li>• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment</li> <li>• 60-70% accuracy achieved while undertaking different work with those demanded by the component/job/set standards.</li> <li>• A fairly good level of neatness and consistency in the finish</li> <li>• Occasional support in completing the project/job.</li> </ul>
<b>(b)Weightage in the range of above75% - 90% to be allotted during assessment</b>	
<p>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.</p>	<ul style="list-style-type: none"> <li>• Good skill levels in the use of hand tools, machine tools and workshop equipment</li> <li>• 70-80% accuracy achieved while undertaking different work with those demanded by the component/job.</li> <li>• A good level of neatness and consistency in the finish</li> <li>• Little support in completing the project/job</li> </ul>
<b>(c) Weightage in the range of above 90% to be allotted during assessment</b>	
<p>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.</p>	<ul style="list-style-type: none"> <li>• High skill levels in the use of hand tools, machine tools and workshop equipment</li> <li>• Above 80% accuracy achieved while undertaking different work with those demanded by the component/job/set standards.</li> <li>• A high level of neatness and consistency in the finish.</li> <li>• Minimal or no support in completing the project.</li> </ul>

### 3. JOB ROLE

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**Welder, Gas;** 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 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.

**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).

**Gas Cutting;** cuts metal to require 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.

**Brazer;** 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.

**Tungsten Inert Gas (TIG) welder;** 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.

**Gas Metal Arc Welder/ Metal Inert Gas/ Metal Active Gas/ Gas Metal Welder (MIG/MAG/GMAW);** 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.

**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 involve setting-up and preparing operations interpreting the right information from the specification documents, obtaining the right consumables and other materials, etc.

Plan and organize assigned work and detect & resolve issues during execution in his own work area within defined limit. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

**Reference NCO 2015:**

- (i) 7212.0100 – Welder, Gas
- (ii) 7212.0200 – Welder, Electric
- (iii) 7212.0700 – Welder, Resistance

- (iv) 7212.0400 – Gas Cutter
- (v) 7212.0500 – Brazer
- (vi) 7212.0105 – Tungsten Inert Gas Welder
- (vii) 7212.0303 – Gas Metal Arc Welder/ Metal Inert Gas/ Metal Active Gas/ Gas
- (viii) Metal Welder (MIG/MAG/GMAW)
- (ix) 7212.0111- Repair Welder
- (x) 7212.0402- Plasma Cutter – Manual

## 4. GENERAL INFORMATION

<b>Name of the Trade</b>	<b>Welder</b>
<b>Trade Code</b>	DGT/1004
<b>NCO - 2015</b>	7212.0100, 7212.0200, 7212.0700,7212.0400, 7212.0500, 7212.0105, 7212.0303, 7212.0111, 7212.0402
<b>NSQF Level</b>	Level – 4
<b>Duration of Craftsmen Training</b>	One year (1600 Hours)
<b>Entry Qualification</b>	Passed 8 <sup>th</sup> class examination
<b>Minimum Age</b>	14 years as on first day of academic session.
<b>Eligibility for PwD</b>	LD, LC, DW, AA, DEAF, HH
<b>Unit Strength (No. Of Student)</b>	20 (There is no separate provision of supernumerary seats)
<b>Space Norms</b>	80 Sq. m
<b>Power Norms</b>	16 KW
<b>Instructors Qualification for</b>	
<b>1. Welder Trade</b>	<p>B.Voc/Degree in Mechanical/ Metallurgy/ Production Engineering/ Mechatronics from AICTE /UGC recognized university/ college with one year experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>03 years Diploma in Mechanical and allied from AICTE/ recognized technical board of education or relevant Advanced Diploma (Vocational) from DGT with two years experience in relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/NAC passed in the Trade of “Welder” with three years’ experience in the relevant field.</p> <p><b>Essential Qualification:</b> Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT.</p> <p><b>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.</b></p>
<b>2. Workshop Calculation &amp; Science</b>	<p>B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>03 years Diploma in Engineering from AICTE/ recognized board of</p>

	<p>technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any one of the engineering trades with three years' experience.</p> <p><b><u>Essential Qualification:</u></b></p> <p>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 one-year experience in the 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 two years' experience in the relevant field.</p> <p style="text-align: center;"><b>OR</b></p> <p>NTC/ NAC in any one of the Engineering trades with three years experience.</p> <p><b><u>Essential Qualification:</u></b></p> <p>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. Employability Skill</b>	<p>MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes.</p> <p>(Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above)</p> <p style="text-align: center;"><b>OR</b></p> <p>Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.</p>				
<b>5. Minimum Age for Instructor</b>	21 Years				
<b>List of Tools and Equipment</b>	As per Annexure – I				
<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>Employability Skills</b>
40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours

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

### 5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

1. Set the gas welding plant and join MS sheet in different position following safety precautions. *[Different position: - 1F, 2F, 3F, 1G, 2G, 3G.]*
2. Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure. *[different types of joints- Fillet ( T-joint, lap & Corner), Butt (Square & V); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G]*
3. Set the oxy- acetylene cutting plant and perform different cutting operations on MS plate. *[Different cutting operation – Straight, Bevel, circular]*
4. Perform welding in different types of MS pipe joints by Gas welding (OAW). *[Different types of MS pipe joints – Butt, Elbow, T-joint, angle (45°) joint, flange joint]*
5. Set the SMAW machine and perform welding in different types of MS pipe joints by SMAW. *[Different types of MS pipe joints – Butt, Elbow, T-joint, angle (45°) joint, flange joint]*
6. Choose appropriate welding process and perform joining of different types of metals and check its correctness. *[appropriate welding process – OAW, SMAW; Different metal – SS, CI, Brass, Aluminium]*
7. Demonstrate arc gouging operation to rectify the weld joints.
8. Test welded joints by different methods of testing. *[different methods of testing- Dye penetration test, Magnetic particle test, Nick break test, Free band test, Fillet fracture test]*
9. Set GMAW machine and perform welding in different types of joints on MS sheet/plate by GMAW in various positions by dip mode of metal transfer. *[different types of joints- Fillet ( T-joint, lap, Corner), Butt (Square & V); various positions- 1F, 2F, 3F,4F, 1G, 2G, 3G]*
10. Set 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 ( T-joint, lap, Corner), Butt (Square & V) ; different metals- Aluminium, Stainless Steel; different position- 1F & 1G]*
11. Perform Aluminium & MS pipe joint by GTAW in flat position.
12. Set the Plasma Arc cutting machine and cut ferrous & non-ferrous metals.
13. Set the resistance spot welding machine and join MS& SS sheet.
14. Perform joining of different similar and dissimilar metals by brazing operation as per standard procedure. *[different similar and dissimilar metals- Copper, MS, SS]*

15. Repair Cast Iron machine parts by selecting appropriate welding process. [*Appropriate welding process- OAW, SMAW*]
16. Hard facing of alloy steel components/ MS rod by using hard facing electrode.



## 6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Set the gas welding plant and join MS sheet in different position following safety precautions. [Different position: - 1F, 2F, 3F, 1G, 2G, 3G.]	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.
2. Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure. [different types of joints- Fillet ( T-joint, lap & Corner), Butt (Square & V); 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 gauges.
3. Set 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.
4. Perform welding in different types of MS pipe joints by Gas welding (OAW).	Plan and prepare the development for a specific type of pipe joint.
	Mark and cut the MS pipe as per development.

<p><i>[Different types of MS pipe joints – Butt, Elbow, T-joint, angle (45°) joint, flange joint]</i></p>	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.
<p>5. Set the SMAW machine and perform welding in different types of MS pipe joints by SMAW. <i>[Different types of MS pipe joints – Butt, Elbow, T-joint, angle (45°) joint, flange joint]</i></p>	Plan and prepare the development for a specific type of pipe joint.
	Mark and cut the MS pipe as per development.
	Select the electrode size and welding current for welding.
	Set and tack the pieces as per drawing.
	Deposit the weld bead maintaining proper technique and safety aspects.
Inspect the welded joint visually for root penetration, uniformity of bead and surface defects.	
<p>6. Choose appropriate welding process and perform joining of different types of metals and check its correctness. <i>[appropriate welding process – OAW, SMAW; Different metal – SS, CI, Brass, Aluminium]</i></p>	Plan and prepare the pieces for welding.
	Select the type and size of filler rod and flux/electrode, size of nozzle and gas pressure/welding current, preheating method and temperature as per requirement.
	Set and tack metals as per drawing.
	Deposit the weld maintaining appropriate technique and safety aspects.
	Cool the welded joint by observing appropriate cooling method. Use post heating, peening etc. as per requirement.
Clean the joint and inspect the weld for its uniformity and different types of surface defects.	
<p>7. Demonstrate arc gouging operation to rectify the weld joints.</p>	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.
8. Test welded joints by	Plan and select the job and clean the surface thoroughly.

different methods of testing. <i>[different methods of testing- Dye penetration test, Magnetic particle test, Nick break test, Free band test, Fillet fracture test]</i>	Select the appropriate testing methods.
	Perform testing of welded joints adapting standard operating procedure.
	Record the test result & compare with standard parameter/ result value.
	Accept/reject the job based on test result.
9. Set GMAW machine and perform welding in different types of joints on MS sheet/plate by GMAW in various positions by dip mode of metal transfer. <i>[different types of joints- Fillet ( T-joint, lap, Corner), Butt (Square &amp; V); various positions- 1F, 2F, 3F,4F, 1G, 2G, 3G]</i>	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.
	Set up the 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).
10. Set 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. <i>[different types of joints- Fillet ( T-joint, lap, Corner), Butt (Square &amp; V) ; different metals- Aluminium, Stainless Steel; different position- 1F &amp; 1G]</i>	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).
11. Perform Aluminium & MS pipe joint by GTAW in flat position.	Plan and prepare development or edge preparation for specific type of pipe joint.
	Mark and cut the MS pipe as per development.
	Select the type of welding current, size and type of tungsten electrode, size of nozzle, gas flow rate and

	welding current as per requirement.
	Set and tack the piece as per drawing.
	Deposit the weld bead maintaining proper technique and safety aspects.
	Inspect the welded joint visually for root penetration, bead uniformity and surface defects.
12. Set the Plasma Arc cutting machine and cut ferrous & non-ferrous metals.	Plan and mark on Ferrous/Non ferrous metal plates surface for plasma cutting.
	Select the torch/nozzle size, current and working pressure of gas as per requirement.
	Set the marked plate properly on cutting table.
	Set the plasma cutting machine and perform the cutting operation by adapting proper techniques and safety aspects.
	Clean and inspect the cut surface for quality of cutting.
13. Set the resistance spot welding machine and join MS & SS sheet.	Plan and select the material and clean the surface thoroughly.
	Set the spot welding parameters on machine.
	Spot weld the joint adapting appropriate techniques and safety.
	Inspect the joint for soundness of weld.
14. Perform joining of different similar and dissimilar metals by brazing operation as per standard procedure. <i>[different similar and dissimilar metals- Copper, MS, SS]</i>	Plan and select the nozzle size, working pressure type of flame, filler rod and flux as per requirement.
	Prepare, set and tack the pieces as per drawing.
	Braze the joint adapting proper brazing technique and safety aspect.
	Carry out visual inspection to ascertain quality weld joint.
15. Repair Cast Iron machine parts by selecting appropriate welding process. [Appropriate welding process- OAW,	Plan and prepare the job as per requirement.
	Select the type & size of electrode, power source, polarity, welding current as per requirement.
	Set the part properly.
	Deposit the weld adapting appropriate welding technique and safety aspects.

SMAW]	Clean the welded joint thoroughly.
	Carry out visual inspection to ascertain quality of weld joint.
16. Hard facing of alloy steel components / MS rod by using hard facing electrode.	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. TRADE SYLLABUS

### SYLLABUS - WELDER

DURATION: ONE YEAR

Duration	Reference Learning Outcome	Process code	Professional Skills (Trade Practical) With Indicative Hrs.	Professional Knowledge (Trade Theory)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	<p>Set the gas welding plant and join MS sheet in different position following safety precautions. <i>[Different position: - 1F, 2F, 3F, 1G, 2G, 3G.]</i></p> <p>Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure. <i>[different types of joints- Fillet (T-joint, lap &amp; Corner), Butt (Square &amp; V); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G]</i></p>		<ol style="list-style-type: none"> <li>Demonstration of Machinery used in the trade. (6 hrs.)</li> <li>Identification to safety equipment and their use etc. (4 hrs.)</li> <li>Hack sawing, filing square to dimensions. (7 hrs.)</li> <li>Marking out on MS plate and punching. (8 hrs.)</li> </ol>	<ul style="list-style-type: none"> <li>Importance of trade Training.</li> <li>General discipline in the Institute</li> <li>Elementary First Aid.</li> <li>Importance of Welding in Industry</li> <li>Safety precautions in Shielded Metal Arc Welding, and Oxy-Acetylene Welding and Cutting. (07 hrs)</li> </ul>
		OAW-01  SMAW-01	<ol style="list-style-type: none"> <li>Setting of oxy-acetylene welding equipment, Lighting and setting of flame. (5 hrs.)</li> <li>Perform fusion run without filler rod on MS sheet 2mm thick in flat position. (5 hrs.)</li> <li>Setting up of Arc welding machine &amp; accessories and striking an arc. (5 hrs.)</li> <li>Deposit straight line bead on MS plate in flat position. (10 hrs.)</li> </ol>	<ul style="list-style-type: none"> <li>Introduction and definition of welding.</li> <li>Arc and Gas Welding Equipments, tools and accessories.</li> <li>Various Welding Processes and its applications.</li> <li>Arc and Gas Welding terms and definitions. (07 hrs)</li> </ul>

Professional Skill 25 Hrs;  Professional Knowledge 07 Hrs	Set the gas welding plant and join MS sheet in different position following safety precautions. <i>[Different position: - 1F, 2F, 3F, 1G, 2G, 3G.]</i>	OAW-02  OAW-03	9. Depositing bead with filler rod on M.S. sheet 2 mm thick in flat position. (10 hrs.)  10. Edge joint on MS sheet 2 mm thick in flat position without filler rod. (15 hrs.)	- Different process of metal joining methods: Bolting, riveting, soldering, brazing, seaming etc.  - Types of welding joints and its applications. Edge preparation and fit up for different thickness.  - Surface Cleaning (07 hrs)
Professional Skill 25 Hrs;  Professional Knowledge 07 Hrs	Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure. <i>[different types of joints- Fillet ( T-joint, lap &amp; Corner), Butt (Square &amp; V); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G]</i>	SMAW-02  SMAW-03	11. Straight line beads on M.S. plate 10 mm thick in flat position. (10 hrs.)  12. Weaved bead on M. S plate 10mm thick in flat position. (15 hrs.)	- Basic electricity applicable to arc welding and related electrical terms & definitions.  - Heat and temperature and its terms related to welding  - Principle of arc welding. And characteristics of arc. (07 hrs)
Professional Skill 25 Hrs;  Professional Knowledge 07 Hrs	Set the oxy- acetylene cutting plant and perform different cutting operations on MS plate. <i>[Different cutting operation – Straight, Bevel,</i>	OAGC-01  OAGC-02	13. Setting up of oxy-acetylene and make straight cuts (freehand) (2 hrs.)  14. Perform marking and straight line cutting of MS plate 10 mm thick	- Common gases used for welding & cutting, flame temperatures and uses.  - Chemistry of oxy-acetylene flame.  - Types of oxy-acetylene flames and uses.

	<i>circular]</i>	OAGC-03	by gas. Accuracy within $\pm 2$ mm. (4 hrs.) 15. Beveling of MS plates 10 mm thick, cutting regular geometrical shapes and irregular shapes, cutting chamfers by gas cutting. (7 hrs.)	- Oxy-Acetylene Cutting Equipment principle, parameters and application. (07 hrs)
		OAGC-04	16. Circular gas cutting on MS plate 10 mm thick by <i>profile cutting machine</i> . (7 hrs.)	
		OAGC-05	17. Marking and perform radial cuts, cutting out holes using oxy-acetylene gas cutting. (3 hrs.)	
		OAGC-06	18. Identify cutting defects viz., distortion, grooved, fluted or ragged cuts; poor draglines; rounded edges; tightly adhering slag. (2 hrs.)	
Professional Skill 150 Hrs; Professional Knowledge 42 Hrs	Set the gas welding plant and join MS sheet in different position following safety precautions. [Different position: - 1F, 2F, 3F, 1G, 2G, 3G.]  Set the SMAW machine and perform different type of joints on MS in different position observing	OAW-04	19. Square butt joint on M.S. sheet 2 mm thick in flat Position. <b>(1G)</b> (9 hrs.)	- Arc welding power sources: Transformer, Motor Generator set, Rectifier and Inverter type welding machines and its care & maintenance..
		SMAW-04	20. Fillet "T" joint on M.S. Plate 10 mm thick in flat position. <b>(1F)</b> (7 hrs.)	- Advantages and disadvantages of A.C. and D.C. welding machines (06 hrs)
		OAW-05	21. Open corner joint on MS sheet 2 mm thick in flat Position <b>(1F)</b> (9 hrs.)	
		SMAW-05	22. Fillet lap joint on M.S. plate 10 mm thick in flat position. <b>(1F)</b> (7 hrs.)	- Welding positions as per EN & ASME: flat, horizontal, vertical and over head position.
		OAW-06	23. Fillet "T" joint on MS	



<p>standard procedure. [different types of joints- Fillet ( T-joint, lap &amp; Corner), Butt (Square &amp; V); different position - 1F, 2F, 3F,4F, 1G, 2G, 3G, 4G]</p>	SMAW-06	<p>sheet 2 mm thick in flat position. <b>(1F)</b>(7 hrs.)</p> <p>24. Open Corner joint on MS plate 10 mm thick in flat position. <b>(1F)</b>(8 hrs.)</p>	<ul style="list-style-type: none"> <li>- Weld slope and rotation.</li> <li>- Welding symbols as per BIS &amp; AWS. (06 hrs)</li> </ul>
	OAW-07	<p>25. Fillet Lap joint on MS sheet 2 mm thick in flat position. <b>(1F)</b>(08 hrs.)</p>	<ul style="list-style-type: none"> <li>- Arc length – types – effects of arc length.</li> <li>- Polarity: Types and applications.</li> <li>- Weld quality inspection, common welding mistakes and appearance of good and defective welds</li> <li>- Weld gauges &amp; its uses. (06 hrs)</li> </ul>
	SMAW-07	<p>26. Single “V” Butt joint on MS plate 12 mm thick in flat position <b>(1G)</b>. (11 hrs.)</p>	
	I&T-01	<p>27. Testing of weld joints by visual inspection. (1 hr.)</p> <p>28. Inspection of welds by using weld gauges. (1 hr.)</p>	
	OAW-08	<p>29. Square Butt joint on M.S. sheet. 2 mm thick in Horizontal position. <b>(2G)</b>(8 hrs.)</p>	<ul style="list-style-type: none"> <li>- Calcium carbide properties and uses.</li> <li>- Acetylene gas properties and generating methods.</li> <li>- Acetylene gas Purifier, Hydraulic back pressure valve and Flash back arrestor. (06hrs)</li> </ul>
SMAW-08	<p>30. Straight line beads and multi layer practice on M.S. Plate 10 mm thick in Horizontal position. (4 hrs.)</p>		
SMAW-09	<p>31. Fillet “T” joint on M.S. plate 10 mm thick in Horizontal position. <b>(2F)</b>(7 hrs.)</p>	<ul style="list-style-type: none"> <li>- Oxygen gas and its properties</li> <li>- Production of oxygen by Air liquefaction.</li> <li>- Charging process of oxygen and acetylene gases</li> <li>- Oxygen and Dissolved Acetylene gas cylinders</li> </ul>	
OAW-09	<p>32. Fillet Lap joint on M.S. sheet 2 mm thick in horizontal position <b>(2F)</b>(10 hrs.)</p>		
SMAW-10	<p>33. Fillet Lap joint on M.S. plate 10 mm thick in horizontal position. (11 hrs.) <b>(2F)</b></p>		

				and Color coding for different gas cylinders. - Gas regulators, types and uses. (06 hrs)
		OAW-10	34. Fusion run with filler rod in vertical position on 2mm thick M.S sheet. (7 hrs.)	- Oxy acetylene gas welding Systems (Low pressure and High pressure). Difference between gas welding blow pipe(LP &HP) and gas cutting blow pipe - Gas welding techniques. Rightward and Leftward techniques. (06 hrs)
		OAW-11	35. Square Butt joint on M.S. sheet. 2 mm thick in vertical position <b>(3G)</b> (7 hrs.)	
		SMAW-11	36. Single Vee Butt joint on M.S. plate 12 mm thick in horizontal position <b>(2G)</b> . (8hrs.)	
		SMAW- 12	37. Weaved bead on M.S Plate 10mm in vertical position.(7 hrs.)	- Arc blow – causes and methods of controlling. - Distortion in arc & gas welding and methods employed to minimize distortion - Arc Welding defects, causes and Remedies. (06 hrs)
		OAW-12	38. Fillet “T” joint on M.S sheet 2 mm thick in vertical position. <b>(3F)</b> (7 hrs.)	
		SMAW-13	39. Fillet “T” joint on M.S. plate 10 mm thick in vertical position. <b>(3F)</b> (8 hrs.)	
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure. <i>[different types of joints- Fillet ( T-joint, lap &amp; Corner), Butt (Square &amp; V); different</i>	OAW-13	40. Structural pipe welding butt joint on MS pipe Ø 50 and 3mm WT in 1G position. (15 hrs.)	- Specification of pipes, various types of pipe joints, pipe welding all positions, and procedure. - Difference between pipe welding and plate welding. (07 hrs)
		SMAW-14	41. Fillet Lap joint on M.S. Plate 10 mm in vertical position. <b>(3G)</b> (10 hrs.)	
		SMAW-15	42. Open Corner joint on MS plate 10 mm thick in	

	<p><i>position - 1F, 2F, 3F, 4F, 1G, 2G, 3G, 4G]</i></p> <p>Perform welding in different types of MS pipe joints by Gas welding (OAW). [Different types of MS pipe joints – Butt, Elbow, T-joint, angle (45°) joint, flange joint]</p>	OAW-14	43. Pipe welding - Elbow joint on MS pipe Ø 50 and 3mm WT. <b>(1G)</b> (15 hrs.)	vertical position. <b>(2F)</b> (10 hrs.)	joint and branch joint - Manifold system (07 hrs)
		OAW-15	44. Pipe welding “T” joint on MS pipe Ø 50 and 3mm WT. <b>(1G)</b> (10 hrs.)		- Gas welding filler rods, specifications and sizes. - Gas welding fluxes – types and functions.
		SMAW-16	45. Single “V” Butt joint on MS plate 12 mm thick in vertical position (3G). (15 hrs.)		- Gas Brazing & Soldering : principles, types fluxes & uses - Gas welding defects, causes and remedies (07 hrs)
		OAW-16	46. Pipe welding 45 ° angle joint on MS pipe Ø 50 and 3mm WT. <b>(1G)</b> (15 hrs.)		- Electrode : types, functions of flux, coating factor, sizes of electrode Coding of electrode as per BIS, AWS, - Effects of moisture pick up.
		SMAW-17	47. Straight line beads on M.S. plate 10mm thick in over head position. (10 hrs.)		- Storage and baking of electrodes. - Special purpose electrodes and their applications. (07 hrs)
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure. [different types of joints- Fillet ( T-joint, lap & Corner), Butt (Square & V); different position - 1F, 2F,	SMAW-18	48. Pipe Flange joint on M.S plate with MS pipe Ø 50 mm X 3mm WT <b>(1F)</b> (15 hrs.)		- Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature. (07 hrs)
		SMAW-19	49. Fillet “T” joint on M.S. plate 10 mm thick in over head position. <b>(4F)</b> (10 hrs.)		
		SMAW-20	50. Pipe welding butt joint on MS pipe Ø 50 and 5 mm WT. in 1G position.		- Classification of steel. - Welding of low, medium and high carbon steel and

	<p><i>3F,4F, 1G, 2G, 3G, 4G]</i></p> <p>Set the SMAW machine and perform welding in different types of MS pipe joints by SMAW. <i>[Different types of MS pipe joints – Butt, Elbow, T-joint, angle (45°) joint, flange joint]</i></p>	<p>SMAW-21</p> <p>SMAW-22</p> <p>SMAW-23</p>	<p>(15 hrs.)</p> <p>51. Fillet Lap joint on M.S. plate 10 mm thick in over head position. <b>(4G)</b>. (10 hrs.)</p> <p>52. Single “V” Butt joint on MS plate 10mm thick in over head position<b>(4G)</b> (15 hrs.)</p> <p>53. Pipe butt joint on M. S. pipe Ø 50mm WT 6mm <b>(1G</b> Rolled).(10 hrs.)</p>	<p>alloy steels. (07 hrs)</p> <p>- Effects of alloying elements on steel</p> <p>- Stainless steel types- weld decay and weldability. (07 hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge 07 Hrs</p>	<p>Choose appropriate welding process and perform joining of different types of metals and check its correctness. <i>[appropriate welding process – OAW, SMAW; Different metal – SS, CI, Brass, Aluminium]</i></p>	<p>OAW-17</p> <p>SMAW -24</p> <p>OAW-18</p>	<p>54. Square Butt joint on S.S. sheet. 2 mm thick in flat position. <b>(1G)</b>(8 hrs.)</p> <p>55. Square Butt joint on S.S. Sheet 2 mm thick in flat position. <b>(1G)</b>(8 hrs.)</p> <p>56. Square Butt joint on Brass sheet 2 mm thick in flat position. <b>(1G)</b>(9 hrs.)</p>	<p>- Brass – types – properties and welding methods.</p> <p>- Copper – types – properties and welding methods. (07 hrs)</p>
<p>Professional Skill 25 Hrs;</p> <p>Professional Knowledge 07 Hrs</p>	<p>Choose appropriate welding process and perform joining of different types of metals and check its correctness. <i>[appropriate welding process – OAW, SMAW; Different metal – SS, CI, Brass, Aluminium]</i></p> <p>Demonstrate arc gauging operation to</p>	<p>OAW-19</p> <p>SMAW-25</p> <p>AG-01</p>	<p>57. Square Butt &amp; Lap joint on M.S. sheet 2 mm thick by brazing in flat position. (11 hrs.)</p> <p>58. Single “V” butt joint C.I. plate 6mm thick in flat position. <b>(1G)</b>(11 hrs.)</p> <p>59. Arc gouging on MS plate 10 mm thick. (3 hrs.)</p>	<p>- Aluminium and its alloys, properties and weldability, Welding methods</p> <p>- Arc cutting &amp; gouging, (07 hrs)</p>

	rectify the weld joints.			
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Choose appropriate welding process and perform joining of different types of metals and check its correctness. <i>[appropriate welding process – OAW, SMAW; Different metal – SS, CI, Brass, Aluminium]</i>	OAW-20  OAW-21	60. Square Butt joint on Aluminium sheet. 3 mm thick in flat position. (12 hrs.) 61. Bronze welding of cast iron (Single “V” butt joint) 6mm thick plate <b>(1G)</b> .(13 hrs.)	- Cast iron and its properties types. - Welding methods of cast iron. (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Test welded joints by different methods of testing. <i>[different methods of testing- Dye penetration test, Magnetic particle test, Nick break test, Free band test, Fillet fracture test]</i>	I&T-02  I&T-03  I&T-04  I&T-05  I&T-06	62. Dye penetrant test. (5 hrs.) 63. Magnetic particle test. (5 hrs.) 64. Nick- break test. (5 hrs.) 65. Free bend test. (5 hrs.) 66. Fillet fracture test. (5 hrs.)	- Types of Inspection methods - Classification of destructive and NDT methods - Welding economics and Cost estimation. (07 hrs)
Professional Skill 200 Hrs; Professional Knowledge 56 Hrs	Set GMAW machine and perform welding in different types of joints on MS sheet/plate by GMAW in various positions by dip mode of metal transfer. <i>[different types of joints- Fillet (T-joint, lap, Corner), Butt (Square &amp; V); various positions- 1F, 2F, 3F,4F, 1G, 2G, 3G]</i>	GMAW- 01  GMAW - 02	67. Introduction to safety equipment and their use etc. (2 hrs.) 68. Setting up of GMAW welding machine & accessories and striking an arc. (4 hrs.) 69. Depositing straight line beads on M.S Plate. (10 hrs.) 70. Fillet weld – “T” joint on M.S plate 10mm thick in flat position by	- Safety precautions in Gas Metal Arc Welding and Gas Tungsten Arc welding. - Introduction to GMAW - equipment – accessories. - Various other names of the process. (MIG/MAG/CO <sub>2</sub> welding.) (05 hrs)

			Dip transfer. <b>(1F)</b> (4 hrs.)	
		GMAW -03	71. Fillet weld – Lap joint on M.S. sheet 3mm thick in flat position by Dip transfer. <b>(1F)</b> (5 hrs.)	<ul style="list-style-type: none"> <li>- Advantages of GMAW welding over SMAW , limitations and applications</li> <li>- Process variables of GMAW.</li> <li>- Modes of metal transfer – dip or short circuiting transfer, spray transfer (free flight transfer) and globular transfer (intermittent transfer) and Pulsed metal transfer. (05 hrs)</li> </ul>
		GMAW -04	72. Fillet weld – “T” joint on M.S. sheet 3mm thick in flat position by Dip transfer. <b>(1F)</b> (5hrs.)	
		GMAW -05	73. Fillet weld – corner joint on M.S. sheet 3mm thick in flat position by Dip transfer. <b>(1F)</b> (5 hrs.)	
		GMAW -06	74. Butt weld – Square butt joint on M.S sheet 3mm thick in flat position <b>(1G)</b> (07 hrs.)	<ul style="list-style-type: none"> <li>- Wire feed system – types – care and maintenance.</li> <li>- Welding wires used in GMAW, standard diameter and codification as per AWS. (05 hrs)</li> </ul>
		GMAW -07	75. Butt weld – Single “V” butt joint on M.S plate 10 mm thick by Dip transfer in flat position. <b>(1G)</b> (8 hrs.)	
		GMAW -08	76. Fillet weld – “T” joint on M.S plate 10mm thick in Horizontal position by Dip transfer. <b>(2F)</b> (10 hrs.)	<ul style="list-style-type: none"> <li>- Types of shielding gases and gas mixtures used in GMAW and its applications.</li> <li>- Flux cored arc welding – description, advantage, welding wires, coding as per AWS. (06 hrs)</li> </ul>
		GMAW -09	77. Fillet weld – corner joint on M.S plate 10mm thick in Horizontal position by	

			Dip transfer. <b>(2F)</b> (15 hrs.)	
		GMAW -10	78. Fillet weld – “T” joint on M.S. sheet 3mm thick in Horizontal position by Dip transfer. <b>(2F)</b> (10 hrs.)	<ul style="list-style-type: none"> <li>- Edge preparation of various thicknesses of metals for GMAW.</li> <li>- GMAW defects, causes and remedies (07 hrs)</li> </ul>
		GMAW -11	79. Fillet weld – corner joint on M.S. sheet 3mm thick in Horizontal position by Dip transfer. <b>(2F)</b> (15 hrs.)	
		GMAW -12	80. Fillet weld – “T” joint on M.S plate 10mm thick in vertical position by Dip transfer. <b>(3F)</b> (10 hrs.)	<ul style="list-style-type: none"> <li>- Heat input and techniques of controlling heat input during welding.</li> <li>- Heat distribution and effect of faster cooling (07 hrs)</li> </ul>
		GMAW -13	81. Fillet weld – corner joint on M.S plate 10mm thick in vertical position by dip transfer. <b>(3F)</b> (15 hrs.)	
		GMAW -14	82. Fillet weld – Lap joint on M.S. sheet 3mm thick in vertical position by Dip transfer. <b>(3F)</b> (10 hrs.)	<ul style="list-style-type: none"> <li>- Pre heating &amp; Post Weld Heat Treatment</li> <li>- Use of temperature indicating crayons. (07 hrs)</li> </ul>
		GMAW -15	83. Fillet weld – corner joint on M.S. sheet 3mm thick in vertical position by Dip transfer. <b>(3F)</b> (15 hrs.)	

		GMAW -16	84. Fillet weld – Lap and “T” joint on M.S sheet 3mm thick in over head position by Dip transfer. <b>(4F)</b> (15 hrs.)	- Submerged arc welding process –principles, equipment, advantages and limitations
		GMAW -17	85. Tee Joints on MS Pipe Ø 60 mm OD x 3 mm WT 1G position – Arc constant (Rolling) (10 hrs.)	- Electro slag and Electro gas welding processes– principles, equipments, advantages and limitations. (07 hrs)
		GMAW -18	86. Depositing bead on S.S sheet in flat position. (10 hrs.)	- Thermit welding process- types, principles, equipments, Thermit mixture types and applications.
		GMAW -19	87. Butt joint on Stainless steel 2 mm thick sheet in flat position by Dip transfer. (15 hrs.)	- Use of backing strips and backing bars (07 hrs)
Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Set 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. <i>[different types of joints- Fillet ( T-joint, lap, Corner), Butt (Square &amp; V) ; different metals- Aluminium, Stainless Steel; different position- 1F &amp; 1G]</i>	GTAW -01	88. Depositing bead on Aluminium sheet 2 mm thick in flat position. (10 hrs.)	- GTAW process - brief description. Difference between AC and DC welding, equipments, polarities and applications.
		GTAW -02	89. Square butt joint on Aluminium sheet 1.6mm thick in flat position. (15 hrs.)	- Various other names of the process (TIG, Argonarc) - Power sources for GTAW - AC &DC (07 hrs)
		GTAW -03	90. Fillet weld – “T” joint on Aluminium sheet 1.6 mm thick in flat position. <b>(1F)</b> (10 hrs.)	- Tungsten electrodes – types & uses, sizes and preparation
		GTAW -04	91. Fillet weld – Outside corner joint on Aluminium sheet 2 mm thick in flat position. <b>(1F)</b> (15 hrs.)	- GTAW Torches- types, parts and their functions - GTAW filler rods and selection criteria. (07 hrs)



		GTAW -05	92. Butt weld - Square butt joint on Stainless steel sheet 1.6 mm thick in flat position with purging gas <b>(1G)</b> (25 hrs.)	<ul style="list-style-type: none"> <li>- Edge preparation and fit up.</li> <li>- GTAW parameters for welding of different thickness of metals</li> <li>- Pulsed TIG welding - brief description, pulse parameters slope up and slope down.</li> </ul> (07 hrs)
		GTAW -06	93. Fillet weld – “T” joint on Stainless steel sheet 1.6 mm thick in flat position. <b>(1F)</b> (25 hrs.)	<ul style="list-style-type: none"> <li>- Argon / Helium gas properties – uses.</li> <li>- GTAW Defects, causes and remedy.</li> </ul> (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform Aluminium & MS pipe joint by GTAW in flat position.	GTAW -07	94. Pipe butt joint on Aluminium pipe Ø 50 mm x 3 mm WT in Flat position. <b>(1G)</b> (25 hrs.)	<ul style="list-style-type: none"> <li>- Friction welding process-equipment and application</li> <li>- Laser beam welding (LBW)and Electron beam welding(EBW)</li> </ul> (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Perform Aluminium & MS pipe joint by GTAW in flat position.  Set the Plasma Arc cutting machine and cut ferrous & non-ferrous metals.	GTAW -08  PAC-01	95. “T” Joints on MS Pipe Ø 50 mm OD x 3 mm WT, position – Flat <b>(1F)</b> (15 hrs.)  96. Straight cutting on ferrous and non ferrous (10 hrs.)	<ul style="list-style-type: none"> <li>- Plasma Arc Welding (PAW) and cutting (PAC) process – equipments and principles of operation.</li> <li>- Types of Plasma arc, advantages and applications.</li> </ul> (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Set the resistance spot welding machine and join MS & SS sheet.	RW-01  RW-02	97. Lap joint on Stainless steel sheet by Resistance Spot welding. (10 hrs.)  98. MS sheets joining by Resistance Spot welding (15 hrs.)	<ul style="list-style-type: none"> <li>- Resistance welding process -types, principles, power sources and welding parameters.</li> <li>- Applications and limitations.</li> </ul> (07 hrs)
Professional	Perform joining of different similar and	OAW-01	99. Square butt joint on Copper sheet 2mm	<ul style="list-style-type: none"> <li>- Metalizing – types of metalizing principles,</li> </ul>

Skill 50 Hrs; Professional Knowledge 14 Hrs	dissimilar metals by brazing operation as per standard procedure. <i>[different similar and dissimilar metals- Copper, MS, SS]</i>	OAW-02	100. "T" joint on Copper to MS sheet 2mm thick in flat position by Brazing <b>(1F)</b> (10 hrs.)	<p>thick in flat position. <b>(1G)</b> (15 hrs.)</p> <p>equipments, advantages and applications</p> <p>- Manual Oxy – acetylene powder coating process-principles of operation and applications (07 hrs)</p>
		OAW-03	101. Silver brazing on S.S Sheet with copper sheet "T" joint. (10 hrs.)	- Welding codes and standards
		OAW-04	102. Silver brazing on copper tube to tube. (15 hrs.)	- Reading of assembly drawing - Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) (07 hrs)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	<p>Repair Cast Iron machine parts by selecting appropriate welding process. <i>[Appropriate welding process- OAW, SMAW]</i></p> <p>Hard facing of alloy steel components / MS rod by using hard facing electrode.</p>	OAW - 05	103. Repair welding of broken C.I. machine parts by oxy-acetylene welding with C.I and bronze filler rod. (10 hrs.)	- Hard facing/ surfacing necessity, surface preparation, various hard facing alloys and advantages of hard facing. (06 hrs)
		SMAW-01	104. Repair welding of broken C.I machine parts by C.I. electrode. (8 hrs.)	
		SMAW-02	105. Hard surfacing practice on M.S round rod Ø 25 mm by using Hard facing electrode in flat position. (7 hrs.)	

**In-plant training / Project work**

**Broad area:**

- a) Universal welding manipulator
- b) Metal rack
- c) Cylinder trolley with chain provision for locking
- d) Welding fixture for TIG- butt/ corner joint with purging facility

### **SYLLABUS FOR CORE SKILLS**

1. Workshop Calculation & Science ( Common for one year trades) (80 hrs)
2. Engineering Drawing (80 hrs)
3. Employability Skills ( Common for all CTS trades) (160 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](http://www.bharatskills.gov.in).

<b>LIST OF TOOLS AND EQUIPMENT</b>			
<b>WELDER (For batch of 20 Candidates)</b>			
<b>S No.</b>	<b>Name of the Tools&amp; Equipment</b>	<b>Specification</b>	<b>Quantity</b>
<b>A. TRAINEES TOOL KIT ( For each additional unit trainees tool kit Sl. 1-15 is required additionally)</b>			
1.	Welding helmet fiber		20+1 Nos.
2.	Welding hand shield fiber		20+1 Nos.
3.	Chipping hammer	with metal handle 250 Grams	20+1 Nos.
4.	Chisel cold	flat 19 mm x 150 mm	20+1 Nos.
5.	Centre punch	9 mm x 127 mm	20+1 Nos.
6.	Dividers	200 mm	20+1 Nos.
7.	Stainless steel rule	300mm	20+1 Nos.
8.	Scriber	150 mm double point	20+1 Nos.
9.	Flat Tongs	350mm long	20+1 Nos.
10.	Hack saw frame	fixed 300 mm	20+1 Nos.
11.	File half round	bastard 300 mm	20+1 Nos.
12.	File flat	350 mm bastard	20+1 Nos.
13.	Hammer ball pane	1 kg with handle	20+1 Nos.
14.	Tip Cleaner		20+1 Nos.
15.	Try square	6"	20+1 Nos.
<b>B. INSTRUMENTS AND GENERAL SHOP OUTFIT - For 2 (1+1) units no additional items are required</b>			
<b>TOOLS &amp; EQUIPMENT</b>			
16.	Spindle key		4 Nos.
17.	Screw Driver	300mm blade and 250 mm blade	1 each
18.	Number punch	6 mm	2 set
19.	Letter punch	6 mm	2 set
20.	Magnifying glass	100 mm dia.	2 Nos.
21.	Universal Weld measuring gauge		2 Nos.
22.	Earth clamp	600A	6 Nos.
23.	Spanner D.E.	6 mm to 32mm	2 sets
24.	C-Clamps	10 cm and 15 cm	2 each
25.	Hammer sledge	double faced 4 kg	1 No.
26.	S.S tape	5 meters flexible in case	1 No.
27.	Electrode holder	600 amps	6 Nos.
28.	H.P. Welding torch	with 5 nozzles	2 sets

29.	Oxygen Gas Pressure	regulator double stage	2 Nos.
30.	Acetylene Gas Pressure	regulator double stage	2 Nos.
31.	CO <sub>2</sub> Gas pressure regulator	with flow meter	2 set
32.	Argon Gas pressure regulator	with flow meter	2 set
33.	Metal rack	182 cm x 152 cm x 45 cm	1 No.
34.	First Aid box		1 No.
35.	Steel lockers	with 8 Pigeon holes	2 Nos.
36.	Steel almirah / cupboard		2 Nos.
37.	Black board and easel with stand		1 No.
38.	Flash back arrester (torch mounted)		4 pairs
39.	Flash back arrester (cylinder mounted)		4 pairs
<b>GENERAL SHOP OUTFIT</b>			
40.	Welding Transformer	with all accessories (400A, OCV 60–100 V, 60% duty cycle)	1 set
41.	Welding Transformer (or) Inverter based welding machine	with all accessories (300A, OCV 60 – 100 V, 60% duty cycle)	1 set
42.	D.C Arc welding rectifiers set with all accessories	(400 A. OCV 60 – 100 V, 60% duty cycle )	1 sets
43.	GMAW welding machine	400A capacity with air cooled torch, Regulator, Gas pre-heater, Gas hose and Standard accessories	1 set
44.	AC/DC GTAW welding machine	with water cooled torch 300 A, Argon regulator, Gas hose, water circulating system and standard accessories.	1 set
45.	Air Plasma cutting equipment	with all accessories, capacity to cut 12 mm clear cut	1 set
46.	Air compressor suitable for above air plasma cutting system.		1 No.
47.	Auto Darkening Welding Helmet		2 Nos.
48.	Spot welding machine	15 KVA with all accessories	1 set
49.	Portable gas cutting machine	capable of cutting Straight & Circular with all accessories	1 set
50.	Pedestal grinder fitted with coarse	300 mm dia.	1 No.

	and medium grain size grinding wheels		
51.	Bench grinder fitted with fine grain size silicon carbide green grinding wheel	150 mm dia.	1 No.
52.	AG 4 Grinder		2 Nos.
53.	Suitable gas welding table	with fire bricks	2 Nos.
54.	Suitable Arc welding table	with positioner	6 Nos.
55.	Trolley for cylinder (H.P. Unit)		2 Nos.
56.	Hand shearing machine capacity	cut 6 mm sheets and flats	1 No.
57.	Power saw machine	14''	1 No.
58.	Portable drilling machine	(Cap. 6 mm)	1 No.
59.	Oven, electrode drying	0 to 350°C, 10 kg capacity	1 No.
60.	Work bench	340x120x75 cm with 4 bench vices of 150 mm jaw opening	4 sets
61.	Oxy Acetylene Gas cutting blow pipe		2 sets
62.	Oxygen, Acetylene Cylinders **		2 each
63.	CO <sub>2</sub> cylinder **		2 Nos.
64.	Argon gas cylinder **		2 Nos.
65.	Anvil 12 sq. inches working area with stand		1 No.
66.	Swage block		1 No.
67.	Die penetrant testing kit		1 set
68.	Magnetic particle testing Kit #		1 set
69.	Fire extinguishers (foam type and CO <sub>2</sub> type)		1. No.
70.	Fire buckets with stand		4 Nos.
71.	Portable abrasive cut-off machine		1 No.
72.	Suitable Gas cutting table		1 No.
73.	Welding Simulators for SMAW/GTAW/GMAW		1 each (Optional)
<b>C. CONSUMABLE</b>			
74.	Leather Hand Gloves	14''	20 pairs
75.	Cotton hand Gloves	8''	20 pairs
76.	Leather Apron leather		20 Nos.
77.	S.S Wire brush	5 rows and 3 rows	20 Nos. each
78.	Leather hand sleeves	16''	20 pairs
79.	Safety boots for welders		20 pairs
80.	Leg guards leather		20 pairs
81.	Rubber hose clips	½''	20 Nos.

82.	Rubber hose oxygen	8 mm dia X 10 Mtr. long as per BIS	2 Nos.
83.	Rubber hose acetylene	8 mm dia X 10 Mtr. long as per BIS	2 Nos.
84.	Arc welding cables multi cored copper	400/ 600 amp as per BIS	45 mts. each
85.	Arc welding single coloured glasses	108 mm x 82 mm x 3 mm. DIN 11A &12 A	34 Nos.
86.	Arc welding plain glass	108 mm x 82 mm x 3 mm.	68 Nos.
87.	Gas welding Goggles	with Colour glass 3 or 4A DIN	34 Nos.
88.	Safety goggles plain		34 Nos.
89.	Spark lighter		6 Nos.
90.	AG 4 Grinding wheels		10 Nos.
<b>D. CLASS ROOM FURNITURE FOR TRADE THEORY</b>			
91.	Instructor's table and Chair (Steel)		1 set
92.	Students chairs with writing pads		20 Nos.
93.	White board	size 1200mm X 900 mm	1 No.
94.	Instructor's laptop with latest configuration pre-loaded with operating system and MS Office package.		1 No.
95.	LCD projector with screen.		1 No.
96.	Welding Process, Inspection & codes DVD/ CDs.		1 set each (optional)
<p><b>Note:</b></p> <ol style="list-style-type: none"> <li><i>** Optionally Gas cylinders can also be hired as and when required.</i></li> <li><i># One machine per institute irrespective of number of units of welding trade is necessary.</i></li> </ol>			

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

<b>List of Expert members contributed/ participated for finalizing the course curriculum of Welder trade held on 12.01.17 at CSTARI, Kolkata</b>			
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1.	DEEPANKAR MALLICK, DDG (Trg.)	DGT, MSDE, New Delhi	Chairman
2.	H. V. SAMVATSAR, Director	CSTARI, Kolkata	Secretary (Trade Committee)
3.	NIRMALYA NATH, Asst. Director of Trg.	CSTARI, Kolkata	Member cum Co-coordinator
4.	RAJENDRA PRASAD, Director	DTE, Uttar Pradesh	Member
5.	R. N. BANDYOPADHAYA, OSD	Paschim Banga Society For Skill Development, Kolkata	Member
6.	SUMANTA MODAK, General Manager (Works)	EVEREADY Industries Pvt. Ltd. (Representative of <i>CII</i> )	Member
7.	S. D. SATISH CHANDRA, Manager (HR), Trg.	HAL – Koraput Division, Koraput, Odisha	Member
8.	SUMANTA CHATTERJEE, Addl. General Manager	BHEL, Power Sector ER	Member
9.	P. C. BHANDARI, Technical Advisor	J K Cement Ltd., Kanpur	Member
10.	SANJIT BHOWMICK, Asst. General Manager	Hindalco Industries Ltd., Belur Math, Howrah	Member
11.	DEBASHIS BHATTACHARYYA, JWM, /FTI	Rifle Factory, Ishapore, Ministry of Defence, Govt. India, WB	Member
12.	SATYABADI SATAPATHY, Training Officer	HAL – Koraput Division, Koraput, Odisha	Member
13.	PRABHAT SAMIR PAL, Jr. Manager	GRSE Ltd., Kolkata	Member
14.	JOYDEEP PAL MAJUMDER Asst. Work Manager	Rifle Factory, Ishapore, Ministry of Defence, Govt. India, WB	Member
15.	BHABANI PROSAD MONDAL CM/FTI	Rifle Factory, Ishapore, Ministry of Defence, Govt. India, WB	Member
16.	SUNIRMAL BASU, Asst. Inspecting Officer	Railway Workshop, Kanchrapara	Member



17.	K. L. KULI, Joint Director of Trg.	CSTARI, Kolkata	Member
18.	M. THAMIZHARASAN, Joint Director of Trg.	CSTARI, Kolkata	Member
19.	SANJAY KUMAR, Joint Director of Trg.	CSTARI, Kolkata	Member
20.	L. K. MUKHERJEE, Dy. Director of Trg.	CSTARI, Kolkata	Member
21.	U. K. MALLICK, Dy. Director	DTE&T, Odisha	Member
22.	N. R. PATTANAİK, Principal	Govt. ITI Balasore, Odisha	Member
23.	DEEPAK KUMAR, SSE/Drg./C&W	Railway Workshop, Kanchrapara	Member
24.	D. W. PATNE, Secretary	Association of Non Govt. ITI, Maharastra	Member
25.	VIVEK CHAUDHARI, Principal	Ujjwal ITI Nashirabad, Dist- Jalgaon, Maharastra	Member
26.	Fr. JOSE PADAMATTAM, Principal	Don Bosco Technical Institute, Park Circus	Member
27.	SWAMI GUNINDRANANDA, Superintendent	R. K. Mission Shilpayatan Belurmah, Howrah	Member
28.	TAPAS SENGUPTA, Instructor	ITI Howrah Homes	Member
29.	DEBIPROSHAD SARKAR, Instructor	ITI Howrah Homes	Member
30.	G. B. KOLAPATE, Instructor	Govt. ITI Andhari, Mumbai, Maharastra	Member
31.	H. B. KOSHTI, Craft Instructor	Govt. ITI Byculla, Mumbai - 400011	Member
32.	N. B. NARKAR, Craft Instructor	ITI Ambarnath, Thane, Maharastra	Member
33.	PARTHA SARKAR, Jr. Engineer/Drawing (Mech.)	Railway Workshop, Kanchrapara	Member
34.	S. K. BHATTACHARYA, Instructor	STC/KPA, Eastern Railways, Kanchrapara	Member
35.	BIKASH CHAUDHURI, Instructor	Ramakrishna Mission Shilpayatan, Belur, Howah	Member
36.	SACHIN M. LAMSE, Instructor	ITI Aundh, Pune, Maharastra	Member
37.	SOMNATH B. SAPKAL, Instructor	ITI Anudh, Pune, Maharastra	Member
38.	K. K. PANIGRAHI, Instructor	Gun Shell Factory, Cossipore	Member
39.	TARAKNATH GARAI, Instructor	ITI Howrah Homes	Member
40.	SUDHANGSHU MUKHERJEE, Sr. Tech./Dy. CEE/KPN	Eastern Railway, Kanchrapara	Member
41.	S. N. TAMBATKAR, Craft Instructor	Govt. ITI, Adheri, Mumbai	Member

Sl. No.	Name & Designation Sh/Mr./Ms.	Organization	Mentor Council Designation
<b>Members of Sector Mentor council</b>			
1.	Dr. G. Buvanashakaran	AGM, WRI, Trichy - Chairman	Chairman
2.	Dr. K. Ashok kumar	AGM, BHEL, Trichy	Member
3.	Prof. Jyothi Mukhopadhyaya	IIT, Ahmedabad	Member
4.	B. Pattabhiraman	MD, GB Engineering, Tricgy	Member
5.	Dr. Rajeev Kumar	IIT, Mandi	Member
6.	Dr. Vishalchauhan	IIT, Mandi	Member
7.	D.K. Singh	IIT, 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,	Mentor
<b>Members of Core Group</b>			
12.	M Thamizharasan	JDT, CSTARI, Kolkata	Member
13.	M Kumaravel	DDT, FTI , Bangalore	Team Leader
14.	Sushil Kumar	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, Ludhiana	Member
19.	Gopalakrishnan	TO, NIMI, Chennai	Member
20.	Manjunatha B.S	JTO, GITI, K.G.F. Karnataka	Member
21.	Venugopal PC	ITI Chalakudi, Kerala	Member

## ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprentice 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
SMAW	Shielded Metal Arc Welding
OAW	Oxy-Acetylene Gas Welding
OAG C	Oxy-Acetylene Gas Cutting
GMAW	Gas Metal Arc Welding
GTAW	Gas Tungsten Arc Welding
PAC	Plasma Arc Cutting
RW	Resistance Welding
OAW	Oxy-Acetylene Gas Welding
OAG C	Oxy-Acetylene Gas Cutting
I&T	Inspection & Testing
WT	Wall Thickness.

