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

COMPETENCY BASED CURRICULUM

WELDER (OF)

(Duration: 900 hrs.)

FLEXI MoU SCHEME

NSQF Level 4

Sector – Capital Goods & Manufacturing

Directorate General of Training

WELDER (OF)

FLEXI MoU SCHEME

(Designed in 2020)

Version: 1.0

NSQF LEVEL - 4

Developed By

Ministry of Defense

Directorate General of Ordnance Factories

ORDNANCE FACTORY BOARD

10-A, S.K. Bose Road, Kolkata – 700 001

www.ofb.gov.in

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Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata - 700 091

www.cstaricalcutta.gov.in

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1. COURSE INFORMATION

During the 8 months' duration a candidate is trained on subjects Professional Skill, Professional Knowledge & Engineering Drawing. The practical skills are imparted in simple to complex manner to understand the operations & simultaneously basic theory subject is taught to understand the terminology and definition of the topics while executing tasks.

The trainees will be imparted safety aspects which covers components like use of PPs, Fire extinguishers, First Aid, OSH&E. In addition, trainees will be imparted knowledge of 5S and safely use of Tools and equipment's. The practical part starts with basic fitting to the complex operations. The topics covered under this course are filing, chipping, drilling, turning, Pipe joints, measurement etc.

The course element of employability skills, library & extracurricular activities, project work and revision & examination has not been considered in this course being as trainees are NCVT complied Govt. Servants and course is meant to re-skill the working employees to other engineering trades.

2. TRAINING SYSTEM

2.1 GENERAL

OFB is a giant industrial setup which functions under the Department of Defence Production of the Ministry of Defence Mission of OFB is Production of State of the Art Battle Field Equipment. It needs large number of skilled resources in various fields. With the changing need of the armed forces there is shift in production requirements because of which there is a pressing need for re-skilling of employees working in the tailoring and other trades.

Flexible Memorandum of Understanding or Flexi-MoU scheme, a pioneer program of DGT, is designed to cater to the needs of both industry as well as trainee, allowing industries to train candidates as per their skill set requirements and providing trainees with an industry environment aligned with the market demand and latest technology to undergo training. The scheme gives the industry the flexibility to create tailored skilling programs with customized courses, having content and curriculum that is market relevant and meets the industry requirements.

Candidates broadly need to demonstrate that they are able to:

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

2.2 PROGRESSION PATHWAYS:

Training is imparted to re-skill the employees in other trades to make them align with the changing demands. The carrier progression will be as : -

Semi-Skilled (SS) > Skilled (SK) > High Skilled-II (HS-II) > High Skilled-I (HS-I) > Master Craftsman (MCM).

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements: -

S No.	Course Element	Hours
1	Professional Skill (Trade Practical)	660
2	Professional Knowledge (Trade Theory)	160
3	Workshop Calculation & Science	40
4	Engineering Drawing	40
	Total	**900**
	NOTE : Employability subject is exempted as entrants are NCVT qualified Govt Employees	

2.4 ASSESSMENT & CERTIFICATION:

The training will be tested for skill and knowledge during the period of course. There will be internal assessment in every two months conducted by faculty/trainer for the course element covered during the period.

The final assessment will be in the form of summative assessment method. The Trade Test for awarding NCVT equivalent certification will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure are being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment in accordance with above course elements. 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

The minimum pass percentage for practical is 60% & minimum pass percentage of theory subjects is 33%. There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE

Assessment will be evidence based comprising the following:

- Job carried out in workshop
- Record book/Daily Diary maintained by trainee and countersigned by

Trainer.

- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality

Evidences and records of internal assessments are to be preserved until forthcoming examination for audit and verification by examination body.

3. JOB ROLE

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.

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.

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 CO2 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.

REFERENCE NCO:2015

7212.0100 – Welder, Gas
7212.0200 – Welder, Electric
7212.0300 – Welder, Machine
7212.0400 – Gas Cutter
7212.0500 – Brazer

4. GENERAL INFORMATION

Name of the Trade	**Welder OF**
Trade Code	DGT/7016
NSQF Level	**Level 4**
Duration of Craftsmen Training	900 Hours
Entry Qualification	NCVT qualified Govt Employees
Minimum Age	18 years as on first day of academic session.
Eligibility for PwD	N/A
Unit Strength (No. Of Student)	20
Space Norms	80 Sq. m
Power Norms	16 KW
Instructors Qualification for	
1. Welder OF Trade, Workshop Calculation & Science and Engineering Drawing	B.E./B.Tech/B.Voc. Degree in Mechanical / Welding Engineering from recognized Engineering College/ university **OR** 03 years Diploma in Mechanical / Welding Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT. ***Note- Trainer should have minimum3-4 years' experience in the field of Engg. production.***
2. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES

1. Set the gas welding plant and join MS sheet in different position following safety precautions.
2. Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure.
3. Set the oxy- acetylene cutting plant and perform different cutting operations on MS plate
4. Perform welding in different types of MS pipe joints by Gas welding (OAW).
5. Set the SMAW machine and perform welding in different types of MS pipe joints by SMAW.
6. Test welded joints by different methods of testing
7. 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.
8. 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
9. Perform joining of different similar and dissimilar metals by brazing operation as per standard procedure.

6. ASSESSMENT CRITERIA

LEARNINGOUTCOMES	ASSESSMENT CRITERIA
1. Set the gas welding plant and join MS sheet in different position following safety precautions.	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.	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.	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*	Plan and prepare the development for a specific type of pipe joint.
	Mark and cut the MS pipe as per development.

Gas welding (OAW).	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.
5. Set the SMAW machine and perform welding in different types of MS pipe joints by SMAW.	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.
	Insect the welded joint visually for root penetration, uniformity of bead and surface defects.
6. Test welded joints by different methods of testing.	Plan and select the job and clean the surface thoroughly.
	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.
7. 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.	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).

8. 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.	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).
9. Perform joining of different similar and dissimilar metals by brazing operation as per standard procedure.	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.

7. TRADE SYLLABUS

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Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skills – 80 Hrs Professional Knowledge – 15 Hrs	Set the gas welding plant and join MS sheet in different position following safety precautions	Demonstration of Machinery used in the trade Identification to safety equipment and their use etc Hack sawing, filing square to dimensions Marking out on MS plate and punching. Setting of oxy-acetylene plant	- Importance of trade Training. - General discipline in the Institute - Elementary First Aid. - Importance of Welding in Industry - Safety precautions in Shielded Metal Arc Welding, and Oxy Acetylene Welding and Cutting. - Introduction and definition of welding.
Professional Skills – 60 Hrs Professional Knowledge – 15 Hrs	Set the SMAW machine and perform different type of joints on MS in different position observing standard procedure.	Perform fusion run Setting up of Arc welding Deposit straight line bead Depositing bead with filler rod on MS sheet 2 mm thick in flat position Edge joint on MS sheet 2 mm thick in flat position without filler rod Straight line beads on MS plate 10 mm thick in flat position Weaved bead on M S plate 10mm thick in flat position	- Arc and Gas Welding Equipments, tools and accessories. - Various Welding Processes and its applications. - Arc and Gas Welding terms and definitions. - 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 - 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.

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Professional Skills – 40 Hrs **Professional Knowledge – 10 Hrs**	Set the oxy-acetylene cutting plant and perform different cutting operations on MS plate.	Setting up of oxyacetylene Perform marking and Beveling of MS plates 10 Circular gas cutting on MS Marking and perform radial cuts, cutting out holes using oxy-acetylene gas cutting Identify cutting defects viz , distortion, grooved, fluted or ragged cuts; poor draglines; rounded edges; tightly adhering slag Square butt joint on MS sheet 2 mm thick in flat Position (1G)	- Common gases used for welding & cutting, flame - Chemistry of oxy-acetylene flame. - Types of oxy-acetylene flames and uses. - Oxy-Acetylene Cutting Equipment principle, parameters and application. - Arc welding power sources: Transformer, Motor Generator set, Rectifier and Inverter type welding machines and its care &maintenance.. - Advantages and disadvantages of A.C. and D.C. welding machines
Professional Skills – 80 Hrs **Professional Knowledge – 20 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, 3F,4F, 1G, 2G,3G, 4G]*	Fillet "T" joint on MS Plate 10 mm thick in flat position (1F) Open corner joint on MS sheet 2 mm thick in flat Position (1F) Fillet Lap joint on MS plate 10 mm thick in flat position (1F) Fillet "T" joint on MS sheet 2 mm thick in flat position (1F) Open Corner joint on MS plate 10 mm thick in flat position (1F) Fillet Lap joint on MS sheet 2 mm thick in flat position (1F) Single "V" Butt joint on MS plate 12 mm thick in flat position (1G) Testing of weld joints by visual inspection Inspection of welds by using weld gauges Square butt joint on MS sheet 2 mm thick in Horizontal position (2G) Straight line beads and multi layer practice on MS Plate 10 mm thick in Horizontal position Fillet " T" joint on MS plate 10 mm thick in Horizontal position (2F)	- Welding positions as per EN &ASME : flat, horizontal, vertical and over head position. - Weld slope and rotation. - Welding symbols as per BIS & AWS. - Arc length – types – effects of arc length. - Polarity: Types and applications. - Weld quality inspection, common welding mistakes and appearance of good and defective welds - Weld gauges &its uses - Calcium carbide properties and uses. - Acetylene gas properties and generating methods. - Acetylene gas Purifier, Hydraulic back pressure valve and Flash back arrestor - Oxygen gas and its properties - Production of oxygen by Air liquefaction.

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		Fillet Lap joint on MS Fillet Lap joint on MS Fusion run with filler rod in vertical position on 2mm thick MS sheet Square Butt joint on MS sheet 2 mm thick in vertical position (3G) Single Vee Butt joint on MS plate 12 mm thick in horizontal position (2G) Weaved bead on M S Plate 10mm in vertical position Fillet "T" joint on MS sheet 2 mm thick in vertical position (3F) Fillet "T" joint on MS plate 10 mm thick in vertical position (3F)	- Charging process of oxygen and acetylene gases - Oxygen and Dissolved Acetylene gas cylinders and Color coding for different gas cylinders. - Gas regulators, types and uses. - 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. - Arc blow – causes and methods of controlling. - Distortion in arc & gas welding and methods employed to minimize distortion - Arc Welding defects, causes and Remedies.
Professional Skills – 60 Hrs **Professional Knowledge – 15 Hrs**	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]	Structural pipe welding Fillet Lap joint on MS Open Corner joint on MS plate 10 mm thick in vertical position (2F) Pipe welding - Elbow joint on MS pipe Ø 50 and 3mm WT (1G) Pipe welding "T" joint on MS pipe Ø 50 and 3mm WT (1G) Single "V" Butt joint on MS plate12 mm thick in vertical position (3G) Pipe welding 45 ° angle joint on MS pipe Ø 50 and 3mm WT (1G) Straight line beads on MS plate 10mm thick in over head position	- Specification of pipes, various types of pipe joints, pipe welding all positions, and procedure. - Difference between pipe welding and plate welding. - Pipe development for Elbow joint, "T" joint, Y joint and branch joint - Manifold system - Gas welding filler rods, specifications and sizes. - Gas welding fluxes – types and functions. - Gas Brazing &Soldering : principles, types fluxes & uses - Gas welding defects, causes and remedies. - Electrode : types, functions of flux, coating factor, sizes of

		Pipe Flange joint on MS	electrode Coding of electrode as per BIS, AWS, - Effects of moisture pick up. - Storage and baking of electrodes. - Special purpose electrodes and their applications. - Weldability of metals, importance of pre heating, post heating and maintenance of inter pass temperature.
Professional Skills – 60 Hrs **Professional Knowledge – 15 Hrs**	*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]*	Fillet "T" joint on MS Pipe welding butt joint on MS pipe Ø 50 and 5 mm WT in 1G position Fillet Lap joint on MS plate 10 mm thick in over head position (4G) Single "V" Butt joint on MS plate 10mm thick inover head position(4G) Pipe butt joint on MS pipe Ø 50mm WT 6mm (1G Rolled)	- Classification of steel. - Welding of low, medium and high carbon steel and alloy steels. - Effects of alloying elements on steel - Stainless steel types- weld decay and weldability.
Professional Skills – 40 Hrs **Professional Knowledge – 10 Hrs**	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]	Dye penetrant test Magnetic particle test Nick- break test Free bend test Fillet fracture test	- Types of Inspection methods - Classification of destructive and NDT methods - Welding economics and Cost estimation.
Professional Skills – 80 Hrs **Professional Knowledge – 20 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. *[different*	Introduction to safety equipment and their use etc Setting up of GMAW welding machine & accessories and striking an arc Depositing straight line beads on MS Plate Fillet weld – "T" joint on MS plate 10mm thick in flat position by Dip transfer (1F)	- 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_2 welding.) - Advantages of GMAW welding

	types of joints- Fillet (T-joint, lap, Corner), Butt (Square & V); various positions- 1F, 2F, 3F,4F, 1G, 2G, 3G]	Fillet weld – Lap joint on MS sheet 3mm thick in flat position by Dip transfer (1F) Fillet weld – "T" joint on MS sheet 3mm thick in flat position by Dip transfer (1F) Fillet weld – corner joint on MS sheet 3mm thick in flat position by Dip transfer Butt weld – Square Butt weld – Single "V" Fillet weld – "T" joint on MS plate 10mm thick in Horizontal position by Dip transfer (2F) Fillet weld – corner joint on MS plate 10mm thick in Horizontal position by Dip transfer (2F) Fillet weld – "T" joint on MS sheet 3mm thick in Horizontal position by Dip transfer (2F) Fillet weld – corner joint on MS sheet 3mm thick in Horizontal position by Dip transfer (2F) Fillet weld – "T" joint Fillet weld – corner Fillet weld – Lap joint on MS sheet 3mm thick in vertical position by Dip transfer (3F) Fillet weld – corner joint on MS sheet 3mm thick in vertical position by Dip transfer (3F) Fillet weld – Lap and "T" joint on MS sheet 3mm thick inover head position by Dip transfer (4F) Tee Joints on MS Pipe Ø 60 mm OD x 3 mm WT 1G position – Arc constant (Rolling) (25 hrs Depositing bead on SS sheet in flat position Butt joint on Stainless steel 2 mm thick sheet in flat position by Dip transfer	over SMAW , limitations and applications - Process variables of GMAW. - Modes of metal transfer – dip or short circuiting transfer, spray transfer (free flight transfer) and globular transfer (intermittent transfer) and Pulsed metal transfer. - Wire feed system – types – care and maintenance. - Welding wires used in GMAW, standard diameter and codification as per AWS. - Types of shielding gases and gas mixtures used in GMAW and its applications. - Flux cored arc welding – description, advantage, welding wires, coding as per AWS. Edge preparation of various thicknesses of metals for GMAW. GMAW defects, causes and remedies - Heat input and techniques of controlling heat input during welding. - Heat distribution and effect of faster cooling - Pre heating & Post Weld Heat Treatment - Use of temperature indicating crayons - Submerged arc welding process –principles, equipment, advantages and limitations - Electro slag and Electro gas welding processes–principles, equipments, advantages and limitations

			- Thermit welding process- types, principles, equipments, Thermit mixture types and applications. - Use of backing strips and backing bars
Professional Skills – 80 Hrs **Professional Knowledge – 20 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. *[different types of joints- Fillet (Tjoint, lap, Corner), Butt (Square & V) ; different metals- Aluminium, Stainless Steel; different position- 1F & 1G]*	Depositing bead on Square butt joint on Fillet weld – "T" joint on Aluminium sheet 1 6 mm thick in flat position (1F) Fillet weld – Outside corner joint on Aluminium sheet 2 mm thick in flat position (1F) Butt weld - Square butt joint on Stainless steel sheet 1 6 mm thick in flat position with purging gas (1G) Fillet weld – "T" joint on Stainless steel sheet 1 6 mm thick in flat position (1F)	- GTAW process - brief description. Difference between AC and DC welding, equipments, polarities and applications. - Various other names of the process (TIG, Argonarc) - Power sources for GTAW - AC &DC - Tungsten electrodes –types & uses, sizes and preparation - GTAW Torches- types, parts and their functions - GTAW filler rods and selection criteria - Edge preparation and fit up. - GTAW parameters for welding of different thickness of metals - Pulsed TIG welding - brief description, pulse parameters slope up and slope down. - Argon / Helium gas properties – uses. - GTAW Defects, causes and remedy.
Professional Skills – 80 Hrs **Professional Knowledge – 20 Hrs**	Perform joining of different similar and dissimilar metals by brazing operation as per standard procedure. *[different similar and dissimilar metals- Copper, MS, ss]*	Square butt joint on Copper sheet 2mm thick in flat position (1G) "T" joint on Copper to MS sheet 2mm thick in flat position by Brazing (1F) Silver brazing on SS Sheet with copper sheet "T" joint Silver brazing on copper tube to tube	- Metalizing – types of metalizing principles, equipments, advantages and applications - Manual Oxy – acetylene powder coating process- principles of operation and applications - Welding codes and standards - Reading of assembly

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			drawing - Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR)

SYLLABUS FOR CORE SKILLS

Workshop Calculation & Science

LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Demonstrate basic mathematical concept and principles to perform practical operations.	Solve different problems like unit conversion etc. with the help of a calculator.
	Demonstrate conversion of Fraction to Decimal and vice versa.
	Solve simple problems on area, perimeter etc of regular shapes.
	Solve simple trigonometric ratios and height & distance.
2. Understand and explain basic science in the field of study including simple machine.	Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure.
	Explain relationship between different scales of temperature, concept of heal and temperature.
	Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.

Sl. No.	Syllabus	Time in hrs.
I.	**Unit, Fractions**	**4**
1	Classification of Unit System	
2	Fundamental and Derived Units F.P.S, C.G.S, M.K.S and SI Units	
3	Measurement Units and Conversion	
4	Factors, HCF, LCM and Problems	
III.	**Material Science**	**4**
1	Types of metals	
2	Physical and Mechanical Properties of metals	
3	Types of ferrous and non-ferrous metals	
IV.	**Mass, Weight, Volume, and Density**	**4**
1	Mass, volume, density, weight & specific gravity	
2	Related problems for mass, volume, density, weight & specific gravity	
V.	**Speed and Velocity, Work Power and Energy**	**6**
1	Rest, motion, speed, velocity, difference between speed and velocity,	

	acceleration and retardation	
2	Related problems on speed and velocity	
VI.	**Heat &Temperature and Pressure**	**4**
1	Concept of heat and temperature, effects of heat, difference between heat and temperature	
2	Scales of temperature, Celsius, Farenhieght, Kelvin and Conversion between scales of temperature	
VII.	**Basic Electricity**	**6**
1	Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC and their comparison, voltage , resistance and their units	
2	Conductor, Insulator, types of connections- Series and Parallel,	
	Ohm's Law, relation between VIR & related problems	
3	Electrical power, energy and their units, calculation with assignments	
VIII.	**Mensuration**	**6**
1	Area and perimeter of square, rectangle and parallelogram	
2	Area an Perimeter of Triangle	
3	Area and Perimeter of Circle, Semi-circle , circular ring, sector of circle, hexagon and ellipse	
X.	**Trigonometry**	**6**
1	Measurement of Angle, Trigonometrical Ratios, Trigonometric Table	
2	Trigonometry-Application in calculating height and distance (Simple Applications)	
	Total	**40**

Engineering Drawing

LEARNING OUTCOME WITH ASSESSMENT CRITERIA

ENGINEERING DRAWING	
LEARNING OUTCOME	**ASSESSMENT CRITERIA**
1. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read & analyses the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

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Sl. No.	Topic	Time in hrs.
1.	Engineering Drawing – Introduction Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Viewing of engineering drawing sheets. • Method of Folding of printed Drawing sheet as per BIS SP: 46-2003	1
2.	Drawing Instrument • Drawing board, T-square, Drafter (Drafting M/c), Set squares, Protector, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), pencils of different grades, Drawing pins/ Clips.	1
3.	Free hand drawing of – • Lines, polygons, ellipse etc. • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Solid objects – Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone with dimensions.	6
4.	Lines • Definition, types and applications in drawing as per BIS: 46-2003 • Classification of lines (Hidden, centre, construction, extension, Dimension, Section) • Drawing lines of given length (Straight, curved) • Drawing of parallel lines, perpendicular line	2
5.	Drawing of Geometrical figures: Definition, nomenclature and practice of – • Angle: Measurement and its types, method of bisecting. • Triangle: different types • Rectangle, Square, Rhombus, Parallelogram. • Circle and its elements	4
6.	Dimensioning and its Practice • Definition, types and methods of dimensioning (functional, non-functional and auxiliary) • Position of dimensioning (Unidirectional, Aligned) • Types of arrowhead	4
7.	Sizes and layout of drawing sheets • Selection of sizes • Title Block, its position and content • Item Reference on Drawing Sheet (Item list)	2
8.	Method of presentation of Engg. Drawing • Pictorial View	2

	• Orthographic View • Isometric View	
9.	Symbolic representation – different symbols used in the trades • Fastener (Rivets, Bolts and Nuts) • Bars and profile sections • Weld, Brazed and soldered joints • Electrical and electronics element • Piping joints and fitting	6
10.	Projections • Concept of axes plane and quadrant • Orthographic projections • Method of first angle and third angle projections (definition and difference) • Symbol of 1st angle and 3rd angle projection in 3rd angle.	8
11.	Reading of fabrication drawing	4
Total		**40**

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.

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
WELDER (For batch of 20Candidates)			
S No.	**Name of the Tools& Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-15 is required additionally)			
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. INSTRUMENTS AND GENERAL SHOP OUTFIT - For 2 (1+1) units no additional items are required			
TOOLS & EQUIPMENT			
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_2 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
GENERAL SHOP OUTFIT			
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_2 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_2type)		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)
C. CONSUMABLE			
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		20pairs
80.	Leg guards leather		20pairs
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.
D. CLASS ROOM FURNITURE FOR TRADE THEORY			
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 latestconfiguration pre-loaded with operating system and MS Office package.		1No.
95.	LCD projector with screen.		1No.
96.	Welding Process, Inspection& codes DVD/ CDs.		1 set each (optional)

Note:

1. *** Optionally Gas cylinders can also be hired as and when required.*
2. *# One machine per institute irrespective of number of units of welding trade is necessary.*


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