

**SYLLABUS FOR THE TRADE  
OF**

# **WELDER (GAS & ELECTRIC)**

**(SEMESTER PATTERN)**

**UNDER  
CRAFTSMEN TRAINING SCHEME (CTS)**

Designed in: 2013

*By*  
Government of India  
**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**  
**Directorate General of Employment & Training**  
**Ministry of Labour & Employment**  
EN-Block, Sector-V, Salt Lake  
Kolkata-700 091

**List of members of Trade Committee meeting for the Trade of "WELDER (Gas & Electric)"**

**Held on..... at Foremen Training Institute, Bangalore -22**

SL. NO	NAME	REPRESENTING ORGANIZATION	REMARKS
1	Shri. B.S aviprasath, Joint Director/ Director I/c,	FTI, Bangalore.	Chairman
2	M.Kumaravel, Deputy Director of Training	FTI, Bangalore	Convener
3	M.Thamizharasan, Deputy Director of Training	ATI, Chennai	Member
4	C.H.Subbarao Deputy Director of Training	ATI, Hyderabad.	Member
5	J.D.Masilamani, Deputy Director of Training	FTI, Bangalore	Member
6	B.V.S.Seshachari, Deputy Director of Training	FTI, Bangalore	Member
7	D.N.Sharma, Training Officer	FTI, Bangalore	Member
8	V.L.Ponmozhi Training Officer,	CTI, Chennai	Member
9	Pazhanimurugan Junior Training Officer	Govt. ITI, KGF, Bangalore	Member
10	D.Ravichandar Junior Training Officer	Govt. ITI, Peenya, Bangalore	Member
11	M.S.Hanumantharayappa Junior Training Officer	Govt. ITI, Hosur road, Bangalore	Member
12	V.Venugopala, Junior Training Officer	Govt. ITI, Hosur road, Bangalore	Member
13	V.Muralidharan, Regional Director	IIW, Chennai.	Member
14	Martindoss, Manager	TuV Rheindland, Bangalore	Member
15	Balasubramanya, Consultant	Wipro Infrastructure Engineering, Bangalore	Member
16	V.Muralidharan, Regional Director- South	IIW-india, Chennai.	Member
17	Kishan Cariappa, Senior Manger	Volvo Construction Equipments, Bangalore.	Member
18	K.Vijayakumar, AGM,	Volvo Construction Equipments, Bangalore.	Member
19	G.Sundarraaj, AGM,	Volvo Construction Equipments, Bangalore.	Member
20	D.B.Anandkuma, Senior Engineer,	ACE Designers Ltd., Bangalore.	Member
21	M.Puttaraju, Chief Manager	HAL Engine Division, Bangalore.	Member
22	A.Chakravorty Chief Executive,	Weldcraft(P) Ltd., Bangalore.	Member
23	C.Ramnath, Group Director(Retd),	GTRE,DRDO, Bangalore.	Member
24	Trimal, Asst. Manager,	Fouress Engineering, Bangalore.	Member

**List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6<sup>th</sup> to 10<sup>th</sup> May'2013 at CSTARI, Kolkata.**

<b>Sl. No.</b>	<b>Name &amp; Designation</b>	<b>Organisation</b>	<b>Remarks</b>
1.	R.N. Bandyopadhyaya, Director	CSTARI, Kolkata-91	Chairman
2.	K. L. Kuli, Joint Director of Training	CSTARI, Kolkata-91	Member
3.	K. Srinivasa Rao, Joint Director of Training	CSTARI, Kolkata-91	Member
4.	L.K. Mukherjee, Deputy Director of Training	CSTARI, Kolkata-91	Member
5.	Ashoke Rarhi, Deputy Director of Training	ATI-EPI, Dehradun	Member
6.	N. Nath, Assistant Director of Training	CSTARI, Kolkata-91	Member
7.	S. Srinivasu, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
8.	Sharanappa, Assistant Director of Training	ATI-EPI, Hyderabad-13	Member
9.	Ramakrishne Gowda, Assistant Director of Training	FTI, Bangalore	Member
10.	Goutam Das Modak, Assistant Director of Trg./Principal	RVTI, Kolkata-91	Member
11.	Venketesh. Ch. , Principal	Govt. ITI, Dollygunj, Andaman & Nicobar Island	Member
12.	A.K. Ghate, Training Officer	ATI, Mumbai	Member
13.	V.B. Zumbre, Training Officer	ATI, Mumbai	Member
14.	P.M. Radhakrishna pillai, Training Officer	CTI, Chennai-32	Member
15.	A.Jayaraman, Training officer	CTI Chennai-32,	Member
16.	S. Bandyopadhyay, Training Officer	ATI, Kanpur	Member
17.	Suriya Kumari .K , Training Officer	RVTI, Kolkata-91	Member
18.	R.K. Bhattacharyya, Training Officer	RVTI, Trivandrum	Member
19.	Vijay Kumar, Training Officer	ATI, Ludhiana	Member
20.	Anil Kumar, Training Officer	ATI, Ludhiana	Member
21.	Sunil M.K. Training Officer	ATI, Kolkata	Member
22.	Devender, Training Officer	ATI, Kolkata	Member
23.	R. N. Manna, Training Officer	CSTARI, Kolkata-91	Member
24.	Mrs. S. Das, Training Officer	CSTARI, Kolkata-91	Member
25.	Jyoti Balwani, Training Officer	RVTI, Kolkata-91	Member
26.	Pragna H. Ravat, Training Officer	RVTI, Kolkata-91	Member
27.	Sarbojit Neogi, Vocational Instructor	RVTI, Kolkata-91	Member
28.	Nilotpala Saha, Vocational Instructor	I.T.I., Berhampore, Murshidabad, (W.B.)	Member
29.	Vijay Kumar, Data Entry Operator	RVTI, Kolkata-91	Member

## **GENERAL INFORMATION**

1. Name of the Trade : WELDER (Gas & Electric)
2. N.C.O. Code No.
3. Duration of Craftsmen Training : 12 months (2 Semesters) :
4. Power norms 15.4 KW
5. Space norms : Workshop: 66 Square meter.
6. Entry Qualification : Pass 8<sup>th</sup> Class Examination.
7. Unit size (No. of student) : 12
8. Instructor's /Trainer's qualification (A) : (i) NTC/NAC with Three years Experience in relevant field.  
(ii) Diploma in Mechanical with two years experience in relevant field.  
(iii) Degree Mechanical engineering with one year experience in relevant field.  
  
(B) Desirable qualification : Preference will be given to a candidate with Craft Instructor Certificate.

Note: At least one Instructor must have Degree/Diploma in Mechanical Engineering)

## Syllabus for the Trade of "WELDER (Gas & Electric)" under C.T.S.

Duration : Six Month

First Semester

Code : WLD-Sem-I

Week No.	Practical	Theory	Engg. Drawing	Workshop Calculation & Sciences
1	Induction training: - Familiarisation with the Institute. - Importance of trade Training - Machinery used in the trade. - Introduction to safety equipment and their use etc. - Setting up of Arc and gas Apparatus. - Lighting and setting of flame. - Striking an arc	- General discipline in the Institute - Elementary First Aid. - Importance of Welding in Industry - Safety in Manual - Metal Arc Welding, Oxy-Acetylene Welding and Cutting.	- Importance of Engineering Drawing and its Knowledge.	- Importance of Science and Calculation to the Trade skill and fundamental Arithmetical operations Addition, Subtraction, Multiplication and Division.
2	- Hack sawing, filing square to dimensions. - Marking out on MS plate and punching	- Arc and Gas Welding Equipments, tools and accessories . - Various Welding Processes and its applications . - Arc and Gas Welding terms and definitions.	- Use of Drawing Instruments. T- Square Drawing Board etc.	General simplifications - Fraction-Addition, Subtraction, multiplication and Division-Problems
3	- Fusion run with and without filler rod on M.S. sheet 1.6 mm thick in flat position by Gas welding Edge joint on M.S sheet 1.6 mm thick in flat position without filler rod by Gas welding	- Different process of metal joining bolting, riveting, soldering, brazing, seaming etc. - Types of welding joints and its applications. Edge preparation and fit up for different thickness.	- Letters, Numbers and Alphabets as per BIS	- Fraction-Addition, Subtraction, Multiplication and Division-Problems.

4	<ul style="list-style-type: none"> <li>- Straight line beads on M.S. 10 mm thick in flat position by 3.15 mm 9 electrode by arc welding</li> <li>- Weaved bead on M. S 10mm in flat position by 4 mm 0 electrode in D/H position by arc welding</li> </ul>	<ul style="list-style-type: none"> <li>- Basic electricity applicable to arc welding and related electrical terms &amp; definitions.</li> <li>- Principle of Manual Metal Arc Welding arc welding. <ul style="list-style-type: none"> <li>- Elements of flux coating</li> <li>- Shielding gases produced during welding and its importance for welding</li> <li>- Forces acting for metal transfer</li> <li>- Slag and its characteristics and functions</li> </ul> </li> <li>- Arc Welding Techniques in different positions</li> </ul>	<ul style="list-style-type: none"> <li>- Letters, Numbers and Alphabets as per BIS</li> </ul>	<ul style="list-style-type: none"> <li>- Decimal-Addition, Subtraction, Multiplication, and Division-Problems.</li> </ul>
5	<ul style="list-style-type: none"> <li>- Marking and Straight line cutting on MS flats by Gas cutting</li> <li>- Square butt joint on M.S. sheet. 2 mm thick in flat Position by gas welding.</li> <li>- Fillet Tee joint on M.S.10 mm in flat position by Arc welding. .</li> </ul>	<ul style="list-style-type: none"> <li>- Oxy-Acetylene Cutting Equipment principles, cutting parameters and applications</li> <li>- Common gases used for welding, their flame temperatures and uses.</li> <li>- Chemistry of oxy-acetylene flame.</li> <li>- Types of oxy-acetylene flames and uses.</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand Sketching of straight lines, rectangles, Circles, Polygons etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Conversion of Fraction to Decimal and vice-versa.</li> </ul>
6	<ul style="list-style-type: none"> <li>- Marking and circular cutting on MS plates 10 mm thick by Gas cutting</li> <li>- Outside corner joint on M S 2 mm in flat Position by gas welding. .</li> <li>- Fillet lap joint on M.S. 10 mm in flat position by Arc welding .</li> </ul>	<ul style="list-style-type: none"> <li>- Arc welding power sources-Transformer, Motor Generator set, Rectifier and Inverter type welding machines.</li> <li>- Advantages and disadvantages of A.C. and D.C. welding machines</li> </ul>	<ul style="list-style-type: none"> <li>- Use of different types of line and symbols for drawing.</li> <li>- Importance of putting dimension on the drawing as per BIS.</li> </ul>	<ul style="list-style-type: none"> <li>- Decimal-Addition, Subtraction, Multiplication, and Division-Problems.</li> </ul>
7	<ul style="list-style-type: none"> <li>- Beveling of MS flats on MS plates 10 mm thick by Gas cutting</li> <li>- Fillet Tee joint on M S 2 mm in flat position by gas welding .</li> <li>- Outside Corner joint on M S 10</li> </ul>	<ul style="list-style-type: none"> <li>- Welding positions - flat-horizontal-vertical and over head position. Weld slope and rotation.</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand sketching with dimension scale and proportionate sketching,</li> </ul>	<ul style="list-style-type: none"> <li>- Decimal-Addition, Subtraction, Multiplication, and Division-Problems.</li> </ul>

	mm in flat position by arc welding			
8	<ul style="list-style-type: none"> <li>- Fillet Lap joint on M S 2 mm in flat position by gas welding .</li> <li>- Single Vee Butt joint on M S 12 mm in flat position by arc welding.</li> </ul>	<ul style="list-style-type: none"> <li>- Arc length - types - effects of arc length.</li> <li>- Polarity and its uses.</li> </ul>	- Reading of simple blue print.	Metals: - Properties and uses of cast iron, wrought iron, plain carbon steels and alloy steels
9	<ul style="list-style-type: none"> <li>- Square Butt joint on M.S. sheet. 3 mm in Horizontal vertical position by gas welding</li> <li>- Straight line beads on M.S. 10 mm in Horizontal vertical position by arc welding</li> <li>- Fillet Tee joint on M.S. 6 mm in Horizontal vertical position by Arc welding .</li> </ul>	<ul style="list-style-type: none"> <li>- Calcium carbide properties and uses.</li> <li>- Manufacture of calcium carbide. -Acetylene gas Generators and manufacturing methods and properties.</li> </ul>	- Isometric views and oblique views with dimensions of such as Cube, Rectangular, Block, Cylinder etc	- Properties and uses of Cast iron, Plain carbon steels and alloy steels
10	<ul style="list-style-type: none"> <li>- Outside Corner joint on M S 2 mm in horizontal position by gas welding .</li> <li>- Fillet Lap joint on M.S. 10 mm in horizontal position by arc welding.</li> </ul>	- Acetylene gas Purifier, Hydraulic back pressure valve. Charging methods of oxygen and acetylene gases	- Explanation of simple Orthographic Projection 1st angle as per BIS	- Properties and uses of Copper, Zinc, Lead, Tin and Aluminum
11	<ul style="list-style-type: none"> <li>- Fillet Tee joint on MS 2 mm in horizontal position by gas welding</li> <li>- Outside Corner joint on M S 10 mm in horizontal position by arc welding.</li> </ul>	- Oxygen and Acetylene gas cylinders and color coding for different gas cylinders.	- Explanation of simple Orthographic projection 3rd angle, as per BIS	- Properties and uses of Brass, Bronze, Solder, Rubber and Timber.
12	<ul style="list-style-type: none"> <li>- Fillet Lap joint on M S 2 mm in horizontal position by gas welding</li> <li>- Single Vee Butt joint on MS 12 mm in horizontal position by arc welding</li> </ul>	- Gas regulators, types and uses. -Welding and gas cutting torches and types.	- Sketching the views solid bodies when viewed perpendicular to their surfaces and axes.	- System of Units -British, Metric and S. I. Units for Length, Mass, Area, Volume, Capacity, time.

13	<ul style="list-style-type: none"> <li>- Square Butt joint on M.S. sheet. 3 mm in vertical position by gas welding</li> <li>- Straight line Beads on M.S. 10 mm in vertical position by arc welding</li> <li>- Fillet Tee joint on M.S. 6 mm in vertical position by Arc welding</li> </ul>	<ul style="list-style-type: none"> <li>- Arc blow - causes and methods to control arc blow.</li> <li>- Distortion in welding and methods employed to minimize distortion</li> </ul>	<ul style="list-style-type: none"> <li>- Sketching the views solid bodies when viewed perpendicular to their surfaces and axes.</li> </ul>	<ul style="list-style-type: none"> <li>- Conversions between British and Metric Systems.</li> </ul>
14	<ul style="list-style-type: none"> <li>- Outside Corner joint on M S sheet 2 mm in vertical position by gas welding .</li> <li>- Fillet Lap joint on M.S. 10 mm in vertical position by arc welding .</li> </ul>	<ul style="list-style-type: none"> <li>- Electrode - types - functions of flux, coating factor, sizes of electrode. Coding of electrode as per BIS, AWS, and BS.</li> <li>- Effects of moisture pick up on electrodes and backing.</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand Sketching of plan and elevation of simple objects like Hexagonal bar, square bar, Circular bar, tapered bar and Hollow bar etc.</li> </ul>	<ul style="list-style-type: none"> <li>Square roots:</li> <li>- The Square and Square root of a Whole Number and Decimal,</li> <li>- Shop Problems.</li> <li>- Pythagoras Theorem-Shop Problems.</li> </ul>
15	<ul style="list-style-type: none"> <li>- Fillet Tee joint on M S sheet 2 mm in vertical position by gas welding</li> <li>- Outside Corner joint on MS plate 10 mm in vertical position by arc welding.</li> </ul>	<ul style="list-style-type: none"> <li>- Gas welding filler rods, specifications and sizes. Welding techniques - right and leftward methods.</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand Sketching of plan and elevation of simple objects like Hexagonal bar, square bar, Circular bar, tapered bar and Hollow bar etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Effects of Heat, Thermometric Scales such as a Celsius, Fahrenheit and Kelvin-Temperature measuring Instruments</li> </ul>
16	<ul style="list-style-type: none"> <li>- Fillet lap joint on M S sheet 2 mm in vertical position by gas welding.</li> <li>- Single Vee Butt joint on MS plate 12 mm in vertical position by arc welding</li> </ul>	<ul style="list-style-type: none"> <li>- Resistance welding- principle of resistance welding - types and applications.</li> </ul>	<ul style="list-style-type: none"> <li>- Views of simple Hollow and solid Bodies with Dimensions.</li> </ul>	<ul style="list-style-type: none"> <li>- Conversions between the above Scales of Temperature.</li> <li>- Units of Heat-Calorie, Specific Heat, Latent Heat, Heat Loss and Heat Gain-Simple -Problems.</li> </ul>
17	<ul style="list-style-type: none"> <li>- Square Butt joint on M.S. sheet. 3 mm in over head position by gas welding</li> <li>- Fillet Tee joint on M.S. 6 mm in over head position by Arc welding</li> </ul>	<ul style="list-style-type: none"> <li>- Brass - types - properties- uses.</li> <li>- Copper - types - properties and uses.</li> </ul>	<ul style="list-style-type: none"> <li>- Views of simple Hollow and Solid Bodies with Dimensions.</li> </ul>	<ul style="list-style-type: none"> <li>- Changing Percent to Decimal and Fraction and vice versa-Problems on Percentages related to The Trade.</li> </ul>



18	<ul style="list-style-type: none"> <li>- Outside Corner joint on M S sheet 2 mm in over head position by gas welding.</li> <li>- Fillet Lap joint on M.S. plate 10 mm in over head position by arc welding .</li> </ul>	<ul style="list-style-type: none"> <li>- Aluminium - properties- weld ability of aluminium by different welding process.</li> <li>- Cast iron- types and fusion welding of cast iron and bronze welding of cast iron.</li> </ul>	<ul style="list-style-type: none"> <li>- Construction of Orthographic Projection from the given Isometric view of shaped Blocks in First angle method.</li> </ul>	<ul style="list-style-type: none"> <li>- Percentage-Changing Percent to Decimal and Fraction and vice versa-</li> </ul>
19	<ul style="list-style-type: none"> <li>- Fillet Tee joint on M S sheet 2 mm in over head position by gas welding</li> <li>- Single Vee Butt joint on M S plate 10mm in over head position by arc welding</li> </ul>	<ul style="list-style-type: none"> <li>- Stainless steel - types- uses - welds decay and stainless steel welding by gas.</li> <li>- Welding Technique-Right Hand-Left Hand - Explanation</li> </ul>	<ul style="list-style-type: none"> <li>- Construct an orthographic Projection from the given Isometric view of shaped Blocks in First angle method.</li> </ul>	<ul style="list-style-type: none"> <li>- Problems on Percentages related to the Trade</li> </ul>
20.	<ul style="list-style-type: none"> <li>- Square Butt joint on Brass sheet. Sheet 2 mm in flat position by gas welding</li> </ul>	<ul style="list-style-type: none"> <li>- Classification of steel.</li> <li>- Welding of low, medium and high carbon steel and alloy steels.</li> </ul>	<ul style="list-style-type: none"> <li>- Construct an Orthographic Projection from the given Isometric view of shaped Blocks in 3rd angle method.</li> </ul>	<ul style="list-style-type: none"> <li>- Newton's Laws of Motion-Definite of Force-Units of Force in M.K.S. Systems and S .I. Unit of force.</li> </ul>
21	<ul style="list-style-type: none"> <li>- Square Butt joint on M.S. sheet 1.6mm by brazing.</li> <li>- Tee joint on M.S.sheet 1.6 mm by brazing.</li> </ul>	<ul style="list-style-type: none"> <li>- Weldability of metals, importance of pre heating, post heating and maintenance of interpass temperature.</li> </ul>	<ul style="list-style-type: none"> <li>- Construct an orthographic Projection from the given Isometric view of shaped Blocks In 3rd angle method.</li> </ul>	<ul style="list-style-type: none"> <li>- Ratio-Simple Problems in Ratios.</li> </ul>
22	<ul style="list-style-type: none"> <li>- Square Butt joint on Aluminium sheet. 3 mm in flat position by gas welding</li> </ul>	<ul style="list-style-type: none"> <li>- Effects of alloying elements on steel</li> </ul>	<ul style="list-style-type: none"> <li>- Construct an orthographic Projection from the given Isometric view of shaped Blocks in 3rd angle method.</li> </ul>	<ul style="list-style-type: none"> <li>- Proportion-Direct and Inverse Proportion</li> <li>- Shops Problems.</li> </ul>

23	- Bronze welding on cast iron (Single vee butt joint) 6mm by oxy-acetylene process.	- Pipe welding - specification of pipes, various types of pipe joints and welding procedure such as up-hill and downhill method	- Construct an orthographic Projection from the given Isometric view of shaped Blocks in 3rd angle method.	- Proportion-Direct and Inverse Proportion - Shops Problems.
24	- Square Butt joint on S.S. sheet. 1.6 mm in flat position by gas welding	- Pipe welding - specification of pipes, various types of pipe joints and welding procedure such as up-hill and downhill method	- Construct an orthographic Projection from the given Isometric view of shaped Blocks in 3rd angle method.	- Proportion-Direct and Inverse Proportion - Shops Problems.
25	<b>(i) Project Work , (ii)</b>			
	<b>Industrial Visit (Optional)</b>			
26	<b>Examination</b>			

## Syllabus for the Trade of "WELDER (Gas & Electric)" under C.T.S.

Duration : Six Month

Second Semester

Code : WLD-Sem-II

Week No.	Practical	Theory	Engg. Drawing	Workshop Calculation & Sciences
1	<ul style="list-style-type: none"> <li>- Depositing bead on M.S (10mm thick) in flat position (1.2mm wire and Dip transfer)</li> <li>- Fillet weld - Lap joint on M.S (10mm thick) in flat position (1.2mm wire and Dip transfer).</li> <li>- Fillet weld - Tee joint on M.S (10mm thick ) in flat position (1.2mm wire and Dip transfer).</li> <li>- Fillet weld - corner joint on M.S (10mm thick ) in flat position (1.2mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Introduction to CO<sub>2</sub> welding - equipment - accessories.</li> <li>- Description of CO<sub>2</sub> welding set with diagram.</li> </ul>	<ul style="list-style-type: none"> <li>- Print Reading related to missing lines and missing views. Exercise on Blue print</li> </ul>	<ul style="list-style-type: none"> <li>- Electricity, Current, Power, resistance, Conductors, insulators, Ohm's law, Faraday's laws of Electromagnetic induction,</li> </ul>
2	<ul style="list-style-type: none"> <li>- Fillet weld - Lap joint on M.S. (3mm thick) in flat position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - Tee joint on M.S. (3mm thick) in flat position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - corner joint on M.S. (3mm thick) in flat position (0.8 mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Advantages of CO<sub>2</sub> welding over MMAW , limitations and applications</li> <li>- Process variables and modes of metal transfer - dip or short circuiting transfer, spray transfer (free flight transfer) and globular transfer (intermittent transfer) etc.</li> </ul>	<ul style="list-style-type: none"> <li>- Simple Isometric drawing- from the given orthographic views of simple objects</li> <li>- Welding Symbols as per BIS.</li> </ul>	<ul style="list-style-type: none"> <li>- Types of Current, Effects of current and related problems.</li> </ul>

3	<ul style="list-style-type: none"> <li>- Butt weld - Single Vee butt joint on M.S (10mm thick) in flat position (1.2mm wire and Dip transfer) .</li> <li>- Butt weld - Square butt joint on M.S (3mm thick) in flat position. (0.8 mm wire and Dip transfer)</li> <li>- Butt weld - Double Vee butt joint on M.S (1.6 mm thick) in flat position (1.6mm wire and Spray transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Welding wires used in CO<sub>2</sub> welding , diameter , designation as per specification.</li> <li>- Various gases and gas mixtures used in MIG/MAG welding and its applications.</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand Sketching on rivets and washers with dimensions from samples as per BIS</li> <li>- Freehand Sketching of Riveted joints.</li> </ul>	<ul style="list-style-type: none"> <li>- Units of work in M.K.S, System and S .I. Unit of Work-</li> <li>- Simple Problems.</li> </ul>
4	<ul style="list-style-type: none"> <li>- Fillet weld - Lap joint on M.S (10 mm thick) in Horizontal position (1.2 mm wire and Dip transfer).</li> <li>- Fillet weld - Tee joint on M.S (10 mm thick ) in Horizontal position (1.2 mm wire and Dip transfer).</li> <li>- Fillet weld - corner joint on M.S (10 mm thick ) in Horizontal position (1.2 mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Wire feed system - types - applications limitations care and maintenance.</li> <li>- Flux cored arc welding - description, advantage, welding wires, diameters and specification</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand Sketching of Riveted joints.</li> <li>- Exercise on Blue Print. reading related to missing dimensions and missing section.</li> </ul>	<ul style="list-style-type: none"> <li>- Practical Units of Power such as Watt and Horse Power,</li> <li>- Definition of I.H.P., B.H.P. and Efficiency.</li> </ul>
5	<ul style="list-style-type: none"> <li>- Fillet weld - Lap joint on M.S. (3mm thick)in Horizontal position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - Tee joint on M.S. (3mm thick) in Horizontal position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - corner joint on M.S. (3mm thick) in Horizontal position (0.8 mm wire and Dip</li> </ul>	<ul style="list-style-type: none"> <li>- Edge preparation and fit up for CO<sub>2</sub> welding various thickness of metals</li> <li>- CO<sub>2</sub> Welding defects, causes and remedies</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand sketching of nuts and bolts with dimensions from Samples.</li> <li>- Freehand sketching of hand tools of the Trade.</li> </ul>	<ul style="list-style-type: none"> <li>- Definition of Energy,</li> <li>- Potential Energy.</li> <li>- Kinetic Energy</li> <li>- Law of Conservation of Energy, S.I. Unit of Energy</li> <li>- Simple Problems in P.E. and K.E.</li> </ul>

| transfer). | | |

6	<ul style="list-style-type: none"> <li>- Fillet weld - Lap joint on M.S (10mm thick) in vertical position (1.2mm wire and Dip transfer).</li> <li>- Fillet weld - Tee joint on M.S (10mm thick ) in vertical position (1.2mm wire and Dip transfer).</li> <li>- Fillet weld - corner joint on M.S (10mm thick ) in vertical position (1.2mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Importance of pressure vessel and pipe Welding</li> <li>- Safety in pressure vessel welding</li> <li>- Preparation of pipe j oints for thin wall pipe and thick wall pipes, cleaning of joints and fit-up</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand sketching of-hand tools of the trade.</li> </ul>	<ul style="list-style-type: none"> <li>- Algebraic Symbols and Fundamentals Addition, Subtraction, Multiplication and Division-Problems</li> </ul>
7	<ul style="list-style-type: none"> <li>- Fillet weld - Lap joint on M.S. (3mm thick) in vertical position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - Tee joint on M.S. (3mm thick) in vertical position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - corner joint on M.S. (3mm thick) in vertical position (0.8 mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Tack welding procedure, maintaining length of tack, pitch of tack and feathering the edges of tack welds</li> <li>- Heat input and techniques of controlling heat input during welding.</li> <li>- Heat distribution and effect of faster</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand sketching of hand tools of the trade.</li> </ul>	<ul style="list-style-type: none"> <li>- Algebraic Symbols and Fundamentals Addition, subtraction, multiplication and Division-Problems</li> </ul>
8	<ul style="list-style-type: none"> <li>- Fillet weld - Lap and Tee joint on M.S (10mm thick) in over head position (1.2mm wire and Dip transfer).</li> <li>- Fillet weld - Lap and Tee joint on M.S (3mm thick) in over head position (0.8mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Submerged arc welding process -principles, equipments advantages and limitations</li> </ul>	<ul style="list-style-type: none"> <li>- Freehand sketching of keys and cotters with their dimensions from samples as per BIS</li> </ul>	<ul style="list-style-type: none"> <li>- Algebra-Simple Equations -Problems.</li> </ul>

Single Vee butt joint on M.S pipe (100 mm OD x 6mm WT) 1.2 mm wire Position .Arc constant (Rolling) Tee  
 Elbow Joint on MS Pipe( 60 mm OD x 3 mm WT) 1.2 mm wire Dip transfer position - Arc constant (Rolling) Tee  
 Joints on MS Pipe ( 60 mm OD x 3 mm WT) 1.2 mm wire Dip transfer position - Arc constant (Rolling) Tee

Electro slag and Electro gas welding process principles, equipments, advantages and limitations dimensions from samples as per BIS

10	<ul style="list-style-type: none"> <li>- Fillet weld - Lap, Tee and corner joint on Stainless steel (2 mm thick sheet) in flat position (0.8 mm wire and Dip transfer).</li> <li>- Fillet weld - Tee a joint on Aluminium (6 mm thick) in flat position (1.2 mm wire and Dip transfer).</li> </ul>	<ul style="list-style-type: none"> <li>- Thermit welding process- equipments, thermit mixture types and applications</li> </ul>	<ul style="list-style-type: none"> <li>- Geometrical Development of Prism. Pyramid and Isometrics.</li> </ul>	<ul style="list-style-type: none"> <li>- Simple problems on straight and ball cranked levers</li> <li>- Density &amp; specific gravity</li> <li>- Mass, weight, Archimedes principle &amp; related problems.</li> </ul>
11	<ul style="list-style-type: none"> <li>- Depositing bead on Aluminium (2 mm thick) in flat position by TIG welding</li> <li>- Butt weld - Square butt joint on Aluminium (1.6mm thick ) in flat position by TIG welding</li> <li>- Fillet weld - Tee joint on Aluminium (1.6 mm thick) in flat position by TIG welding.</li> <li>- Fillet weld - Outside corner joint on Aluminium (2 mm thick ) in flat position by TIG welding.</li> </ul>	<ul style="list-style-type: none"> <li>- TIG welding process - Difference between AC and DC TIG welding, brief description, equipments ,types of polarities and applications.</li> <li>- Power sources for TIG welding AC &amp; DC - high frequency unit, D.C. suppressor unit and uses.</li> </ul>	<ul style="list-style-type: none"> <li>- Exercise on Blue Print reading related identification of welding symbols.</li> </ul>	<ul style="list-style-type: none"> <li>- Mensuration :</li> <li>- Areas - Square, Rectangle, Equilateral Triangle, Isosceles Triangle, Right Angled Triangle, Scalene Triangle-Problems</li> </ul>

12	<ul style="list-style-type: none"> <li>- Butt weld - Square butt joint on Stainless steel sheet (1.6 mm thick) in flat position by TIG welding</li> <li>- Fillet weld - Tee joint on Stainless steel sheet (1.6 mm thick) in flat position by TIG welding</li> <li>- Fillet weld - Outside corner joint on Stainless steel sheet (1.6 mm thick) in flat position. by TIG welding</li> </ul>	<ul style="list-style-type: none"> <li>- Tungsten electrodes -types &amp; uses, sizes and preparation</li> <li>- TIG welding Torches- types, parts and their functions</li> <li>- TIG welding filler rods and selection criteria</li> <li>- Edge preparation and fit up.</li> <li>- TIG welding parameters for welding different thickness of metals</li> </ul>	<ul style="list-style-type: none"> <li>- Triangular Prism and Hexagonal Prism -projection and Development</li> </ul>	<ul style="list-style-type: none"> <li>- Areas-Square, Rectangle, Equilateral Triangle, Isosceles Triangle, Right Angled Triangle, Scalene Triangle-Problems.</li> </ul>
13	<ul style="list-style-type: none"> <li>- Pipe butt joint on Aluminium pipe dia. 50 max 3 mm wall thickness in Flat position by TIG welding .</li> <li>- Root pass welding on M.S pipe (100mm ODX 6 mm WT) in Flat position by TIG welding</li> </ul>	<ul style="list-style-type: none"> <li>- Pulsed TIG welding- brief description, pulse parameters slope up and slope down</li> <li>- Argon / Helium gas properties - uses. Defects, causes and remedy</li> </ul>	<ul style="list-style-type: none"> <li>- Cylinder Projection and Development, Cone Projection and Development.</li> <li>- Examples based on right cones.</li> </ul>	<ul style="list-style-type: none"> <li>- Areas</li> <li>- Hexagon, Circle, Circular ring, Sector Ellipse-Problems.</li> </ul>
14	<ul style="list-style-type: none"> <li>- Square butt joint on M.S pipe (50 mm OD x 3 mm WT) Position -Flat by TIG welding</li> <li>- Elbow Joint on MS Pipe( 50 mm OD x 3 mm WT) position - Flat by TIG welding</li> <li>- Tee Joints on MS Pipe ( 50 mm OD x 3 mm WT) position - Flat by TIG welding</li> </ul>	<ul style="list-style-type: none"> <li>- Friction welding process-equipment and application</li> <li>- Friction stir welding process-description and advantage</li> <li>- Development of pipe for pipe welding Elbow connection</li> <li>- Development of pipe for pipe welding Tee connection</li> </ul>	<ul style="list-style-type: none"> <li>- Cylinder Projection and Development, Cone Projection and Development.</li> <li>- Examples based on right cones.</li> </ul>	<ul style="list-style-type: none"> <li>- Volume and Weight of Simple Solid bodies such as Cube, Square Prism, Rectangular Prism, Hexagonal Prism,</li> </ul>



15	<ul style="list-style-type: none"> <li>- Square butt joint on M.S pipe (50 mm OD x 3 mm WT) Position -by TIG welding</li> <li>- Elbow Joint on MS Pipe( 50 mm OD x 3 mm WT) position - Flat by TIG welding</li> <li>- Tee Joints on MS Pipe ( 50 mm OD x 3 mm WT) position - Flat by TIG welding</li> </ul>	<ul style="list-style-type: none"> <li>- Laser beam welding (LBW)and Electron beam welding(EBW)</li> <li>- Development of pipe for pipe welding Elbow connection.</li> <li>- Development of pipe for pipe welding Tee connection.</li> </ul>	<ul style="list-style-type: none"> <li>- Views of simple' solid bodies cut by section plane on drawing standard methods. (Full and Half Sections) BIS.</li> </ul>	<ul style="list-style-type: none"> <li>- Triangular Prism, Cone, Cylinder, Hollow Cylinder- Shop Problems.</li> </ul>
16	<ul style="list-style-type: none"> <li>- Pipe flange joint on M.S sheet to M.S pipe ( 50 mm OD x 3 mm WT) - position - Flat by TIG welding</li> <li>- Pipe branch joint 45° on M.S pipe ( 50 mm OD x 3 mm WT) -position - Flat by TIG welding</li> </ul>	<ul style="list-style-type: none"> <li>- Plasma Arc Welding (PAW) process - principles of operation, equipment, difference between TIG welding and Plasma Arc welding, types of arc, advantages and applications.</li> <li>- Development of pipe for Pipe welding branch joint 'Y' connection 45°</li> </ul>	<ul style="list-style-type: none"> <li>- Views of simple solid bodies cut by section plane on drawing standard methods (Full and Half Sections) BIS</li> </ul>	<ul style="list-style-type: none"> <li>- Volume and Weight of Simple Solid bodies such as Cube, Square Prism, Rectangular Prism, Hexagonal Prism, Triangular Prism, - Shop Problems.</li> </ul>
17	<ul style="list-style-type: none"> <li>- Pipe flange joint on M.S sheet to M.S pipe ( 50 mm OD x 3 mm WT) position - Flat by TIG welding</li> <li>- Pipe 'Y' joint 45° on M.S pipe ( 50 mm OD x 3 mm WT) -position - Flat by TIG welding</li> </ul>	<ul style="list-style-type: none"> <li>- Surfacing /metal buildup-Purpose, applications and different surfacing methods</li> <li>- Development of pipe for Pipe welding branch joint 'Y' connection 45°</li> </ul>	<ul style="list-style-type: none"> <li>- Exercise on Blue Print Reading.</li> <li>Sketching of finished articles from drawing and preparation of sequence of operations.</li> </ul>	<ul style="list-style-type: none"> <li>- Volume and Weight of Simple Solid bodies such as, Cone, Cylinder, Hollow Cylinder-Shop Problems.</li> </ul>
18	<ul style="list-style-type: none"> <li>- Single Vee butt joint on Cast Iron (10mm thick) by fusion welding in flat position by Gas welding</li> <li>- Lap joint on Stainless steel and MS sheets by Resistance Spot welding</li> </ul>	<ul style="list-style-type: none"> <li>- Hard facing - necessity, method of preparation, various hard facing alloys and advantages of hard facing</li> </ul>	<ul style="list-style-type: none"> <li>- Exercise on Blue Print Reading.</li> <li>Sketching of finished articles from drawing and preparation of sequence of operations.</li> </ul>	<ul style="list-style-type: none"> <li>- Finding the capacity in Liters of Square, Rectangular, Hexagon, Cone and Cylinder Shaped Vessels</li> </ul>

19	<ul style="list-style-type: none"> <li>- Square butt joint on Copper (2mm thick) in flat position</li> <li>- Tee joint on Copper to MS (2mm thick) in flat position by Brazing</li> </ul>	<ul style="list-style-type: none"> <li>- Metalizing - types of metalizing principles, equipments, advantages and applications</li> <li>- Manual Oxy - acetylene powder spray process (hot and cold) principles of operation and applications</li> </ul>	<ul style="list-style-type: none"> <li>- Free sketching of simple objects related to the trade and preparation of simple working drawing from the Sketches.</li> </ul>	<ul style="list-style-type: none"> <li>- Finding the lateral Surface Area and Total Surface Area of Square, Rectangular, Hexagon, Cone and Cylinder Shaped</li> </ul>
20	<ul style="list-style-type: none"> <li>- Silver brazing on S.S Sheet with copper sheet (Tee joint)</li> <li>- Hard surfacing practice on M.S round rod 9 25 mm by using Hard facing electrode</li> </ul>	<ul style="list-style-type: none"> <li>- Welding codes and standards</li> </ul> <p>Reading of assembly drawing</p>	<ul style="list-style-type: none"> <li>- Free sketching of simple objects related to the trade and preparation of simple working drawing from the Sketches.</li> </ul>	<ul style="list-style-type: none"> <li>- Meaning of Stress, Strain- Simple Problems.</li> </ul>
21	<ul style="list-style-type: none"> <li>- Butt weld-single Vee butt joint on 8" schedule 60 miled steel pipe in down hand position (1G) by MMAW</li> <li>- Butt weld-single Vee butt joint on 8" schedule 60 miled steel pipe in horizontal position (2G) by MMAW</li> </ul>	<ul style="list-style-type: none"> <li>- Procedure of high pressure pipe welding in 1G,2G,5G and 6G positions</li> </ul>	<ul style="list-style-type: none"> <li>- Free sketching of simple objects related to the trade and preparation of simple working drawing from the Sketches.</li> </ul>	<ul style="list-style-type: none"> <li>- Meaning of Stress, Strain- Simple Problems.</li> </ul>

22	<ul style="list-style-type: none"> <li>- Butt weld-single Vee butt joint on 8" schedule 60 mild steel pipe in 5G position (pipe axis horizontally fixed) by uphill welding MMAW</li> <li>- Butt weld-single Vee butt joint on 8" schedule 60 mild steel pipe in 6G position (up hill) by MMAW(pipe axis 45° inclined -fixed)</li> </ul>	<ul style="list-style-type: none"> <li>- Types of welding defects.</li> <li>- Identification, causes and remedy</li> </ul>	<ul style="list-style-type: none"> <li>- Conventional representation of Materials by I.S.I.</li> </ul>	<ul style="list-style-type: none"> <li>- Meaning of Stress, Strain- Simple Problems.</li> </ul>
23	Testing of weld joints by visual inspection ,Dye penetrate test, Nick-break test, and Magnetic particle test	<ul style="list-style-type: none"> <li>- Weld quality inspection, common welding mistakes and appearance of good and defective welds</li> </ul>	- Conventional representation of Materials by I.S.I.	<ul style="list-style-type: none"> <li>- Types of Current, Effects of current and related problems.</li> </ul>
24	Testing of weld joints by visual inspection ,Dye penetrate test, Nick-break test, and Magnetic particle test	<ul style="list-style-type: none"> <li>- Types of Inspection methods</li> <li>- Classification of destructive and NDT methods</li> </ul>	- Conventional representation of Materials by I.S.I.	<ul style="list-style-type: none"> <li>- Types of Current, Effects of current and related problems.</li> </ul>

25 Revision

26 Examination

LIST OF TOOLS & EQUIPMNT FOR THE TRADE OF  
**"WELDER (GAS & ELECTRIC)"**

Tools & Equipments for 12 Trainees + one

**Trainees Kit - (As per the below table)**

SI. No.	Name of the items	Quantity
1	Hand Gloves	13 nos.
2	Apron leather	13 nos.
3	Welding helmet	13 nos.
4	Welding hand shield	13 nos.
5	Gas welding Goggles with Colour glass	13 nos.
6	Chipping hammer	13 nos.
7	Chisel cold flat 19 mm x 150 mm	13 nos.
8	Centre punch 9 mm x 127 mm	13 nos.
9	Dividers 200 mm	13 nos.
10	Caliper outside 150 mm	13 nos.
11	Stainless steel rule 300mm	13 nos.
12	Wire brush 5 rows and 3 rows	13 nos.
13	Leather sleeves 16"	13 nos.
14	Safety boots for welders	13 nos.
15	Safety goggles	13 nos.
16	Scriber 150 mm	13 nos.
17	Tongs holding 350mm	13 nos.

**General Machinery Shop outfit ( as per the table)**

SI. No.	Name and Description of Tools	Quantity
18	Stainless steel rule 300mm	4
19	Hammer ball peen 1 kg with handle	4
20	Spark lighter	4
21	Spindle key	2
22	Screw Driver 300mm blade and 250 mm blade	1 each
23	Tip cleaner set	2
24	Number punch 6 mm and 1 set letter punch 6 mm	1 set
25	Hacksaw frame fixed 300 mm	4
26	Arc welding coloured glasses 108 mm x 82 mm x 3 mm. DIN 11 A &12 A	12 nos
27	Magnifying glass 100 mm dia.	2
28	Weld measuring gauge fillet and butt	1 each
29	File half round bastard 350 mm.	6
30	File flat 350 mm rough	6
31	Earth clamp	6

32	Spanner D.E. 6 mm to 32mm	2 sets
33	Clamps 10 cm and 15 cm	4 each
34	Hammer sledge double faced 4 kg	1
35	Pipe wrench 25 cm and 35 cm	1 each
36	Steel tape 5 meters flexible in case	1
37	Electrode holder 400 amps	6
38	H.P. Welding torch No. 2 with nozzle nos. 1,2,3, 5 & 7	2 sets
39	Rubber hose clips $\frac{3}{4}$ "	10
40	Welding rubber hose, oxygen 8mm. dia x 5mts.long	2
41	Welding rubber hose Acetylene 8mm. dia x 5mts. long	2
42	Gas Pressure regulator oxygen double stage	2
43	Gas Pressure regulator acetylene double stage	2

#### General Installation

44	Welding Transformer with all accessories ( 400A , OCV 60 - 100 V, 60% duty cycle)	2 sets
45	Welding Transformer with all accessories ( 300A , OCV 60 - 100 V, 60% duty cycle)	2 sets
46	D.C Arc welding rectifiers set with all accessories (400 A. OCV 60 -100 V, 60% duty cycle )	1 sets
47	Welding Generator DC rotary set 200-300 amps with all accessories	1 set
48	Suitable gas welding table with fire bricks	6 sets
49	Suitable Arc welding table with positioner	6
50	Trolley for cylinder (H.P. Unit)	2
51	Bench shear capacity up to 5 mm	1
52	Pedestal grinder fitted with coarse and medium grain size grinding wheels dia. 300 mm	2
53	Work bench 340x120x75 cm with 4 bench vices of 125 mm jaw opening	2 sets
54	Power hacksaw machine	1
55	AG 7 Grinder	1
57	Portable drilling machine (Cap. 6 mm)	1
58	Fire extinguishers (foam type and CO <sub>2</sub> type)	1
59	Metal rack 182 cm x 152 cm x 45 cm	1
60	Instructor's table and Chair (Steel)	1 set
61	Blackboard or white board	1
62	First Aid box	1
63	Fire buckets with stand	4
64	Steel lockers with 8 Pigeon holes	2
65	Oven, electrode drying 0 to 250°C, 10 kg capacity	1
66	High pressure Oxy Acetylene Gas cutting blow pipe with cutting nozzles 0.8 mm,1.2 mm and 1.6 mm	2 sets
67	Oxygen, Acetylene Cylinders	1 each
68	CO <sub>2</sub> Arc welding machine 400A capacity with air cooled torch, regulator, gas	1 set

	preheater, Gas hose and standard accessories	
<b>General Furniture</b>		
<b>SI. No</b>	<b>Names &amp; Description of Furniture</b>	<b>Quantity</b>
1.	Work bench 250x120x75 with four vices of 12.5 cm	4
2.	Locker with 8 drawers ( standard size )	2
3.	Metal Rack 180x150x45cm	2
4.	Steel almirah / cupboard	1
5.	Black board and easel	1
6.	Instructor's Desk or table	1
7.	Chair	1
69	AC/DC TIG welding machine with water cooled torch 300 A, Argon regulator, gas hose, water circulating pump and standard accessories	1 set
70	Bench grinder fitted with fine grain size silicon carbide green grinding wheel dia. 150 mm	1
71	Die penetrant testing kit	1 set
72	Magnetic particle testing Kit	1 set
73	Tip Cleaner	8 nos.

NOTE:

1. No additional items are required to be provided for unit or batch working in the Second shift except the items under trainee's tool kit lockers.
2. Provision of cleaning of periodically welding helmets and goggles with antiseptic solution should be made as these are likely to be used by more than one trainee.