

**SYLLABUS OF SEMESTER SYSTEM  
FOR THE TRADE OF**

**WELDER (Welding & Inspection)**

**SEMESTER-I & II**

**Under**

**Craftsmen Training Scheme (CTS)  
(One year/Two Semesters)**

**Redesigned in  
2014**

**By  
Government of India  
Ministry of Labour & Employment (DGE&T)**

## **GENERAL INFORMATION**

- 1. Name of the Trade** : **WELDER ( Welding & Inspection)**
- 2. N.C.O. Code No.** : **7212.10, 7212.20, 7212.40, & 7212.50**
- 3. Duration of Craftsmen Training** : 12 months (2 Semesters)
- 4. Power norms** : 16 KW
- 5. Space norms** : Workshop: 80 Square meters. (5 Sq.m/trainee)
- 6. Entry Qualification** : Pass 8<sup>th</sup> Class Examination
- 7. Unit size (No. of student)** : 16

**8. Instructor's /Trainer's qualification Trade theory & trade practical**

(A) : Essential (any one of the below)

- (i) NTC/NAC with Three years Experience in relevant field with Craft Instructors Training Certificate.
- (ii) Diploma in Mechanical and allied with two years experience in relevant field.
- (iii) Degree in Mechanical / Metallurgy / Production Engineering/Mechatronics with one Year experience in relevant field.

(B) Desirable qualification: for (ii) & (iii) Craft Instructors Training Certificate.

**Note:**

- (i) Out of two Instructors required for the unit of 1+1, one must have Degree/Diploma and other must have NTC/NAC qualifications.
- (ii) Instructor qualification for W/shop Calculation, Engg Drawing & Employability Skill would be as per the training manual.

## **COURSE INFORMATION**

### **Introduction**

- This course is meant for the candidates who aspire to become a professional welder with inspection skills.
- This course is renamed & restructured as WELDER(WELDING & INSPECTION) from the existing COE Fabrication sector as follows.
  - First year BBT - Basic welding ( 2months) module is converted in to CTS first semester WELDER (WELDING & INSPECTION) course.
  - Second year advanced module WELDING INSPECTION & TESTING is converted in to CTS Second semester WELDER (WELDING & INSPECTION) course.

### **Terminal Competencies/Deliverables:**

After successful completion of this course the trainee shall be able to perform the following skills with proper sequence.

1. Welding of M.S. Sheet and M.S. Pipe by GAS welding process.
2. Welding of M.S. Plate in all position by SMAW process.
3. Straight, Bevel & Circular cutting on MS. Plate by Oxy-Acetylene cutting process.
4. Repair & Maintenance works
5. Measurement using Vernier calipers, Micrometer, height gauges and weld gauges
6. Carry out welding using GMAW & GTAW plants
7. Inspect and test welds by using Non-destructive Testing methods-PT, MPT, UT
8. Study of IIW /ASTM reference Radiograph to Interpret Radiographic films
9. Prepare weld test reports.

### **Employment opportunities:**

On successful completion of this course, the candidates shall be gain fully employed in the following sectors of industries:

1. Structural Fabrication like bridges, Roof and Building construction.
2. Site construction activities for power stations, process industries and mining.
3. Service industries like road transportation and Railways.
4. Ship building and repair
5. Automobile and body building industries
6. In public sector industries like HAL, BHEL,BEML, NTPC, etc. and private industries in India and abroad.
7. Petrochemical industries like ONGC,IOCL,HPCL etc
8. In addition to the above, the candidate by virtue of his capability to inspect the weld, shall be employed as welding supervisors and in quality control activities.
- 9 Self employment

### **Further learning pathways:**

- On successful completion of the course trainees can opt for additional NCVT certificates in the following courses by doing the second semester since the first semester is common for all welder courses.
  - WELDER,
  - WELDER (GTAW &GMAW),
  - WELDER (PIPE),
  - WELDER (STRUCTURAL),
  - WELDER (FABRICATION & FITTING)
- Also on successful completion of the course they can pursue Apprenticeship training in the reputed Industries / Organisations.

**SYLLABUS FOR TRADE PRACTICAL AND TRADE THEORY**

**SEMESTER-I**

| <b>Week No</b> | <b>Trade Practical</b>   | <b>Trade Theory</b>   |
|----------------|--|---|
| 1              | F-01<br>F-02<br>- Induction training:<br>- Familiarisation with the Institute.<br>- Importance of trade Training<br>- Machinery used in the trade.<br>- Introduction to safety equipment and their use etc.<br>- Hack sawing, filing square to dimensions.<br>- Marking out on MS plate and punching . | - General discipline in the Institute<br>- Elementary First Aid.<br>- Importance of Welding in Industry<br>- Safety precautions in Shielded Metal Arc Welding, and Oxy-Acetylene Welding and Cutting.                                   |
| 2              | - Setting up of Arc welding machine & accessories and Striking an arc<br>- Setting of oxy-acetylene welding equipment, Lighting and setting of flame.  | - Introduction and definition of welding.<br>- Arc and Gas Welding Equipments, tools and accessories .<br>- Various Welding Processes and its applications .<br>- Arc and Gas Welding terms and definitions.                            |
| 3              | OAW-01<br>OAW-02<br>OAGC-01<br>- Fusion run without and with filler rod on M.S. sheet 2 mm thick in flat position.<br>- Edge joint on MS sheet 2 mm thick in flat position with out filler rod.<br>- Marking and straight line cutting of MS plate. 10 mm thick by gas.                                | - Different process of metal joining methods: Bolting, riveting, soldering, brazing, seaming etc.<br>- Types of welding joints and its applications. Edge preparation and fit up for different thickness.<br>- Surface Cleaning         |
| 4              | SMAW-01<br>SMAW-02<br>- Straight line beads on M.S. plate 10 mm thick in flat position.<br>- Weaved bead on M. S plate 10mm thick in flat position.  | - Basic electricity applicable to arc welding and related electrical terms & definitions.<br>- Heat and temperature and its terms related to welding<br>- Principle of arc welding. And characteristics of arc .                        |
| 5              | OAW-03<br>SMAW-03<br>- Square butt joint on M.S. sheet 2 mm thick in flat Position .<br>- Fillet "T" joint on M.S. Plate 10 mm thick in flat position.   | - Common gases used for welding & cutting, flame temperatures and uses.<br>- Chemistry of oxy-acetylene flame.<br>- Types of oxy-acetylene flames and uses.<br>- Oxy-Acetylene Cutting Equipment principle, parameters and application. |
| 6              | OAGC-02<br>OAW-04<br>SMAW-04<br>- Beveling of MS plates 10 mm thick. By gas cutting.<br>- Open corner joint on MS sheet 2 mm thick in flat Position<br>- Fillet lap joint on M.S. plate 10 mm thick in flat position.  | - Arc welding power sources: Transformer, Motor Generator set, Rectifier and Inverter type welding machines and its care & maintenance..<br>- Advantages and disadvantages of A.C. and D.C. welding machines                            |
| 7              | OAGC-03<br>OAW-05<br>SMAW-05<br>- Circular gas cutting on MS plate 10 mm thick by profile cutting machine.<br>- Fillet "T" joint on MS sheet 2 mm thick in flat position<br>- Open Corner joint on MS plate 10 mm thick in flat position.  | - Welding positions as per EN & ASME : flat, horizontal, vertical and over head position.<br>- Weld slope and rotation.<br>- Welding symbols as per BIS & AWS.  |

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|----|-------------------------------|--|--|
|    |                               |  |  |
| 8  | OAW-06<br>SMAW-06             | <ul style="list-style-type: none"> <li>- Fillet Lap joint on MS sheet 2 mm thick in flat position.</li> <li>- Single “V” Butt joint on MS plate 12 mm thick in flat position (1G) .</li> </ul>   | <ul style="list-style-type: none"> <li>- Arc length – types – effects of arc length.</li> <li>- Polarity: Types and applications.</li> </ul>   |
| 9  | OAW-07<br>SMAW-07<br>SMAW-08  | <ul style="list-style-type: none"> <li>- Square Butt joint on M.S. sheet. 2 mm thick in Horizontal position .</li> <li>- Straight line beads and multi layer practice on M.S. Plate 10 mm thick in Horizontal position.</li> <li>- Fillet “ T” joint on M.S.plate 10 mm thick in Horizontal position.</li> </ul> | <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</li> </ul>  |
| 10 | OAW-08<br>SMAW-9              | <ul style="list-style-type: none"> <li>- Fillet Lap joint on M.S. sheet 2 mm thick in horizontal position .</li> <li>- Fillet Lap joint on M.S. plate 10 mm thick in horizontal position .</li> </ul>  | <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 and Color coding for different gas cylinders.</li> <li>- Gas regulators, types and uses.</li> </ul> |
| 11 | OAW-9<br>OAW-10<br>SMAW-10    | <ul style="list-style-type: none"> <li>- Fusion run with filler rod in vertical position on 2mm thick M.S sheet</li> <li>- Square Butt joint on M.S. sheet. 2 mm thick in vertical position</li> <li>- Single Vee Butt joint on M.S. plate 12 mm thick in horizontal position (2G).</li> <li>-</li> </ul>        | <ul style="list-style-type: none"> <li>- Oxy acetylene gas welding Systems (Low pressure and High pressure). Difference between gas welding blow pipe(LP &amp; HP) and gas cutting blow pipe</li> <li>- Gas welding techniques. Rightward and Leftward techniques.</li> </ul>  |
| 12 | SMAW- 11<br>OAW-11<br>SMAW-12 | <ul style="list-style-type: none"> <li>- Weaved bead on M.S Plate 10mm in vertical position.</li> <li>- Fillet “T” joint on M.S sheet 2 mm thick in vertical position .</li> <li>-Fillet “T” joint on M.S. plate 10 mm thick in vertical position.</li> </ul>  | <ul style="list-style-type: none"> <li>- Arc blow – causes and methods of controlling.</li> <li>- Distortion in arc &amp; gas welding and methods employed to minimize distortion</li> <li>- Arc Welding defects, causes and Remedies.</li> </ul>  |
| 13 | OAW-12<br>SMAW-13             | <ul style="list-style-type: none"> <li>- Structural pipe welding butt joint on MS pipe Ø 50 and 3mm WT in 1G position.</li> <li>- Fillet Lap joint on M.S. Plate 10 mm in vertical position.</li> </ul>  | <ul style="list-style-type: none"> <li>- Specification of pipes, various types of pipe joints, pipe welding positions, and procedure.</li> <li>- Difference between pipe welding and plate welding.</li> </ul>   |
| 14 | SMAW-14<br>OAW-13             | <ul style="list-style-type: none"> <li>- Open Corner joint on MS plate 10 mm thick in vertical position.</li> <li>-Pipe welding - Elbow joint on MS pipe Ø 50 and 3mm WT.</li> </ul>   | <ul style="list-style-type: none"> <li>- Pipe development for Elbow joint, “T” joint, Y joint and branch joint</li> <li>- Manifold system</li> </ul>   |
| 15 | OAW-14<br>SMAW-15             | <ul style="list-style-type: none"> <li>- Pipe welding “T” joint on MS pipe Ø 50 and 3mm WT.</li> <li>- Single “V” Butt joint on MS plate12 mm thick in vertical position (3G) .</li> </ul>   | <ul style="list-style-type: none"> <li>- Gas welding filler rods, specifications and sizes.</li> <li>- Gas welding fluxes – types and functions.</li> <li>- Gas Brazing &amp; Soldering : principles, types fluxes &amp; uses</li> <li>- Gas welding defects, causes and remedies.</li> </ul>  |
| 16 | OAW-15                        | <ul style="list-style-type: none"> <li>- Pipe welding 45 ° angle joint on MS pipe Ø 50 and 3mm WT.</li> </ul>  | <ul style="list-style-type: none"> <li>- Electrode : types, functions of flux, coating factor, sizes of electrode</li> </ul>   |

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|----|---|--|---|
|    | SMAW-16                                   | - Straight line beads on M.S. plate 10mm thick in over head position.  | - Coding of electrode as per BIS, AWS,<br>- Effects of moisture pick up.<br>- Storage and baking of electrodes.<br>- Special purpose electrodes and their applications. |
| 17 | SMAW-17<br>SMAW-18                        | - Pipe Flange joint on M.S plate with MS pipe Ø 50 mm X 3mm WT<br>- Fillet “T” joint on M.S. plate 10 mm thick in over head position.  | - Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature.   |
| 18 | SMAW-19<br>SMAW-20                        | - Pipe welding butt joint on MS pipe Ø 50 and 5 mm WT. in 1G position.<br>- Fillet Lap joint on M.S. plate 10 mm thick in over head position.  | - Classification of steel.<br>- Welding of low, medium and high carbon steel and alloy steels.  |
| 19 | SMAW-21<br>SMAW-22                        | - Single “V” Butt joint on MS plate 10mm thick in over head position(4G)<br>- Pipe butt joint on M. S. pipe Ø 50mm WT 6mm (1G Rolled).   | - Effects of alloying elements on steel<br>- Stainless steel : types- weld decay and weldability.   |
| 20 | OAW-16<br>SMAW -23<br>OAW-17              | - Square Butt joint on S.S. sheet. 2 mm thick in flat position.<br>- Square Butt joint on S.S. Sheet 2 mm thick in flat position.<br>- Square Butt joint on Brass sheet 2 mm thick in flat position. | - Brass – types – properties and welding methods.<br>- Copper – types – properties and welding methods.   |
| 21 | OAW-18<br>SMAW-24<br>AG-01                | - Square Butt & Lap joint on M.S. sheet 2 mm thick by brazing.<br>- Single “V” butt joint C.I. plate 6mm thick in flat position.<br>- Arc gouging on MS plate 10 mm thick.                           | - Aluminium and its alloys, properties and weldability, Welding methods<br>- Arc cutting & gouging,   |
| 22 | OAW-19<br>OAW-20                          | - Square Butt joint on Aluminium sheet. 3 mm thick in flat position .<br>- Bronze welding of cast iron (Single “V” butt joint) 6mm thick plate   | - Cast iron and its properties types.<br>- Welding methods of cast iron.  |
| 23 | <b>Industrial Training / Project Work</b> |  |   |
| 24 | <b>Industrial Training / Project Work</b> |  |   |
| 25 | <b>Revision</b>                           |  |   |
| 26 | <b>Examination</b>                        |  |   |

**Abbreviations:**

|      |                              |
|------|------------------------------|
| SMAW | - Shielded Metal Arc Welding |
| OAW  | - Oxy-Acetylene gas Welding  |
| OAGC | - Oxy-Acetylene Gas Cutting  |
| F    | - Fitting                    |
| WT   | - Wall Thickness.            |

## SYLLABUS FOR TRADE PRACTICAL AND TRADE THEORY

### SEMESTER-I

| Week No | Trade Practical  | Trade Theory  |
|---------|--|---|
| 1       | F-01<br>F-02<br>- Induction training:<br>- Familiarisation with the Institute.<br>- Importance of trade Training<br>- Machinery used in the trade.<br>- Introduction to safety equipment and their use etc.<br>- Hack sawing, filing square to dimensions.<br>- Marking out on MS plate and punching . | - General discipline in the Institute<br>- Elementary First Aid.<br>- Importance of Welding in Industry<br>- Safety precautions in Shielded Metal Arc Welding, and Oxy-Acetylene Welding and Cutting.                                   |
| 2       | - Setting up of Arc welding machine & accessories and Striking an arc<br>- Setting of oxy-acetylene welding equipment, Lighting and setting of flame.  | - Introduction and definition of welding.<br>- Arc and Gas Welding Equipments, tools and accessories .<br>- Various Welding Processes and its applications .<br>- Arc and Gas Welding terms and definitions.                            |
| 3       | OAW-01<br>OAW-02<br>OAGC-01<br>- Fusion run without and with filler rod on M.S. sheet 2 mm thick in flat position.<br>- Edge joint on MS sheet 2 mm thick in flat position with out filler rod.<br>- Marking and straight line cutting of MS plate. 10 mm thick by gas.                                | - Different process of metal joining methods: Bolting, riveting, soldering, brazing, seaming etc.<br>- Types of welding joints and its applications. Edge preparation and fit up for different thickness.<br>- Surface Cleaning         |
| 4       | SMAW-01<br>SMAW-02<br>- Straight line beads on M.S. plate 10 mm thick in flat position.<br>- Weaved bead on M. S plate 10mm thick in flat position.  | - Basic electricity applicable to arc welding and related electrical terms & definitions.<br>- Heat and temperature and its terms related to welding<br>- Principle of arc welding. And characteristics of arc .                        |
| 5       | OAW-03<br>SMAW-03<br>- Square butt joint on M.S. sheet 2 mm thick in flat Position .<br>- Fillet "T" joint on M.S. Plate 10 mm thick in flat position.   | - Common gases used for welding & cutting, flame temperatures and uses.<br>- Chemistry of oxy-acetylene flame.<br>- Types of oxy-acetylene flames and uses.<br>- Oxy-Acetylene Cutting Equipment principle, parameters and application. |
| 6       | OAGC-02<br>OAW-04<br>SMAW-04<br>- Beveling of MS plates 10 mm thick. By gas cutting.<br>- Open corner joint on MS sheet 2 mm thick in flat Position<br>- Fillet lap joint on M.S. plate 10 mm thick in flat position.  | - Arc welding power sources: Transformer, Motor Generator set, Rectifier and Inverter type welding machines and its care & maintenance..<br>- Advantages and disadvantages of A.C. and D.C. welding machines                            |
| 7       | OAGC-03<br>OAW-05<br>SMAW-05<br>- Circular gas cutting on MS plate 10 mm thick by profile cutting machine.<br>- Fillet "T" joint on MS sheet 2 mm thick in flat position<br>- Open Corner joint on MS plate 10 mm thick in flat position.  | - Welding positions as per EN &ASME : flat, horizontal, vertical and over head position.<br>- Weld slope and rotation.<br>- Welding symbols as per BIS & AWS.   |

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|----|-------------------------------|---|--|
| 8  | OAW-06<br>SMAW-06             | <ul style="list-style-type: none"> <li>- Fillet Lap joint on MS sheet 2 mm thick in flat position.</li> <li>- Single “V” Butt joint on MS plate 12 mm thick in flat position (1G) .</li> </ul>  | <ul style="list-style-type: none"> <li>- Arc length – types – effects of arc length.</li> <li>- Polarity: Types and applications.</li> </ul>   |
| 9  | OAW-07<br>SMAW-07<br>SMAW-08  | <ul style="list-style-type: none"> <li>- Square Butt joint on M.S. sheet. 2 mm thick in Horizontal position .</li> <li>- Straight line beads and multi layer practice on M.S. Plate 10 mm thick in Horizontal position.</li> <li>- Fillet “ T” joint on M.S. plate 10 mm thick in Horizontal position.</li> </ul> | <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</li> </ul>  |
| 10 | OAW-08<br>SMAW-09             | <ul style="list-style-type: none"> <li>- Fillet Lap joint on M.S. sheet 2 mm thick in horizontal position .</li> <li>- Fillet Lap joint on M.S. plate 10 mm thick in horizontal position .</li> </ul>   | <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 and Color coding for different gas cylinders.</li> <li>- Gas regulators, types and uses.</li> </ul> |
| 11 | OAW-09<br>OAW-10<br>SMAW-10   | <ul style="list-style-type: none"> <li>- Fusion run with filler rod in vertical position on 2mm thick M.S sheet</li> <li>- Square Butt joint on M.S. sheet. 2 mm thick in vertical position</li> <li>- Single Vee Butt joint on M.S. plate 12 mm thick in horizontal position (2G).</li> <li>-</li> </ul>         | <ul style="list-style-type: none"> <li>- Oxy acetylene gas welding Systems (Low pressure and High pressure). Difference between gas welding blow pipe(LP &amp; HP) and gas cutting blow pipe</li> <li>- Gas welding techniques. Rightward and Leftward techniques.</li> </ul>  |
| 12 | SMAW- 11<br>OAW-11<br>SMAW-12 | <ul style="list-style-type: none"> <li>- Weaved bead on M.S Plate 10mm in vertical position.</li> <li>- Fillet “T” joint on M.S sheet 2 mm thick in vertical position .</li> <li>-Fillet “T” joint on M.S. plate 10 mm thick in vertical position.</li> </ul>   | <ul style="list-style-type: none"> <li>- Arc blow – causes and methods of controlling.</li> <li>- Distortion in arc &amp; gas welding and methods employed to minimize distortion</li> <li>- Arc Welding defects, causes and Remedies.</li> </ul>  |
| 13 | OAW-12<br>SMAW-13             | <ul style="list-style-type: none"> <li>- Structural pipe welding butt joint on MS pipe Ø 50 and 3mm WT in 1G position.</li> <li>- Fillet Lap joint on M.S. Plate 10 mm in vertical position.</li> </ul>   | <ul style="list-style-type: none"> <li>- Specification of pipes, various types of pipe joints, pipe welding positions, and procedure.</li> <li>- Difference between pipe welding and plate welding.</li> </ul>   |
| 14 | SMAW-14<br>OAW-13             | <ul style="list-style-type: none"> <li>- Open Corner joint on MS plate 10 mm thick in vertical position.</li> <li>-Pipe welding - Elbow joint on MS pipe Ø 50 and 3mm WT.</li> </ul>  | <ul style="list-style-type: none"> <li>- Pipe development for Elbow joint, “T” joint, Y joint and branch joint</li> <li>- Manifold system</li> </ul>   |
| 15 | OAW-14<br>SMAW-15             | <ul style="list-style-type: none"> <li>- Pipe welding “T” joint on MS pipe Ø 50 and 3mm WT.</li> <li>- Single “V” Butt joint on MS plate12 mm thick in vertical position (3G) .</li> </ul>  | <ul style="list-style-type: none"> <li>- Gas welding filler rods, specifications and sizes.</li> <li>- Gas welding fluxes – types and functions.</li> <li>- Gas Brazing &amp; Soldering : principles, types fluxes &amp; uses</li> <li>- Gas welding defects, causes and remedies.</li> </ul>  |
| 16 | OAW-15                        | <ul style="list-style-type: none"> <li>- Pipe welding 45 ° angle joint on MS pipe Ø 50 and 3mm WT.</li> </ul>   | <ul style="list-style-type: none"> <li>- Electrode : types, functions of flux, coating factor, sizes of electrode</li> <li>- Coding of electrode as per BIS, AWS,</li> </ul>   |

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|----|---|--|---|
|    | SMAW-16                                   | - Straight line beads on M.S. plate 10mm thick in over head position.  | - Effects of moisture pick up.<br>- Storage and baking of electrodes.<br>- Special purpose electrodes and their applications. |
| 17 | SMAW-17<br>SMAW-18                        | - Pipe Flange joint on M.S plate with MS pipe Ø 50 mm X 3mm WT<br>- Fillet “T” joint on M.S. plate 10 mm thick in over head position.  | - Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature.                   |
| 18 | SMAW-19<br>SMAW-20                        | - Pipe welding butt joint on MS pipe Ø 50 and 5 mm WT. in 1G position.<br>- Fillet Lap joint on M.S. plate 10 mm thick in over head position.  | - Classification of steel.<br>- Welding of low, medium and high carbon steel and alloy steels.                                |
| 19 | SMAW-21<br>SMAW-22                        | - Single “V” Butt joint on MS plate 10mm thick in over head position(4G)<br>- Pipe butt joint on M. S. pipe Ø 50mm WT 6mm (1G Rolled).   | - Effects of alloying elements on steel<br>- Stainless steel : types- weld decay and weldability.                             |
| 20 | OAW-16<br>SMAW -23<br>OAW-17              | - Square Butt joint on S.S. sheet. 2 mm thick in flat position.<br>- Square Butt joint on S.S. Sheet 2 mm thick in flat position.<br>- Square Butt joint on Brass sheet 2 mm thick in flat position. | - Brass – types – properties and welding methods.<br>- Copper – types – properties and welding methods.                       |
| 21 | OAW-18<br>SMAW-24<br>AG-01                | - Square Butt & Lap joint on M.S. sheet 2 mm thick by brazing.<br>- Single “V” butt joint C.I. plate 6mm thick in flat position.<br>- Arc gouging on MS plate 10 mm thick.                           | - Aluminium and its alloys, properties and weldability, Welding methods<br>- Arc cutting & gouging,                           |
| 22 | OAW-19<br>OAW-20                          | - Square Butt joint on Aluminium sheet. 3 mm thick in flat position .<br>- Bronze welding of cast iron (Single “V” butt joint) 6mm thick plate   | - Cast iron and its properties types.<br>- Welding methods of cast iron.  |
| 23 | <b>Industrial Training / Project Work</b> |  |   |
| 24 | <b>Industrial Training / Project Work</b> |  |   |
| 25 | <b>Revision</b>                           |  |   |
| 26 | <b>Examination</b>                        |  |   |

**Abbreviations:**

|      |                              |
|------|------------------------------|
| SMAW | - Shielded Metal Arc Welding |
| OAW  | - Oxy-Acetylene gas Welding  |
| OAGC | - Oxy-Acetylene Gas Cutting  |
| F    | - Fitting                    |
| WT   | - Wall Thickness.            |

**SYLLABUS FOR TRADE PRACTICAL AND TRADE THEORY**  
**SEMESTER-II**

| Week No | Trade Practical   | Trade Theory  |
|---------|---|---|
| 1       | Familiarisation with the machinery/ instruments used in the trade<br>Handling of measuring instruments - Steel tape, Vernier Caliper, spirit level, micrometer, Try square, Plum drop etc.<br>Simple dimensional measurements using the appropriate instruments | Outline of various subjects to be covered<br>Quality and its definition<br>Inspection methods<br>Measuring Instruments and least count<br>Dimension report preparation<br>Types of metals & characteristics<br>Classification of steels   |
| 2       | Identification of materials<br>Setting up of Gas welding equipment  | Types of welding process<br>Advantages & limitations<br>Various types of welding power sources  |
| 3       | Simple gas welding exercises on sheet metals (Butt & Fillet welds )   | Welding parameters<br>Different types of weld joints<br>Gas welding principle and application<br>Safety in welding and cutting  |
| 4       | Lay out marking on plates<br>Marking on structural sections - I, L, C etc.<br>Development marking for cylinders   | Marking with pantograph<br>Gas cutting principles, basic CNC profile cutting<br>Different size and shape of rolled sections   |
| 5       | Gas cutting of MS plate, I section and channels<br>Profile cutting  | Basic welding metallurgy (pre heating, post heating etc.)<br>Welding symbol and its nomenclatures<br>Effects of heat.   |
| 6       | Making square butt joint on MS sheet in down hand position by SMAW<br>Making single V - Butt joint on MS sheet in down hand position by SMAW<br>Use of backing strip for root run welding   | Principle of Shielded metal Arc welding (SMAW)<br>Function of flux and baking requirements<br>Selection of electrodes and coating factors<br>Different type of edge preparation<br>Welding procedure - Edge preparation and fit up, use of backing strips and bars, root run welding and cover pass welding |
| 7       | Setting up GTAW welding plant.<br>Beading practicing by TIG<br>Square butt and corner joint on M.S by TIG<br>Butt, T and Corner joint on S.S sheet  | Introduction to GTAW welding<br>TIG welding equipments<br>Advantages of TIG welding process<br>Accessories - HF unit and DC suppressor.<br>Tungsten electrode, Types, sizes, and uses.<br>Type of shielding gases<br>Purging Methods<br>Parameter setting   |
| 8       | Setting up GMAW welding plant<br>Straight line beads on MS plate by C02 welding<br>Lap T & corner joint on MS plate by C02 welding<br>Single V - Butt joint by C02 welding  | GMAW welding process<br>Power source & accessories<br>Wire Feed unit<br>Modes of metal transfer - Dip, Globular, spray & pulsed transfer and its significance   |

|    |  |   |
|----|--|---|
|    |  | Welding wire types and specification & Parameter setting  |
| 9  | Pipe weld joint development & fit up on elbow and T- joint                     | Classifications of pipes and tubes<br>Various types of pipe joints<br>Development of pipe - elbow and T- joint  |
| 10 | Pipe joint root welding by TIG   | Various equipments used for root pass cleaning<br>Pipe bending<br>Pipe welding procedure  |
| 11 | Visual Inspection of welds.<br>Application of weld gauge                       | Types of Welding defects (Cracks, Inclusions, Incomplete penetration, Lack of fusion, Under cut, Burn through, Overlap etc.)  |
| 12 | Dimensional inspection of weldments using weld measuring gauges                | Causes for defects.<br>Remedial measures<br>Inspection methods  |
| 13 | Hardness Testing<br>Bend Testing of Weldments<br>Tensile testing               | Mechanical Testing of Metals.<br>Principles, Applications of - Hardness testing ( Rockwell and Brinell ) - Impact testing ( Izod and Charpy ) - Tensile testing and Bend Test |
| 14 | Evaluation of welding defects using Dye penetrant testing method on plate      | Non destructive Testing of Metals.<br>Visual inspection<br>Dye penetrant test - Principles - Advantages - Limitations - Types of Penetrants - Cleaners - Dwelling time        |
| 15 | Evaluation of welding defects using Dye penetrant testing method on pipe       | Dye penetrant test - Types of Penetrants - Cleaners - Dwelling time   |
| 16 | Evaluation of welding defects using and Magnetic Particle Testing              | Magnetic Particle Test - Principles - Advantages - Limitations -<br>Types of Magnetation - Current requirements - Testing equipments - Indication and Interpretations         |
| 17 | Ultrasonic Flaw detector- Setting & calibration                                | Ultrasonic Testing - Principles - Advantage - Limitation  |
| 18 | Ultrasonic Flaw detector- probe identification & application on pipes & plates | Types of UT Waves - Attenuation - Types of Transducers - Couplants - Equipments and controls - Type of scans  |
| 19 | Ultrasonic Flaw detector- application on weldments of various metals.          | Measuring Techniques - Standard reference blocks - Contact Testing procedure - Indications and interpretations  |
| 20 | Study of IIW / ASTM reference Radiograph                                       | Radiographic testing - Principles - Advantages - Limitations - Basic Radiation Physics - X-Rays - Gama Rays - Radiation Sources - Types of Films - Film Processing            |
| 21 | Interpretation of Radiographic films   | Radiographic Sensitivity - Image Quality indicators - Radiographic Techniques - Radiographic Interpretation and Evaluation - Radiation Hazard and Control                     |
| 22 | Preparation of welding inspection reports                                      | Certification methods for welding inspectors<br>Codes and standards for welding inspection  |

|    |   |  |
|----|---|--|
|    |   | Welding procedure specifications (WPS)<br>Procedure qualification Record (PQR) |
| 23 | <b>Industrial Training / Project Work</b> |  |
| 24 | <b>Industrial Training / Project Work</b> |  |
| 25 | <b>Revision</b>                           |  |
| 26 | <b>Examination</b>                        |  |

**Abbreviations:**

- SMAW - Shielded Metal Arc Welding
- GMAW - Gas Metal Arc Welding
- GTAW - Gas Tungsten Arc Welding

**LIST OF TOOLS & EQUIPMNT  
FOR SEMESTER I &II**

Tools & Equipments for a batch 16Trainees + one

**Consumable kit**

| SI. No. | Name of the items  | Quantity    |
|---------|--|-------------|
| 1       | Leather Hand Gloves 14"  | 17 pairs .  |
| 2       | Cotton hand Gloves 8"  | 17 pairs    |
| 3       | Leather Apron leather  | 17 nos.     |
| 4       | S.S Wire brush 5 rows and 3 rows   | 17 nos.each |
| 5       | Leather hand sleeves 16"   | 17 pairs    |
| 6       | Safety boots for welders   | 17 pairs    |
| 7       | Leg guards leather   | 17 pairs    |
| 8       | Rubber hose clips 1/2"   | 20 nos      |
| 9       | Rubber hose oxygen 8 mm dia X 10 Mts long as per BIS                     | 2 nos       |
| 10      | Rubber hose acetylene 8 mm dia X 10 Mts long as per BIS                  | 2 nos       |
| 11      | Arc welding cables multi cored copper 400/ 600 amp as per BIS            | 45 mts each |
| 12      | Arc welding single coloured glasses 108 mm x 82 mm x 3 mm. DIN 11A &12 A | 34 nos.     |
| 13      | Arc welding plain glass 108 mm x 82 mm x 3 mm.                           | 68 nos      |
| 14      | Gas welding Goggles with Colour glass 3 or 4A DIN                        | 34 nos      |
| 15      | Safety goggles plain   | 34 nos      |
| 16      | Spark lighter  | 6 nos       |
| 17      | AG 4 Grinding wheels   | 10 nos      |

**Trainees Tools Kit**

| SI. No. | Name of the items                           | Quantity |
|---------|---|----------|
| 1       | Welding helmet fiber                        | 17 nos.  |
| 2       | Welding hand shield fiber                   | 17 nos.  |
| 3       | Chipping hammer with metal handle 250 Grams | 17 nos.  |
| 4       | Chisel cold flat 19 mm x 150 mm             | 17 nos.  |
| 5       | Centre punch 9 mm x 127 mm                  | 17 nos.  |
| 6       | Dividers 200 mm                             | 17 nos.  |
| 7       | Stainless steel rule 300mm                  | 17 nos.  |
| 8       | Scriber 150 mm double point                 | 17 nos.  |
| 9       | Flat Tongs 350mm long                       | 17 nos.  |
| 10      | Hack saw frame fixed 300 mm                 | 17 nos.  |
| 11      | File half round bastard 300 mm              | 17 nos.  |
| 12      | File flat 350 mm bastard                    | 17 nos.  |
| 13      | Hammer ball pane 1 kg with handle           | 17 nos.  |
| 14      | Tip Cleaner                                 | 17 nos.  |
| 15      | Try square 6"                               | 17 nos   |

**General Machinery Shop outfit**

| SI. No. | Name and Description of Tools                           | Quantity |
|---------|---|----------|
| 16      | Spindle key   | 4        |
| 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        |
| 26      | S.S tape 5 meters flexible in case                      | 1        |
| 27      | Electrode holder 600 amps                               | 6        |
| 28      | H.P. Welding torch with 5 nozzles                       | 2 sets   |
| 29      | Oxygen Gas Pressure regulator double stage              | 2        |
| 30      | Acetylene Gas Pressure regulator double stage           | 2        |
| 31      | CO <sub>2</sub> Gas pressure regulator, with flow meter | 1 set    |
| 32      | Argon Gas pressure regulator with flow meter            | 1 set    |
| 33      | Metal rack 182 cm x 152 cm x 45 cm                      | 1        |
| 34      | First Aid box   | 1        |
| 35      | Steel lockers with 8 Pigeon holes                       | 2        |
| 36      | Steel almirah / cupboard                                | 2        |
| 37      | Black board and easel with stand                        | 1        |
| 38      | Flash back arrester (torch mounted)                     | 4 pairs  |
| 39      | Flash back arrester (cylinder mounted)                  | 4 pairs  |
| 40      | Auto Darkening Welding Helmet                           | 2 nos.   |

### **General Installation**

|    |   |                   |
|----|---|-------------------|
| 41 | Welding Transformer with all accessories ( 400A , OCV 60 – 100 V, 60% duty cycle)   | 2 sets            |
| 42 | Welding Transformer or Inverter based welding machine with all accessories ( 300A , OCV 60 – 100 V, 60% duty cycle)                     | 1 sets            |
| 43 | D.C Arc welding rectifiers set with all accessories (400 A. OCV 60 – 100 V, 60% duty cycle )  | 1 sets            |
| 44 | GMAW welding machine 400A capacity with air cooled torch, Regulator, Gas preheater, Gas hose and Standard accessories                   | 1 set             |
| 45 | AC/DC GTAW welding machine with water cooled torch 300 A, Argon regulator, Gas hose, water circulating system and standard accessories. | 1 set             |
| 46 | Air Plasma cutting equipment with all accessories, capacity to cut 25 mm clear cut  | 01 set            |
| 47 | Air compressor Suitable for air plasma cutting system   | 01 no             |
| 48 | Fillet weld gauge   | 8 Nos             |
| 49 | Welding Simulators for SMAW/GTAW/GMAW   | 1 each (Optional) |
| 50 | Pug cutting machine Capable of cutting Straight & Circular with all accessories   | 01 set            |
| 51 | Pedestal grinder fitted with coarse and medium grain size grinding wheels dia. 300 mm   | 1                 |
| 52 | Bench grinder fitted with fine grain size silicon carbide green grinding wheel dia. 150 mm  | 1                 |
| 53 | AG 4 Grinder  | 2 Nos             |

|    |   |          |
|----|---|----------|
| 54 | Suitable gas welding table with fire bricks                       | 2 Nos    |
| 55 | Suitable Arc welding table with positioner                        | 6        |
| 56 | Trolley for cylinder (H.P. Unit)                                  | 2        |
| 57 | Hand shearing machine capacity to cut 6 mm sheets and flats       | 1        |
| 58 | Power saw machine 18''  | 1        |
| 59 | Portable drilling machine (Cap. 6 mm)                             | 1        |
| 60 | Oven, electrode drying 0 to 250°C, 10 kg capacity                 | 1        |
| 61 | Work bench 340x120x75 cm with 4 bench vices of 150 mm jaw opening | 4 sets   |
| 62 | Oxy Acetylene Gas cutting blow pipe                               | 2 sets   |
| 63 | Oxygen, Acetylene Cylinders                                       | 2 each*  |
| 64 | CO <sub>2</sub> cylinder  | 1 No *   |
| 65 | Argon gas cylinder  | 1 No *   |
| 66 | Anvil 12 sq. inches working area with stand                       | 1 No.    |
| 67 | Swage block   | 1 No.    |
| 68 | Die penetrant testing kit   | 1 set    |
| 69 | Magnetic particle testing Kit                                     | 1 set    |
| 70 | Fire extinguishers (foam type and CO <sub>2</sub> type)           | 1        |
| 71 | Fire buckets with stand   | 4 nos    |
| 72 | Portable abrasive cut-off machine                                 | 1 No     |
| 73 | IIW/ASTM reference radiographic standard for steel fusion welds   | 01 set   |
| 74 | Ultrasonic Flaw detector with accessories                         | 01 set   |
| 75 | Rockwell hardness testing machine                                 | 01 set   |
| 76 | Universal Testing machine   | Optional |
| 77 | Suitable gas cutting table  | 1 No     |

**NOTE:**

1. \* Optionally Gas cylinders can also be hired as and when required
2. 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 and steel lockers.

**Class Room Furniture for Trade Theory**

| <b>Sl. No</b> | <b>Names &amp; Description of Furniture</b>  | <b>Quantity</b>       |
|---------------|--|-----------------------|
| 1             | Instructor's table and Chair (Steel)   | 1 set                 |
| 2             | Students chairs with writing pads  | 16                    |
| 3             | White board size 1200mm X 900 mm   | 1                     |
| 4             | Instructors lap top with latest configuration pre loaded with O.S and MS Office package. | 1                     |
| 5             | LCD projector with screen.   | 1                     |
| 6             | Welding Process, Inspection & codes DVD/ CDs   | 1 set each (optional) |

**LIST OF TRADE COMMITTEE MEMBERS**

| <b>Sl. No</b>                           | <b>Names &amp; Designation</b> | <b>Organisation</b>              | <b>Remarks</b> |
|---|--------------------------------|----------------------------------|----------------|
| <b>Members of Sector Mentor council</b> |                                |                                  |                |
| 1                                       | Dr.G.Buvashekarar              | AGM, WRI, Trichy - Chairman      | Chairman       |
| 2                                       | Dr.K.Ashokkumar                | AGM, BHEL, Trichy                | Member         |
| 3                                       | Prof. Jyothi Mukhopadhy        | IIT, Ahmedabad                   | Member         |
| 4                                       | B.Pattabhiraman                | MD, GB Engineering, Trichy       | Member         |
| 5                                       | Dr.Rajeev kumar                | IIT, Mandi                       | Member         |
| 6                                       | Dr. Vishalchauhan              | IIT, Mandi                       | Member         |
| 7                                       | Shri D.K.Singh                 | ITI, Kanpur                      | Member         |
| 8                                       | Shri. Navneet Arora            | IIT, Roorkee                     | Member         |
| 9                                       | Shri. R. K. Sharma             | Head, SDC, JBM Group, Faridabad  | Member         |
| 10                                      | Shri. Puneet Sinha             | Deputy Director, MSME, New Delhi | Member         |
| <b>Mentor</b>                           |                                |                                  |                |
| 1                                       | Shri. Deepankar Mallick        | Director of Training, DGE&T Hq,  | Mentor         |
| <b>Members of Core Group</b>            |                                |                                  |                |
| 1                                       | Shri. M Thamizharasan          | JDT, CSTARI, Kolkata             | Member         |
| 2                                       | Shri. M Kumaravel              | DDT, FTI , Bangalore             | Team Leader    |
| 3                                       | Shri. SushilKumar              | DDT, DGE&T Hq,                   | Member         |
| 4                                       | Shri. S.P.Khataokar            | TO, ATI, Mumbai                  | Member         |
| 5                                       | Shri. V.L. Ponmozhi            | TO, CTI, Chennai                 | Member         |
| 6                                       | Shri. D.Pani                   | TO, ATI, Howrah                  | Member         |
| 7                                       | Shri. Amar Singh               | TO, ATI, Ludhiyana               | Member         |
| 8                                       | Shri. Gopalakrishnan           | TO, NIMI, Chennai                | Member         |
| 9                                       | Shri. Manjunatha B.S           | JTO, GITI, K.G.F. Karnataka      | Member         |
| 10                                      | Shri. Venugopal PC             | ITI Chalakudi, Kerala            | Member         |