

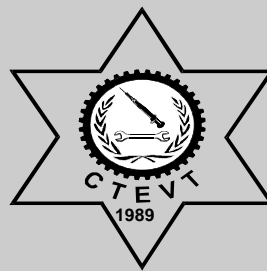
CURRICULUM

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WELDER

(SMAW, OAW, GTAW & GMAW)

(Short Course)



Council for Technical Education and Vocational Training
CURRICULUM DEVELOPMENT DIVISION

Sanothimi, Bhaktapur

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Introduction

This competency based and market oriented curriculum is designed to produce employable **welders** equipped with knowledge, skills and attitudes. In this curriculum, the trainees will practice skills of welding in the steel fabrication industries. Once the trainees acquired the competencies they will have ample opportunity for employment and self-employment through which they will contribute in the national streamline of poverty reduction in the country. The skills and knowledge included in this curriculum improve their knowledge and skills and make them competent welder needed for the occupation. *The major feature of the curriculum is to incorporate the dropout youths who have only primary level schooling experience.*

Aim

The main aim of this curricular program is to produce employable welders who could provide fabrication services in the steel fabrication industries in the country and abroad.

To produce such human resources through institutional training program followed by "On the Job Training (OJT)" is made mandatory. This provision provides the trainees the opportunity for maximum experience & exposure of "The World of Work."

The graduates of this program will be able to be employed or be an entrepreneur.

Objectives

After completion of training the trainees will be able:

1. To develop the concept of welding
2. To prepare working materials related to welding
3. To identify and prepare the machine equipments of welding
4. To perform different welding technologies SMAW, OAW, GTAW and GMAW
5. To perform welding on different position
6. To perform oxy-acetylene gas cutting

Course Description

This course modular is designed based on the job required to be performed by the general welder. It intends to provide knowledge and skills on Shielded Meta Arc welding (SMAW), Oxy Acetylene Welding (OAW), Gas Tungsten Arc Welding (GTAW/TIG), Gas Metal Arc Welding (GMAW/MIG) and Gas cutting related to the occupation.

This course deals with concept of fabricating permanently structural steel, tools and equipment needed, preparation of pre-finished material. This course especially, imparts skills and knowledge on surface welding, square butt joint welding, lap joint welding, T-joint welding, single V-butt welding, double bevel joint welding in flat, horizontal, vertical and overhead position. The provision of On-the- Job Training (OJT) is included to provide the trainees the opportunities to have experience and exposure of "The World of Work" as well as practice the critical competencies. OJT commences after the completion of in- house training.

The duration of particular modules will be as mentioned in the course structure. There will be demonstration by instructors/trainers and the opportunity to practice skills/tasks necessary for this level of technicians. Trainees will practice & learn skills using typical tools, equipment, machines, and materials necessary for the program.

Duration

The total duration of the course extends over 710 hours

1. In-house Training – 3 months (390 hrs)
2. On the job training – 2 months (320 hrs)

Target Group

The target group for this training program will be all interested individuals with educational prerequisite of minimum class eight pass.

Target location

The target group for this training program will be all over Nepal.

Group Size

The group size of this training program will be maximum 24, provided all necessary resources to practice the tasks/ competencies as specified in this curriculum.

Medium of Instruction

The medium of instruction for this program will be Nepali in vocabulary & references in English.

Pattern of Attendance

Trainee should have 90% attendance during the training period to get the certificate.

Focus of Curriculum

This is a competency-based curriculum. This curriculum emphasizes on competency performance. 80% time is allocated for performance and remaining 20% time is for related technical knowledge. So, the main focus will be on performance of the specified competencies in the curriculum.

Entry Criteria

Individuals who meet the following criteria will be allowed to enter this curricular program:

- Minimum of eight class pass or equivalent
- Minimum of 16 years of age
- Should pass entrance examination

Instructional Media and Materials

The following instructional media and materials are suggested for the effective instruction and demonstration.

- **Printed Media Materials** (Assignment sheets, Case studies, Handouts, Information sheets, Procedure sheets, Performance Check lists, Textbooks etc.).
- **Non-projected Media Materials** (Display, Models, Flip chart, Poster, Writing board etc.).
- **Projected Media Materials** (Opaque projections, Overhead transparencies, Slides etc.).
- **Audio-Visual Materials** (Films, Slide-tape programs, Videodiscs, Videotapes etc.).

Teaching Learning Methodologies

The methods of teaching for this program will be a combination of several approaches. Such as Illustrated Lecture, Group Discussion, Demonstration, Guided practice, Practical experiences, and On the Job Training.

- Theory: Lecture, Discussion, Assignment, Group work.
- Practical: Demonstration, Observation, Guided practice Self-practice and On the Job Training.
- OJT

Follow up Provision

- **First follow up:** Six months after the completion of the program
- **Second follow up:** Six months after the completion of the first follow up
- **Follow up cycle:** In a cycle of one year after the completion of the second follow up for five years.

Grading System

The trainees will be graded as follows based on the marks in percentage secured by them in tests/ evaluations.

- Distinction: Passed with 90% or above
- First Division: passed with 75% or above
- Second Division: passed with 65% or above
- Third Division: passed with 60% or above

Students Evaluation Details

- Continuous evaluation of the trainees' performance is to be done by the related instructor/trainer to ensure the proficiency over each competency under each area of the whole course.
- Related technical knowledge learnt by trainees will be evaluated through written or oral tests as per the nature in the institutional phase of training.
- Trainees must secure minimum marks of 40% and 60% in theory and practical evaluations respectively.
- There will be three internal evaluations and one final evaluation of the whole course.
- The ratio between internal and final examination of knowledge test will be 20:80 but for the performance test it will just reverse.
- The entrance test will be administered by the concerned training institute.
- The OJT will be evaluated according to the OJT details stated in the curriculum

Trainers' Qualification (Minimum)

- Diploma in welding engineering or equivalent.
- Diploma in mechanical engineering with min. 3 yrs experience in related field.
- Welding professional with 6G qualification and communicative instructional skills.

Trainer-Trainees Ratio

- In theory classes 1(trainer): 24 (trainees)
- In practical classes (in workshop and laboratory) 1(trainer): 8 (trainees)

Suggestions for Instruction

1. Select objectives

- Write objectives of cognitive domain.
- Write objectives of psychomotor domain.
- Write objectives of affective domain

2. Select Subject matter

- Study subject matter in detail.
- Select content related to cognitive domain.
- Select content related to psychomotor domain.
- Select content related to affective domain.

3. Select Instructional Methods

- Teacher centered methods: like lecture, demonstration, question-answers-inquiry, induction and deduction methods.
 - Student initiated methods like experimental, field trip/excursion, discovery, exploration, problem solving, and survey methods.
 - Interaction methods like discussion, group/team teaching, microteaching and exhibition.
 - Dramatic methods like role play and dramatization
4. Select Instructional method(s) on the basis of objectives of lesson plans and KAS domains.
 5. Select appropriate educational materials and apply at right time and place.
 6. Evaluate the trainees applying various tools to correspond the KAS domains.
 7. Make plans for classroom / field work / workshop organization and management.
 8. Coordinate among objectives, subject matter and instructional methods.
 9. Prepare lesson plan for theory and practical classes.
 10. Deliver /conduct instruction / program.
 11. Evaluate instruction/ program.

Special suggestion for the performance evaluation of the trainees

1. Perform task analysis.
2. Develop a detail task performance checklist.
3. Perform continuous evaluation of the trainees by applying the performance checklist.

Suggestion for skill training

1. Demonstrate task performance in normal speed.
2. Demonstrate slowly with verbal description of each and every step in the sequence of activity of the task performance using question and answer techniques.
3. Repeat 2 for the clarification on trainees demand if necessary.
4. Perform fast demonstration of the task.

Provide the opportunities to practice the task performance demonstration

1. Provide opportunity to trainees to have guided practice.
2. Create environment for practicing the demonstrated task performance.
3. Guide the trainees in each and every step of task performance.
4. Provide trainees to repeat and re-repeat as per the need to be proficient on the given task performance.
5. Switch to another task demonstration if and only trainees developed proficiency in the task performance.

Other suggestions

1. Apply principles of skill training.
2. Allocate 20% time for theory classes and 80% time for task performance while delivering instructions.
3. Apply principles of learning relevant to the learners' age group.
4. Apply principles of intrinsic motivation.
5. Facilitate maximum trainees' involvement in learning and task performance activities.
6. Instruct the trainees on the basis of their existing level of knowledge, skills and attitude.

Certificate Requirements

Training institute itself will provide certificate of "**Welder**" to those trainees who successfully complete the prescribed course and conducted evaluation.

Skill Testing Provision

The graduates who have the completion certificate of "**Welder**" may sit in the skill testing examination as provisioned and administered by National Skill Testing Board.

Physical Facilities

The theory class rooms at least should have area of 10 square feet per trainee and in the workshop it should be at least of 30 square feet per trainees. All the rooms and laboratory should be well illuminated and ventilated.

- Well equipped workshop with adequate space 1 (No.)
- Well furnished class room with adequate space 1 (No.)
- Office room equipped with modern facilities 1 (No.)
- Principle room equipped with modern facilities 1 (No.)
- Reception room equipped with modern facilities 1 (No.)

Course Structure of Welder

S. No	Modules	Nature	Time (hrs)
1	BM: Bench Work (Basic Module) Rajan Basnet	T+P	50
2	M1: Shielded Metal Arc Welding /Manual Metal Arc Welding(SMAW/MMAW) Bhakta Man Nakarmi	T+P	150
3	M2: Oxy Acetylene Welding (OAW)/ Gas Welding (GW) Ishwar Lal Shrestha	T+P	80
4	M3: Gas Tungsten Arc Welding (GTAW/TIG) Arjun Shrestha	T+P	40
5	M4: Gas Metal Arc Welding (GMAW/MIG) Arjun Shrestha	T+P	30
6	Enterpenureship Development	T+P	40
Sub-total			390
7	On-The - Job Training(2 months)	P	320
Total			710

Tasks Analysis

Basic Module (BM)

Bench Work

Description:

This module intends to provide basic knowledge and skill needed to work in mechanical or its related workshops. It deals with filing a solid metal pieces to desire shape or maintain the surfaces as its fitting position when the parts have been repaired by welding; sawing the excessive areas of metals or preparing the structure components; marking and punching the mechanical parts as and when necessary and drilling and boring the holes in fastening the mechanical parts or structural components.

Objectives:

After completion of this module the trainees will be able:

1. To interpret Mechanical Drawing
2. To Orient with safety rules and workshop procedure
3. To identify/enumerate/handle basic tools and hand tools used in bench work in order to build confident in material preparation for welding the structures
4. To carryout bench works activities

Duration: 50 hours

Tasks:

- 1 Interpret Mechanical Drawing
- 2 Orient with safety rule
- 3 Clean rusted parts
- 4 Measure & mark the given W/P
- 5 Saw the metal by hand
- 6 Grind metal surfaces
- 7 File flat surface
- 8 Punch dot / center
- 9 Drill a hole
- 10 Perform forming
- 11 Cut the metal by flat chisel

Task Analysis

1. COMPETENCY: Interpret Mechanical Drawing.

Total Time: 13 hrs
Theory : 3 hrs
Practical : 10 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Collect the mechanical designs and drawing. 2. Interpret the different representative lines. 3. Interpret the symbols given in the drawings. 4. Interpret the views as shown in the drawings 5. Interpret the scale. 6. Interpret the dimensions. 7. Draw or copy the individual components free hand on extra sheet. 8. Practice the same free hand exercise until you draw a clear view. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with mechanical designs and drawings.</p> <p><u>Tasks (What):</u></p> <p>Interpret Mechanical Drawing.</p> <p><u>Standards (How well):</u></p> <p>The working mechanical drawing interpreted and prepared the materials as well. Free hand sketch of components drawn.</p>	<ul style="list-style-type: none"> ➤ Representative lines <ul style="list-style-type: none"> • Constructional • Center • Dimensional • Hidden • Hatching ➤ Representative symbols <ul style="list-style-type: none"> • Thread • Welding • Tolerance • Surface ➤ Different views <ul style="list-style-type: none"> • Pictorial view • Isometric view • Orthographic view ➤ Drawing scale. <ul style="list-style-type: none"> • Increased ratio • Decreased ratio ➤ Dimensions <ul style="list-style-type: none"> • Linear • Circular • arc ➤ Free hand sketch.

Tools Equipments:

Drawing board, Compass, Set square set, templates of holes and hexagon, Pencil 'B', Eraser, Scale, Drawing tape, Clipper, Pencil sharpener, Dusting cloth.

Safety Precautions :

- Keep the workplace dry.
- Keep away the inflammable material.
- Do not carry pointed tools in your pocket.
- Avoid working on damp floor

Task Analysis

2. COMPETENCY: Orient with safety rule.

Total Time: 2 hr
Theory : 1 hr
Practical : 1 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Always wear comfortable dress in work shop preferably “Dangree” 2. Use safety gloves while working with heavy weight, hammering, grinding, welding and painting. 3. Do not spill oil and grease in working floor. If spilled cleaned immediately with <u>soind</u> dust. 4. Use safety goggles while working with machine tools, grinders and welding. 5. Avoid wet while working with electrical lines and accessories. 6. Do not work or leave the electrical connection loose and un-insulated. 7. Use always safety boot in workshop 8. Use Safety belt while working overhead 9. 	<p><u>Condition (Given):-</u> Working in a workshop</p> <p><u>Task (What):-</u> Orient with safety rule.</p> <p><u>Standard (How Well):-</u> All safety procedurs and rules oriented and followed while working in workshop.</p>	<ul style="list-style-type: none"> ➤ Workshop safety rules ➤ Tools & equipment safety. ➤ Electrical safety ➤ First aid

Safety:

- Care should be taken while using tools and equipments.
- Follow workshop safety rules.

Task Analysis

3. COMPETENCY: Clean rusted parts

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain work piece material 2. Obtain emery paper or cloth of operation as required no. 3. Place or hold the w/p securely. 4. Scrub dirt and rusted area from metal parts with scriber 5. Take a piece of emery, fold it thrice or forth. 6. Hold between fore and middle finger. 7. Rub the surfaces until the surface free from rusted layer. 8. Wipe the parts after rubbing. 	<p><u>Condition (Given):-</u> Fully equipped mechanical workshop</p> <p><u>Task (What):-</u> Clean rusted parts.</p> <p><u>Standard (How Well):-</u> Surface area rusted parts absolutely freed from rust and dirt.</p>	<ul style="list-style-type: none"> ➤ Rusted parts cleaning procedures ➤ Safety precautions

Required tools/equipment: Scriber, emery paper etc.

Safety:

- Use gloves while rubbing parts.
- Follow workshop safety rules.

Task Analysis

4. COMPETENCY: Measure & mark the given W/P.

Total Time: 5 hrs
Theory : 1 hr
Practical : 4 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain required drawings. 2. Study drawing carefully. 3. Obtain required tools. 4. Obtain required (material) work piece. 5. De-burr the edges of the w/p 6. Clean the rust surfaces. 7. Measure work piece. 8. Mark the layout according to dimension of given drawing. 9. Clean the working place. 	<p><u>Condition (Given):-</u> Workshop, work piece, measuring & marking instruments.</p> <p><u>Task (What):-</u> Measure & mark the given W/P.</p> <p><u>Standard (How Well):-</u> Work piece measured and marks well.</p>	<ul style="list-style-type: none"> ➤ Identification of measuring and marking tools ➤ Measuring and marking procedure ➤ Safety precautions

Required tools/equipment: Scriber, emery paper, file, steel scale, base back square, marking scriber, measuring tape and centre punch etc.

Safety:

- Handle the tools carefully.
- Follow workshop safety rules.
- Don't put the measuring tools mix with cutting or other tools.

Task Analysis

5. COMPETENCY: Saw the metal by hand.

Total Time: 4 hrs
Theory : 1 hr
Practical : 3 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain work piece. 2. Obtain drawing and instructions. 3. Obtain required tools. 4. Mark the symmetrical lines. 5. Punch dotted on marked line. 6. Clamp the work piece on the vice (the marked line must be out side from the vice) 7. Check the blade & set up the blade on the hack saw frame. 8. Mark a small "V" notch at starting point using small triangular file. 9. Hold hack saw frame & start cutting slowly moving the blade forward. 10. Apply pressure only during forward & back without pressure. 11. Check the cutting ways for straightness. 12. Move slow down while finishing a cut. 13. Check the sawed part. 14. Clean all the tools & equipment & put it back. 15. Clean the working place & vice. 	<p><u>Condition (Given):-</u> Fully equipped mechanical Workshop, drawing, bench vice, hack saw & blade, & work piece material.</p> <p><u>Task (What):-</u> Saw the metal by hand.</p> <p><u>Standard (How Well):-</u> Vee notch before cutting marked. Straight cutting carried out.</p>	<ul style="list-style-type: none"> ➤ Use of hacksaw blade for different metal ➤ Holding of work piece for sawing ➤ Procedure of sawing metal by hand ➤ Safety precautions

Required tools/equipment: Bench vice, Hacksaw Frame with blade, Triangular file, Scriber, emery paper, file, steel scale, base back square, marking scriber, centre punch and steel hammer, measuting tape etc.

Safety:

- The work piece clamped perfectly.
- The teeth of the hack saw blade kept forward direction.
- Don't move the blade left right during sawing.
- Incline the blade is 150 during sawing.
- Follow general safety rules.

Task Analysis

6. COMPETENCY: Grind metal surface.

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hr

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain drawing and instruction. 2. Obtain work piece. 3. Obtain hand grinder. 4. Obtain safety equipments 5. Clamp the work piece on the vice/secure on other fixture devices as per work piece 6. Hold the grinder with one hand position the switch button on thumb & another hand in handle of the machine. 7. Position the feet to safe stance during grinding. 8. Put on the machine and rub the wheel on work surfaces forth and back or left and right movement. 9. Repeat the same motion until producing even surface. 10. Clean all the tools & put it back to proper place. 11. Clean the vice & working place. 	<p><u>Condition (Given):-</u> Fully equipped mechanical workshop with working bench & bench vice, hand grinder, safety equipments and work piece material.</p> <p><u>Task (What):-</u> Grind metal surface.</p> <p><u>Standard (How Well):-</u> Clear grounded work piece produced. the surface edges of De burred / chamfered</p>	<ul style="list-style-type: none"> ➤ Grinding procedure ➤ Safety precautions

Required tools/equipment: Scriber, emery paper, file, steel scale, base back square, marking scriber, bench vice or fixture to secure the workpiece hand grinder, safety equipments.etc.

Safety:

- Stet up the height of bench vice before start grinding.
- Wear safety goggles, hand gloves, and safety shoes.
- Clamp / secure the work piece as much as possible.
- Use cleaning brush for cleaning the working surroundings.
- Follow workshop safety rules.
- Must have weelgard in grander M/C

Task Analysis

7. COMPETENCY: File flat surface.

Total Time: 7 hrs
Theory : 1 hr
Practical : 6 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain drawing and instructions. 2. Obtain work piece material. 3. Obtain required tools equipments. 4. Clamp the work piece on the vice (the flat surface should be up ward) 5. Hold the file's handle with one hand & put another hand's thumb on the file's tip. 6. Position the feet to safe stance. 7. Put the file on top of the work piece & pushing from one hand (holding hand) & pressing only another hands thumb. 8. Return the file without pressure. 9. Apply the same motion to produce even removal of filling surface. 10. Check the flatness diagonally & cross, using steel rule. 11. Repeat the same motion of filling until producing even surface. 12. Clean all the tools & put it back to proper place. 13. Clean the vice & working place. 	<p><u>Condition (Given):-</u> Fully equipped mechanical workshop with Flat files, working bench & bench vice & work piece material.</p> <p><u>Task (What):-</u> File flat surface.</p> <p><u>Standard (How Well):-</u> The even surface in metals and work piece materials produced.</p>	<ul style="list-style-type: none"> ➤ Function of vice ➤ Function of files & its type ➤ Filing procedure ➤ Safety precautions

Required tools/equipment: Flat file, steel scale, base back square, marking scriber, bench vice or fixture to secure the workpiece, safety equipments.etc.

Safety:

- Stet up the height of bench vice before start filling.
- Use the whole length of the file.
- Don't use the file with damage or broken handle.
- Use wires brush for clean the file teeth.
- Follow workshop safety rules.

Task Analysis

8. COMPETENCY: Punch dot / center

Total Time: 2 hrs
Theory : 1 hr
Practical : 1 hr

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain drawing and instruction. 2. Obtain prepared size of work piece. 3. Obtain required tools and equipment. 4. Mark the symmetrical lines as per drawing. 5. Place the work piece on the flat anvil. 6. Hold the center punch by three fingers of left hand & hammer it by right hand. 7. Place the point of center punch at cross of symmetrical line. 8. Apply trail stroke. 9. Check the punch for accuracy. 10. Align if required. 11. Take next cross line & punch the center. 12. Move the center from self-ward while punching numerous dotted in semi vertical lines. 13. Repeat the same step until completing the cross line. 14. Clean tools & working place. 	<p><u>Condition (Given):-</u> Fully equipped mechanical workshop, drawing, anvil, steel rule, hammer, center/dot punch, safety goggles, work piece materials.</p> <p><u>Task (What):-</u> Punch dot/center.</p> <p><u>Standard (How Well):-</u> The dotted marks on layouts punched for drilling and sawing.</p>	<ul style="list-style-type: none"> ➤ Punching procedure ➤ Safety precautions

Required tools/equipment: Steel scale, base back square, marking scriber, bench anvil, Center / Dot punch, safety equipments.etc.

Safety:

- Don't wear bangles & wristwatch during punching.
- Never use mushroom formatted head of punches.
- Look at the punching point during punching, not at the head of punch during punching.
- Follow the general safety rules of workshop.

Task Analysis

9. COMPETENCY: Drill a hole.

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain drawing and instrucion. 2. Obtain required tools and equipment. 3. Obtain layout marked work piece. 4. Punch the center. 5. Clamp the work piece on the machine vice. 6. Mount the required drill bit on drill chuck. 7. Set up R.P.M. as per drill bit size. 8. Set coolant-housing pipe. 9. Start the machine & give hand feed. 10. Drill until obtaining required depth. 11. Stop the machine. 12. Remove the work piece & clean it. 13. Measure the center & the hole size according to the drawing. 14. Remove the drill bit & clean all belongings and surroundings. 	<p><u>Condition (Given):-</u> Fully equipped mechanical workshop with drill m/c, drill bit set, refinished work piece with drill layout, safety goggles.</p> <p><u>Task (What):-</u> Drill a hole.</p> <p><u>Standard (How Well):-</u> A hole drilled. .</p>	<ul style="list-style-type: none"> ➤ Introduction of drill m/c ➤ Drill bits & its types ➤ Drilling procedure ➤ Safety precautions

Required tools/equipment: Steel scale, base back square, marking scriber, bench anvil, Center / Dot punch, safety equipments.etc.

Safety:

- Tighten the work piece perfectly.
- Check drill bit cutting edge before drilling
- Use safety goggles.
- Never use very loose cloth, tie, chain etc.
- Use clan brush to clean the chips.
- Follow general safety rules.

Task Analysis

10. COMPETENCY: Perform forming.

Total Time: 5 hrs
Theory : 1 hr
Practical : 4 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain work piece 2. Obtain drawing and instructions. 3. Obtain required tools. 4. De-burr the edges of the work piece. 5. Mark the line for forming. 6. Perform forming operation. 7. Check the forming shape. 8. Repeat the same steps until completing the shape. 9. Clean tools, equipments and work place. 	<p><u>Condition (Given):-</u> working in a workshop, work piece, measuring and marking instruments, vice, hammers, anvil .</p> <p><u>Task (What):-</u> Make a round and square shape from feat bar.</p> <p><u>Standard (How Well):-</u> Perform shape within tolerance.</p>	<ul style="list-style-type: none"> ➤ Identification of marking and measuring tools. ➤ Measuring and marking procedure ➤ performing operations ➤ Safety precautions

Required tools/equipment: hammer,sladge hammer, steel scale safety gloves, safwty goggles, tong, .etc.

Safety:

- Follow general safety rulesof workshop

Task Analysis

11. COMPETENCY: Cut the metal by flat chisel.

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain drawing and instructions. 2. Obtain work piece 3. Obtain safety equipment. 4. Clean the work piece 5. Remove sharp edges. 6. Marks the cutting lines 7. Clamp the work piece in vice. 8. Cut the metal in mark line by flat chisel. 9. Repeat the same steps until completing the shape. 10. Clean the worked place. 11. Reshape the flat file, if necessary. 	<p><u>Condition (Given):-</u> Working in a workshop, work piece, measuring and marking instruments, anvil, flat chisel, safety goggles, drawing.</p> <p><u>Task (What):-</u> Cut the metal by flat chisel</p> <p><u>Standard (How Well):-</u> Cut the metal with in tolerance.</p>	<ul style="list-style-type: none"> ➤ Identification of marking and measuring tools. ➤ Measuring and marking operations ➤ Chisel cutting angle ➤ Chiseling method ➤ Grind the chisel ➤ Hardening and tempering ➤ Shape and size o chisel ➤ Safety precautions

Required tools/equipment: hammer, sladge hammer, steel scale safety gloves, safwty goggles, tong, .etc.

Safety:

- Follow general safety rulesof workshop

Module 1

Shielded Metal Arc Welding (SMAW)

Description:

This module intends to provide knowledge and skills on electrical arc welding or manual metal arc welding which employs coated or covered electrodes for producing an arc to act as a heat source; the covering on burning provides the necessary shield to protect the molten metal from the ill effects of oxygen and nitrogen from the surrounding atmosphere. It includes arc welding machine preparation, various welding on various joints in different positions. It is used in the fabrication of ships, bridges, pressure vessels and building structural components.

Objectives:

After completion of this module the trainees will be able:

1. To prepare A/C arc welding machine, tools & equipments.
2. To carry out SMAW on various joints in different positions.
3. To fabricate ships, bridges, pressure vessels and building structural components.

Duration: 150 hours

Tasks:

- 1 Apply welding safety equipments / apparels
- 2 Prepare A.C arc welding machine, tools & equipments.
- 3 Strike/maintain the arc
- 4 Perform Straight bead in flat position
- 5 Grind – off welding surfaces
- 6 Weld Fillet Lap joint in flat position
- 7 Weld Fillet Tee joint in flat position
- 8 Weld Fillet Corner joint in flat position
- 9 Weld square butt joint in flat position
- 10 Weld single V-butt joint in flat position
- 11 Weld bevel joint in flat position
- 12 Weld Flange joint in flat position
- 13 Perform straight bead in horizontal vertical position
- 14 Weld square butt joint in horizontal vertical position

Task Analysis

1. COMPETENCY: Apply Welding Safety Equipments / Apparels.

Total Time: 4 hrs
Theory : 2 hrs
Practical : 2 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and materials of safety apparels for welding jobs. 2. Check the illumination of work place. 3. Clean working surroundings. 4. Arrange conditional tools and equipments. 5. Hold the face and eye – protective welding helmet with clear glasses. 6. Wear protective clothes firmly so that they do not disturb your operating actions. 7. Use dry and safe protective clothes. 8. Fasten the metal cover. 9. Wear safety goggle, sleeves, shoes, ear muffs and gloves. 10. Connect the electrical wiring safely. 	<p><u>Condition (Given) :</u></p> <p>Fully equipped workshop with Arc welding transformer and, welding accessories.</p> <p><u>Tasks (What):</u></p> <p>Apply Welding Safety Equipmen/Apparels</p> <p><u>Standards (How well):</u></p> <p>Safe working habit Maintained .</p> <p>The unwanted accidents minimizd Working places kept neat and clean.</p>	<ul style="list-style-type: none"> ➤ Personnal Safety apparels ➤ workshop safety ➤ Safety Equipment ➤ Safe working environment

Tools Equipments:

Welding hand shield, Welding helmet, Safety dark glass, Safety plain glass & goggle, Safety leather glove, leather apron, leather sleeve, shoe, Ear muffs, Ear plugs, Chipping hammer. Safe guard, Wire brush, Tongs, Leather laying.

Safety:

- Follow general safety rules of workshop

Task Analysis

2. COMPETENCY: Prepare AC Arc Welding machine, Tools & Equipments

Total Time: 4 hrs
Theory : 2 hrs
Practical : 2 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Check and plug in the electrical cable connections. 2. Set up electrode Holder and Earthclamp. 3. Change the electrode holder if the handle is broken. 4. Dry electrodes in Oven if damped. 5. Clear off the Welding table from unwanted metal pieces and welding spots. 6. Clean or change the glass of welding helmet as its necessary. 7. Keep the Welding tools close to the working place. 8. Set a welding current on the machine (amp). 9. Wear the safety apparel as provided and check the filter lens of the welding shield. 10. Fit grinding disc on hand grinder. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Prepare AC, arc welding machine Tools & Equipment</p> <p><u>Standards (How well):</u></p> <p>Welding machine, tools and equipments operated</p> <p>The AC machine and their working principle distinguished</p> <p>Welding tools and equipments handled safely.</p>	<ul style="list-style-type: none"> ➤ Introduction of welding ➤ Welding machines <ul style="list-style-type: none"> ● Single/three phase ➤ Welding accessories ➤ Tools and equipment used in weldings ➤ Safety precautions

Tools Equipments:

AC Arc welding transformer, DC Arc welding rectifier, Industrial plugs, Electrode holder, Earth clamp, Different size electrodes, Dry oven. hand grinder

Safety Precautions :

- Avoid using electrode holder with broken handle.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.
- Use safety goggles while grinding

Task Analysis

3. COMPETENCY: Strike/maintain the arc.

Total Time: 6 hrs
Theory : 2 hrs
Practical : 4 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and material. 2. Clean the metal surface with a wire brush and wipe off the oil and greases. 3. Mark the job according to the instruction. 4. Set the work-piece on the welding table in a flat position. 5. Set the arc welding transformer. 6. Select and insert electrode into the holder. 7. Set a welding current on a machine (amp). 8. Wear the safety apparel as provided and check the filter lens of the welding shield. 9. Strike the arc on the marked spots and observe the current setting. 10. Reset the current if necessary. 11. Remove the slag from the weld bead. 12. Practice the task as much as you are confident in developing an arc freely, without sticking and where desired 13. Clean tools, equipments, workpieces and the working area. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Strike / maintain the arc.</p> <p><u>Standards (How well):</u></p> <p>The distance of electrode developing plasma arc maintained.</p>	<ul style="list-style-type: none"> ➤ Arc welding machines ➤ Welding arc ➤ Welding current ➤ Striking method ➤ Striking procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different size electrodes, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes and floor.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

4. COMPETENCY: Perform Straight bead in flat position.

Total Time: 14 hrs
Theory : 2 hrs
Practical : 12 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and material. 2. Obtain safety equipments. 3. Collect welding accessories. 4. Clean the metal surface with a wire brush and wipe off the oil and grease. 5. Mark the job by chalk as the instruction. 6. Set the work-piece on the welding table as instruction in a flat position. 7. Select and insert electrode into the holder. 8. Set a welding current on the machine (amp). 9. Wear the complete safety apparel and check the filter lens of the welding shield. 10. Generate an arc at about 10 to 15 mm ahead of the starting point and return to the point. 11. Move the electrode in a wave motion as instruction to straight line holding 70-80 degrees against the welding direction and complete the bead at the other end of the plate. 12. Maintain correct: angle of the electrode, arc length, wave motion & travel speed. 13. Remove the slag from the weld bead. 14. Repeat the exercise till you achieve good result. 15. Clean tools, equipments, workpieces and the working area. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Perform straight bead in flat position.</p> <p><u>Standards (How well):</u></p> <p>Uniform bead wave, width and reinforcement.</p>	<ul style="list-style-type: none"> ➤ Formation and arc weaving method ➤ Types of welding ➤ Safety precautions ➤ Weld bead edeposition procedure.

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes and Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

5. COMPETENCY: Grind off welding surfaces.

Total Time: 8 hrs
Theory : 2 hrs
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction. 2. Obtain pre-welded workpiece material. 3. Obtain accessories and tools required. 4. Set the workpiece. 5. Wear safety equipments. 6. Connect electrical line to machine. 7. Turn on the machine for a while to observe initial torque. 8. Hold workpiece into vice. 9. Start grinding from end of the beads. 10. Make clear surface grinding all welding spots. 11. Grind 45 degree on all surface corners. 12. Check the angle and even surface. 13. Grind to confirm even surface. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Task :</u></p> <p>Grind off welding surfaces.</p> <p><u>Standards:</u></p> <p>The V- edges prepared for groove weld. Burrs chamferred The welding beads grinded to prepare re weld.</p>	<ul style="list-style-type: none"> ➤ Introduction of grinding ➤ Handling of Hand grinder ➤ Method of wheel exchange ➤ Grinding procedure ➤ Safety precautions

Tools Equipments:

Black smithy vice, Hand grinder, Work piece material and Safety equipments,

Safety Precautions :

- Do not touch on running grinding wheel.
- Do not try to stop the wheel by hand even after turning off the power.
- Avoid using loose electrical connection.
- Wear safety goggles and safety gloves.
- Keep away the inflammable material.
- Always place the guard to safe for other person.
- Keep the workplace dry.
- Hold or clamp the workpiece much as possible.

Task Analysis

6. COMPETENCY: Weld Fillet Lap Joint in flat position.

Total Time: 9 hrs
Theory : 2 hrs
Practical : 7 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Refer steps 1 to 4 of Straight bead welding 2. Mark the job to overlap the 2nd work piece by marking scribe with scale as per drawing. 3. Set the work-piece on the welding table aligning the top piece. 4. Hold the electrode, pointing at the corner of the joint at an angle of 45° to the plate surface. 5. Refer steps 6 to the end of Fillet T-joint welding. 6. Repeat the same exercise till you achieve good weld. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Weld Fillet Lap Joint in flat position</p> <p><u>Standards (How well):</u></p> <p>The work aligned to weld lap joint.</p> <p>The advantage of joining lap joint in fabrication industries understood.</p>	<ul style="list-style-type: none"> ➤ Selection of electrodes and third metals ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Hand grinder, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

7. COMPETENCY: Weld Fillet Tee Joint in flat position

Total Time: 20 hrs
Theory : 2 hrs
Practical : 18 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Refer steps 1 to 4 of Straight bead welding. 2. Set the pieces in alignment, forming a 90° "T" on the welding table. 3. Weld tacks on the workpieces at both ends and in the center if necessary. 4. Clean tacks, check the alignment and reset the job if necessary. 5. Set the base material horizontally on the welding table (tack side down) 6. Deposit the first bead along the joint line with a correct and uniform travel speed. 7. Clean the other side of the joint and grind the tacks flush if necessary. 8. Set the joint in a flat position (weld side down) 9. Make a second weld along the joint line with the same setting and technique as used for the first bead. 10. Clean the weld thoroughly. 11. Repeat the same exercise until you can produce good welds. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Weld Fillet Tee Joint in flat position.</p> <p><u>Standards (How well):</u></p> <p>Fillet welding performed. Two material in different angle positioned and joined. Unwanted welding distortions omitted.</p>	<ul style="list-style-type: none"> ➤ Welding tests and certification ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Hand grinder, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

8. COMPETENCY: Weld Fillet Corner Joint in flat position

Total Time: 8 hrs
Theory : 2 hrs
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
1. Refer step 1 to 4 of Straight bead welding. 2. Set up the work piece on the welding table ensuring the angle required. 3. Refer step 5 to end of Fillet Tee joint welding.	<p><u>Condition (Given):</u></p> Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes. <p><u>Tasks (What):</u></p> Weld fillet corner joint in flat position. <p><u>Standards (How well):</u></p> The work alligned to weld corner joint. the advantage of joining corner joint in fabrication industries understood. ..	<ul style="list-style-type: none"> ➤ Welding defects and their remedies ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Hand grinder, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire .
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

9. COMPETENCY: Weld Square butt joint in flat position

Total Time: 10 hrs
Theory : 2 hr
Practical : 8 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Refer steps 1 to 4 of Straight bead . 2. Set the workpieces on the welding table as butt joint with gap alignment as per drawing. 3. Refer steps 7 to 10 of straight beadwelding. 4. Tack weld on back side of both ends and also on center if necessary. 5. Check the alignment and reset if necessary. 6. Turn the work-piece tack side down. 7. Strike an arc on the tack welding and deposit the first bead along the joint line. 8. Chip off the slag from the bead and brushed out to clean 9. Clean the back side and grind the tacks flush. 10. Deposit the second bead using same setting. 11. Chip off the slag from the bead and brushed out to clean. 12. Practice the same exercise until you can produce a good result. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Weld Square butt joint in flat position</p> <p><u>Standards (How well):</u></p> <p>Two materials performing root gap joined. Developing the penetration.</p>	<ul style="list-style-type: none"> ➤ Welding joints and symbols ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes, Hand grinder, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

10. COMPETENCY: Weld single V- butt Joint in flat position (single / multi run).

Total Time: 14 hrs
Theory : 2 hrs
Practical : 12 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and drawing. 2. Obtain tack welded material 3. Set the arc welding machine 4. Select and insert the electrode into the holder. 5. Set the current 6. Bend the joint outwards slightly (1° to 2°) from bead to ensure straightness after continuous depositing. 7. Set the work-piece on the table. 8. Deposit the root gap along the joint line producing keyhole welding. 9. Chip off the slag from the bead and brushed out to clean. 10. Deposit second bead on the root gap bead line connecting with faces of angles side by side. 11. Deposit as much as required layer to filled in similar way. 12. Repeat the exercise till you achieve good result. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Weld “V” butt joint in flat position.</p> <p><u>Standards (How well):</u></p> <p>Bevel-edge prepared. Two material performing root gap joined. The penetration developed.</p>	<ul style="list-style-type: none"> ➤ Welding position ➤ Welding wave ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Hand grinder, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

11. COMPETENCY: Weld double bevel joint in flat position

Total Time: 13 hrs
Theory : 2 hrs
Practical : 11 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
1. Obtain instruction and drawing. 2. Prepare a material following the steps of Perform tack weld for V-butt joint. 3. Weld V-butt joint in flat position following previous task. 2. Grind off the over penetrated welding beads. 3. Refer steps 7 to 12 of weld V- butt joint welding.	<p><u>Condition (Given):</u></p> Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.	<ul style="list-style-type: none"> ➤ Term penetration, leg, Undercuts, Overlaps etc ➤ Welding procedure ➤ Safety precautions
	<p><u>Tasks (What):</u></p> Weld double bevel groove joint in flat position.	
	<p><u>Standards (How well):</u></p> Bevel-edge prepared Two material performing root gap joined The penetration developed.	

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Hand grinder, Safety equipments and work piece material.

Safety Precautions :

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

12. COMPETENCY: Weld Flange Joint in flat position

Total Time: 12 hrs
Theory : 2 hrs
Practical : 10 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instructional drawing and material. 2. Refer step 2 to 10 of Straight bead welding. 3. Grind off bevel on one side of pipe. 4. Set the work piece on the welding table as per drawing 5. Hold electrode, pointing at the corner of the joint at an angle of 45 to the plate and pipe. 6. Weld tacks, on the workpiece at its all four axis and check the alignment and reset the job if necessary. 7. Chip off the slag from the tack and brushed out to clean. 8. Deposit root gap along the joint line circularly. 9. Chip off the slag and clean. 10. Deposit additional beads as instruction to fill the joint and strength. 11. Repeat the exercise till you achieve good result. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Tasks (What):</u></p> <p>Weld flange joint in flat position.</p> <p><u>Standards (How well):</u></p> <p>Bevel-edge on pipe prepared. Two different shape of material performing root gap joined. The circular penetration developed.</p>	<ul style="list-style-type: none"> ➤ Welding inspection and tests ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Hand grinder, Safety equipments and work piece material.

Safety Precautions:

- Avoid using electrode holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean and to remove slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Use screens to protect bystanders.

Task Analysis

13. COMPETENCY: Perform straight bead in horizontal vertical position

Total Time: 14 hrs
Theory : 2 hrs
Practical : 12 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instructional drawing. 2. Collect work piece. 3. Refer and follow the steps of weld straight bead from 3 to 9. 4. Set the work-piece on the welding stand with clamps and supports in a Horizontal position about 50mm lower than the eye level. 5. weld tacks on both ends. 6. Check and re-set the position. 7. Strike the arc on a rough-piece for trail. 8. Strike the arc on the work-piece at one edge. 9. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 10. Remove the slag from the weld bead. 11. Repeat the exercise till you achieve good result. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Task :</u></p> <p>Perform straight bead in horizontal vertical position.</p> <p><u>Standards:</u></p> <p>Joining of two metals mainted. Welding distortion maintained. Welding penetration maintained Welding procedure horizontal position followed.</p>	<ul style="list-style-type: none"> ➤ Workpiece clamping ➤ Wave of welding in Horizontal position ➤ Penetration of welding in Horizontal position. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Safety equipments and work piece material.

Safety Precautions :

- Avoid using Welding holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Always use well insulated cable.

Task Analysis

14. COMPETENCY: Perform Square butt joint in Horizontal vertical position

Total Time: 14 hrs
Theory : 2 hr
Practical : 12 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instructional drawing. 2. Collect work piece 3. Refer and follow the steps of weld straight bead from 3 to 9. 4. Set the work-piece on the welding stand with clamps and supports in a Horizontal position 5. Perform tack weld on both ends. 6. Check and re-set the position. 7. Strike the arc on a rough-piece for trail. 8. Strike the arc on the work-piece at one edge. 9. Move the electrode developing welding arc following the edges of both w/piece and complete the bead at other end of the plate. 10. Remove the slag from the weld bead. 11. Repeat the exercise till you achieve good result. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with Arc welding transformer, welding accessories and different electrodes.</p> <p><u>Task :</u></p> <p>Perform square butt joint in horizontal vertical position.</p> <p><u>Standards:</u></p> <p>Joining of two metals maintained Welding distortion maintained Welding penetration maintained Welding procedure of horizontal position followed..</p>	<ul style="list-style-type: none"> ➤ Welding metallurgy ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Arc welding machines, Welding accessories, Different electrodes Safety equipments and work piece material.

Safety Precautions :

- Avoid using Welding holder with broken handle and un-insulated wire.
- Always use Chipping hammer and Wire brush to clean up the welding slags.
- Always check the connection of Holder, Shield, and Grips.
- Avoid using damp electrodes.
- While removing the slag wear safety goggles and chip off in opposite direction.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.

Module 2

Oxy Acetylene Welding (OAW)

Description:

This module intends to provide knowledge and skills on acetylene gas welding through mixing with oxygen gas in the welding torch and is then burnt at the torch tip to give a flame with a temperature of about 3300° C which can melt most of the ferrous and non-ferrous metals. It includes welding of root run in pipe and other multi-run welds, light fabrications like ventilation and air-conditioning ducts, and motor vehicle repairs. It also deals with brazing and oxy-acetylene flame cutting.

Objectives:

After completion of this module the trainees will be able:

1. To set up Oxy-acetylene gas and related accessories
2. Perform (OAW) on different joint in different positions
3. To perform cutting in MS plates
4. Perform brazing in copper, steel and brass plates

Duration: 80 hours

Tasks:

1. Prepare safety equipment
2. Prepare Acetylene gas
3. Set up Acetylene gas (Hose pipe and Regulator)
4. Set up Welding Nozzles
5. Run fusion lines without filler rod
6. Run fusion lines with filler rod
7. Weld Butt joint in flat position
8. Weld Corner joint in Flat position
9. Weld Lap joint in the Flat position.
10. Weld T – Joint in the Flat Position.
11. Weld Pipe + pipe joint in flat position
12. Cut straight line in Mild steel manually
13. Cut circular line in MS plate manually
14. Braze in Mild steel

Task Analysis

1. COMPETENCY: Prepare Safety equipment and measures.

Total Time: 4 hrs
Theory : 2 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain Instruction 2. Obtain safety measures and equipment. 3. Follow safety precaution. 4. Wear safety goggle 5. check connection of lose pipe 6. check the leakage of oxygen and acetylene gas with soapy water 7. Place the safety equipment in proper place 8. Keep the fire extinguisher in working area 9. Set up flash back arrestors in hose pipe 10. Check ventilation in workshop 	<p><u>Condition (Given):-</u> Fully equipped workshop</p> <p><u>Task (What):-</u> Prepare safety equipment and measures</p> <p><u>Standard (How Well):-</u> The equipment setup</p>	<ul style="list-style-type: none"> ➤ fire extinguishers ➤ safety precaution

Tools Equipment: fire extinguishers, wrench shape, goggle etc.

Safety: safety precaution

Task Analysis

2.COMPETENCY: Prepare Acetylene gas and safety equipments.

Total Time: 5 hrs

Theory : 1 hr

Practical : 4 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Check the gas level on manometer. 2. close down all valves if gas indicator shows zero. 3. Carry out the gas cylinder to the open place 4. Open main cover. 5. Remove the carbide tray. 6. Clean up all parts and cylinder. 7. Fill up the water into tank up to the water level. 8. Fill up required amount of calcium carbide in the carbide bucket. 9. Put the bucket inside the tank . 11. Tighten the main cover. 12. Open main valve. 13. Check the manometer for the gas level. 14. Connect accetylene rubber hose pipe. 15. Check all connection and cylinder lid to ensure not leaking. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator, acetylene regulator, hose pipes connected to welding torch.</p> <p><u>Tasks (What):</u></p> <p>Prepare Acetylene gas & safety equipments.</p> <p><u>Standards (How well):</u></p> <p>The amount of calcium carbide identified to prepare acetylene gas. Acetylene generator carefully handled. Gas level on manometer read. All connection and cylinder lid checked to ensure not leaking.</p>	<ul style="list-style-type: none"> ➤ Introduction of gas welding. ➤ Preparation and storing of acetylene gas. ➤ Gas welding safety equipments

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Gas welding accessories, Safety equipments, Calcium carbide and Water.

Safety Precautions:

- Never use grease or oil on cylinders.
- Avoid using hammer or wrench to open cylinders valves.
- Check the leakage with soapy water.
- Never use acetylene at pressure over 15 P.S.I.
- Never handle calcium carbide by bare hand.
- Do not over filled calcium carbide than the capacity.

Task Analysis

3. COMPETENCY: Set up Oxygen Acetylene gas (hose pipe & Regular)

Total Time: 3 hrs
Theory : 1 hrs
Practical : 2 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain refilled oxygen cylinder. 2. Keep the cylinder in vertical up right position. 3. Chain them in wall close to the acetylene cylinder. 4. Remove the caps of the cylinder using the wrench. 5. Open the cylinder valve slightly and then close quickly to blow out any dirt in the valve. 6. Attach the respective regulator to the cylinder valve outlet nipple. Tighten the connecting nuts with wrench. 7. Release fully both the adjusting screws, slowly open the cylinder valve then regulator valve. 8. Attach hoses to the respective outlet nipples of regulators. 9. Blow out the dirt from hoses by allowing gases to pass and then again release the pressure by turning again the regulator adjusting screws to the left. 10. Obtain torch handle. 11. Attach the oxygen and acetylene hoses to the respective inlets of the torch. 12. Blow out the torch handle. Open only one valve at a time. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator, oxygen cylinder, regulator, hose pipe to connect welding torch.</p> <p><u>Tasks (What):</u></p> <p>Set up Oxygen gas and rubber hose.</p> <p><u>Standards (How well):</u></p> <p>The rubber hose connector tightened.</p> <p>The gas level in manometer read.</p> <p>The regulator key opened and shut.</p>	<ul style="list-style-type: none"> ➤ Introduction of oxygen and its function in gas welding. ➤ Gas welding accessories and tool equipments. ➤ Setting procedure ➤ Safety precautions

Tools Equipments:

Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Safety equipments and Gas welding torch.

Safety Precautions:

- Avoid exposing cylinders to furnace heat, radiators and open fire.
- If cylinders have to be moved, be sure that the cylinder valves are shut off.
- Avoid transport a cylinder by dragging, sliding, or rolling it on its side.
- Avoid repairing the cylinder valves. If valves do not function properly or if they leak, notify the supplier immediately.
- Keep valve closed, when not in use and on empty cylinders.
- Keep full and empty cylinders apart.

Task Analysis

4. COMPETENCY: Set up welding Nozzles:

Total Time: 4 hrs
Theory : 2 hrs
Practical : 2 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Prepare acetylene gas. 1. Set up oxygen gas and rubber hose. 2. Set up torch handle to attach the nozzle. 3. Obtain nozzle set. 4. Identify the nozzle to be attach as per operation. 5. Attach the nozzle and tighten it. 6. Adjust the regulators to pressures suited to the nozzles in use. 7. Open the oxygen valve slowly to full. Then tighten the adjusting screw until desired pressure is registered on the pressure gauge. 8. Loose the adjusting screw on the acetylene regulator, open the acetylene cylinder valve about three quarters of a turn and tighten the adjusting screw till desired pressure is achieved. 9. Open the acetylene valve on the torch one half of a turn and ignite the gas with a spark lighter. 10. Adjust the acetylene valve till the flame burns clean with minimum smoke. 11. Open the oxygen valve on the torch slowly. As the amount of oxygen is increased, the flame will be come short and will become bluish. 12. Follow this process till the last trace of green unburnt acetylene disappears from the blue cone at the ene of the nozzle tip. 13. To shut off the torch, first close the oxygen valve on the torch and then acetylene valve. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator, oxygen cylinder, regulator, hose pipe to connect welding torch and different welding nozzles.</p> <p><u>Tasks (What):</u></p> <p>Set up welding nozzles.</p> <p><u>Standards (How well):</u></p> <p>The nozzles identified as per the operation. The nozzles connected. The nozzles cleaned. The acetylene valve adjusted till the gas welding flame burns clean with minimum smoke.</p>	<ul style="list-style-type: none"> ➤ Selection of welding nozzles. ➤ Gas welding flames. ➤ Flame control. ➤ Setting procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Safety equipments Gas welding torch and Nozzles.

Safety Precautions :

- Avoid hanging a torch with its hose on regulator or cylinder valves.
- Avoid relighting a blown out torch without first closing both torch valves.
- Stop using acetylene at pressure over 15 P.S.I.
- Avoid opening the valve too much that the flame separates from the tip.
- If the nozzle tip is dirty, use a tip cleaner of the proper diameter.
- The orifice or hole in the tip may be worn by constant cleaning and will not give a round-nosed inner cone.

Task Analysis

5. COMPETENCY: Run fusion lines without filler rod. (Puddling)

Total Time: 5 hrs
Theory : 1 hrs
Practical : 4 hrs

Performance Steps	Terminal Performance Objective	Related Technical knowledge
<ol style="list-style-type: none"> 1. Place two firebricks on the welding table. 2. Obtain workpiece material (MS Sheet) and put on the bricks. 3. Set up welding equipment with correct nozzle. 4. Adjust pressure on regulator suitably. 5. Clean up the surface of workpiece material. 6. Light the torch and adjust till neutral flame is obtained. 7. Hold the torch on the workpiece at an angle of about 60 degree. 8. Maintain the innercone of the flame. About 3 mm above the metal surface. 9. Move the torch in a semi-circle of about 5 mm radius. 10. Form a puddle of molten metal. 11. Maintain the depth of the puddle as much as the thickness of the workpiece. 12. Advance the torch slowly along the required line with semicircular movements. 13. Let the molten metal left behind solidifies in the form of nipples. 14. Repeat till lines of beads of uniform width, penetration and pattern are produce. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator, oxygen cylinder, regulator, hose pipe to connect welding torch.</p> <p><u>Tasks (What):</u></p> <p>Run fusion lines without filler rod. (puddling)</p> <p><u>Standards (How well):</u></p> <p>Neutral flame adjusted on gas welding torch. A puddle of molten metal formed. The depth of the puddle maintained as much as the thickness of the work piece. Portion/puddling melted advance in uniform straight line ripples.</p>	<ul style="list-style-type: none"> ➤ Position and motion of the torch. ➤ Backfire and flashback ➤ Procedure for running a line of fusion or puddling without a fillor rod. ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Safety equipments Gas welding torch and Nozzles.

Safety Precautions :

- Maintain a consistent travel speed to prevent burn – throughs in the workpiece.
- Move the torch from right side of the workpiece to left side in manipulating the semicircle.
- Maintain the innercone of the flame to touch the workpiece or the puddle.
- Avoid using match to light a torch. Use a regulation sparklighter.
- Wear safety apparel (safety goggles, working apron, lether apron and dark glass)
- Avoid conditions that may cause a backfire or flashback.

Task Analysis

6. COMPETENCY: Run fusion lines with the filler rod.

Total Time: 6 hrs
Theory : 1 hrs
Practical : 5 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Repeat the steps from 1 to 8 of the run lines of fusion without filler rod. 2. Obtain filler rod. 3. Hold filler rod at an angle 30° to 40° . 4. Put one end in the molten puddle. 5. Deposit the rod till a bead of 5 to 10 mm wide and 3 mm high is formed. 6. Move the torch and rod in opposite directions using a weaving motion. 7. Advance the torch and rod along the desired line on the workpiece. 8. Withdrawn the torch at the end of the pass, fill the crater by adding filler rod. 9. Practice running consistent straight beads. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator, oxygen cylinder, regulator, hose pipe to connect welding torch, different size of nozzle and MS filler rod.</p> <p><u>Tasks (What):</u></p> <p>Run lines of fusion with filler rod.</p> <p><u>Standards (How well):</u></p> <p>Filler rod deposited with parent metal.</p> <p>The torch and filler rod moved in using a weaving motion. Proper molten puddle established and maintained.</p>	<ul style="list-style-type: none"> ➤ Selection of filler rod. ➤ Laying beads with a filler rod. ➤ Left ward and Right ward welding techniques. ➤ Fusion line running procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch and Nozzles.

Safety Precautions :

Refer to the task Run fusion without filler rod.

Task Analysis

7. COMPETENCY: Weld Butt Joint in Flat position

Total Time: 6 hrs
Theory : 1 hr
Practical : 5 hrs

Performance Steps	Terminal Performance Objective	Related Technical knowledge
<ol style="list-style-type: none"> 1. Refer steps no 1 to 5 of Run lines of fusion without filler rod. 2. Place the two workpiece on fire bricks side by side in position. 3. Leave a space taper gap of 0.8 mm at the end where the welding is to start and 3.2 mm at the other end. 4. Refer steps no.6 to 8 of the Run fusion without filler rod. 5. Warm up the edges of each workpiece slightly by running the flame along the edges quickly. 6. Heat both the workpiece at the point where welding is to start, giving the torch a weaving motion across the edges of both the plates so as to bring them to welding temperature simultaneously. 7. Bring one end of the filler rod under the flame and into the puddle as the puddle forms. 8. Allow a correct size (about 3mm wide and 0.5mm high) bead to form. 9. Continue in this manner till the whole length of edges are welded together. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator, oxygen cylinder, regulator, hose pipe to connect welding torch, different size of nozzle and MS filler rod.</p> <p><u>Tasks (What):</u></p> <p>Weld butt joint in flat position</p> <p><u>Standards (How well):</u></p> <p>The warming up the edges of the flame along the edges understood.</p> <p>Butt joint welding process performed in thin sheet.</p>	<ul style="list-style-type: none"> ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch and Nozzles.

Safety Precautions :

- As the welding goes on, the two MS sheet should come together ahead of the weld, with a gap of 0.8mm. If the sheets come close too fast, tack weld ahead of the weld. If they are to a slow allow the weld to cool a little.
- Refer safety precautions of the Run fusion weld with filler rod.

Task Analysis

8. COMPETENCY: Weld Corner Joint in flat position.

Total Time: 6 hrs
Theory : 1 hr
Practical : 5 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain a workshop drawing. 2. Obtain a workpiece material. 3. Set up all gas welding equipment. 4. Position the workpiece on the welding table as per given drawing. 5. Refer steps no.6 to 8 of the Run lines offusion without filler rod. 6. Refer steps no.5 to 9 to complete welding corner joint. 7. If additional build – up is required, filler rod may be added as the puddle is carried across the joint. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator oxygen & welding torch with different sizes of nozzles.</p> <p><u>Tasks (What):</u></p> <p>Weld corner joint in flat position.</p> <p><u>Standards (How well):</u></p> <p>Different process of welding corner joint performed.</p>	<ul style="list-style-type: none"> ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch and Nozzles.

Safety Precautions :

- Refer to the Task weld edge joint.

Task Analysis

9. COMPETENCY: Weld Lap joint in Flat position.

Total Time: 4 hrs
Theory : 1 hr
Practical : 3 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain a workshop drawing. 2. Obtain a workpiece material. 3. Set up all gas welding equipment. 4. Lay one plate on top of the other plate on the welding table as per given drawing. 5. Refer steps no.6 to 8 of the Run lines of fusion without filler rod. 6. Refer steps no.5 to 8 to complete welding corner joint. 7. Maintain the heat on bottom plate too while manipulating the torch. (The top plate requires less heat and may overheat if too much heat is applied) 8. If additional build – up is required, filler rod may be added as the puddle is carried across the joint. 9. Weld one side of the plate and then practice on the reverse side. 	<p><u>Condition (Given):</u> Fully equipped workshop with acetylene generator oxygen & welding torch with different sizes of nozzles.</p> <p><u>Tasks (What):</u> Weld a Lap joint in flat position.</p> <p><u>Standards (How well):</u> Different process of welding joint performed. Lamination, delamination and penetration identified in gas welding.</p>	<ul style="list-style-type: none"> ➤ Inspection and testing of the gas welding joints. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch and Nozzles.

Safety Precautions :

- Refer to the Task Weld edge joint.

Task Analysis

10. COMPETENCY: Weld T – Joint in the Flat Position.

Total Time: 6 hrs
Theory : 1 hr
Practical : 5 hrs

Performance Steps	Terminal Performance Objective	Related Technical knowledge
<ol style="list-style-type: none"> 1. Obtain a workshop drawing. 2. Obtain a workpiece material. 3. Prepare the dimension as per drawing on the workpiece material. 4. Set up all gas welding equipment. 5. Stand one plate on top of the other plate on the welding table forming T – Joint as per given drawing. 6. Refer steps no.6 to 8 of the Run lines of fusion without filler rod. 7. Refer steps no.5 to 7 of Weld Edge joint to complete welding corner joint. 8. Realign the position if needed. 9. Tilt the tacked pieces 45° to the work surface, placing the fire brick under one side to support the pieces. 10. hold the torch so the tip forms and angle of about 45° to the bottom plate. 11. Maintain the heat on both plate while manipulating the torch. 12. If additional build – up is required, filler rod may be added as the puddle is carried across the joint. 13. Weld one side of the plate and then practice on the reverse side. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator oxygen & welding torch with different sizes of nozzles.</p> <p><u>Tasks (What):</u></p> <p>Weld T – Joint in the Flat Position.</p> <p><u>Standards (How well):</u></p> <p>Process of T-joint welding performed Being deformation controlled while welding.</p>	<ul style="list-style-type: none"> ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch and Nozzles.

Safety Precautions:

- Refer to the Task Weld Square butt joints.

Task Analysis

11. COMPETENCY: Weld Pipe + Pipe joint in Flat position.

Total Time: 7 hrs
Theory : 1 hrs
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain a workshop drawing. 2. Obtain a workpiece material. 3. Prepare Vee shape on workpiece material for welding.(pipes) 4. Set up all gas welding equipment. 5. Place the tube on a Vee Block, leaving a gap of about 1mm to 2mm between the two edges to be welded. 6. Refer steps no.6 to 8 of the Run lines of fusion without filler rod. 7. Tack weld the joint in min. three places. 8. Re-align the pipe if necessary. 9. Start welding from one of the tack weld joint keeping at top side. 10. Advance the torch to the bottom in operator side with criss – cross motion of the torch and rod.(not semi – circular) 11. Keep the first 10mm of the weld deposit narrow and flat but proper fusion and penetration into the joint. 12. Keep the inner cone straight with the line of travel as the welding advances the pipe. 13. Turn the pipe when the welding nears the ¼ of the pipe. 14. Start from the other side of the joint & continue as before reaching the next ¼ of the pipe. 15. Fuse well to the end of the previously deposited weld. 16. Finish the weld at remaining part of pipe smoothly refering above steps. 17. If additional build – up is required, filler rod may be added as the puddle is carried across the joint. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator oxygen & welding torch with different sizes of nozzles with.</p> <p><u>Tasks (What):</u></p> <p>Weld Pipe + Pipe joint in flat position,</p> <p><u>Standards (How well):</u></p> <p>The pipes located to be joint.</p> <p>Process of pipe welding performed.</p>	<ul style="list-style-type: none"> ➤ Defects on pipe welding ➤ Procedure of welding on Pipes ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch, Nozzles and V-blocks.

Safety Precautions :

- Refer to the Task Weld edge joint.

Task Analysis

12. COMPETENCY: Setup cutting torch.

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain Instruction 2. Obtain refilled oxygen and fuel gas. 3. Keep the both cylinder in vertical up right position 4. Connect the regulator and hash pipe in both cylinder 5. Select the cutting torch 6. Connect the cutting torch and flash back arrestors in hose pipe 7. Clean the tip of cutting torch 8. Set up the gas flow rate of oxygen 2.5 bar 9. Light the torch adjust preheated flame. 	<p><u>Condition (Given):-</u> Fully equipped workshop with fuel gas, regulator, oxygen gas, cutting torch</p> <p><u>Task (What):-</u> Set up cutting torch</p> <p><u>Standard (How Well):-</u></p> <ul style="list-style-type: none"> ➤ The equipment setup ➤ Set up the gas flow rate ➤ Selection of cutting torch 	<ul style="list-style-type: none"> ➤ Procedure of gas cutting ➤ Safety precaution ➤ flame safety

Tools Equipment: Refer tool equipment of the cut straight live to MS plat manually.

Safety: safety precaution of cut straight live to Ms plate manually.

Task Analysis

13. COMPETENCY: Cut Straight line to MS plate manually.

Total Time: 7 hrs
Theory : 1 hr
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain a workpiece material (MS Plate) 2. Set up all gas welding equipment. 3. Place the plate on the cutting table in such a way that the plate to be cut comes over the hole or slot in the cutting table 4. Rule a chalk line about 3/4" from one edge of the plate. 5. Select and set up the correct cutting nozzle for the thickness of the metal to be cut. 6. Light the torch, adjust preheated flame. 7. Observe the nature of the cutting flame by pressing down the oxygen control lever. The valve is operated either with the thumb or forefinger. 8. Adjust the flame if necessary to keep the preheating cones burning with a neutral flame. 9. Bring the preheated flame on the edge to be cut & heat edge to cherry – red. 10. Press down the oxygen pressure lever. 11. Move the torch forward slowly along the chalk line maintaining the gap between the plate and the flame. A shower of sparks will be seen to fall from the underside, indicating that the penetration is complete and the cut is proceeding correctly. 12. Reheat from the beginning if the cut does not seem to go through the metal. 13. Blow with hammer to separate the two section. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with LPG gas, regulator, oxygen & gas cutting torch.</p> <p><u>Tasks (What):</u></p> <p>Cut straight line to MS plate manually.</p> <p><u>Standards (How well):</u></p> <p>The MS plate being cut located. The equipments set up. The cutting flame set. The cutting torch straight handled. The metal cut.</p>	<ul style="list-style-type: none"> ➤ Procedure of gas cutting. ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, LPG Gas, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Safety equipments, and Gas cutting torch.

Safety Precautions :

- Wear safety apparels safety goggles, safety gloves, Safety helmet.
- Place a piece of steel close to the line of cut to slide the torch along.
- If the edges of the cut appear to melt and have a very ragged appearance, the metal is not burning through and torch is being moved too slowly.
- When an exceptionally straight cut is desired, clamp a bar across the plate along side the cutting line to act as a guide for the torch to follow.
- Protect to by-standers.

Task Analysis

14. COMPETENCY: Cut circular line to MS plate manually.

Total Time: 7 hrs
Theory : 1 hr
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain a workpiece material (MS Plate) 2. Set up all gas welding equipment. 3. Place the plate on the cutting table in such a way that the plate to be cut comes over the hole or slot in the cutting table 4. Compass a chalk line about 3/4" as desired circle. 5. Select and set up the correct cutting nozzle for the thickness of the metal to be cut. 6. Light the torch, adjust preheated flame. 7. Observe the nature of the cutting flame by pressing down the oxygen control lever. The valve is operated either with the thumb or forefinger. 8. Adjust the flame if necessary to keep the preheating cones burning with a neutral flame. 9. Bring the preheated flame on the edge to be cut & heat edge to cherry – red. 10. Press down the oxygen pressure lever. 11. Move the torch forward slowly along the chalk line maintaining the gap between the plate and the flame. A shower of sparks will be seen to fall from the underside, indicating that the penetration is complete and the cut is proceeding correctly. 12. Reheat from the beginning if the cut does not seem to go through the metal. 13. Blow with hammer to separate the section. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with LPG gas, regulator, oxygen & gas cutting torch.</p> <p><u>Tasks (What):</u></p> <p>Cut circular line to MS plate manually.</p> <p><u>Standards (How well):</u></p> <p>The MS plate being cut located.</p> <p>The equipments set up. The cutting flame set. The cutting torch circular handled. The metal cut. The cutting penetration visualled.</p>	<ul style="list-style-type: none"> ➤ Procedure of gas cutting. ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, LPG Gas, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, cutting trammel, safety equipments, and Gas cutting torch.

Safety Precautions :

- Wear safety apparels safety goggles, safety gloves, Safety helmet.
- Place apiece of steel close to the line of cut to slide the torch along.
- If the edges of the cut appear to melt and have a very ragged appearance, the metal is not burning through and torch is being moved too slowly.
- When an exceptionally circular cut is desired, clamp a trammel on center of the circle to run the nozzle along diameter cutting line to act as a guide for the torch to follow.
- Protect to by-standers.

Task Analysis

15. COMPETENCY: Braze brass in Mild steel plate.

Total Time: 7 hrs
Theory : 1 hr
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain a workshop drawing. 2. Obtain a workpiece material. 3. Set up all gas welding equipment. 4. Remove grease, paint and rust on the joining part with a wire brush and sandpaper. 5. Refer steps no 6 to 8 of the Run fusion without filler rod. 6. Hold the blowpipe at an angle of 45° against the MS plate and preheat around the piece with the white core a little separated until it becomes reddish. 7. Heat the end of the brazing rod and attach flux there. 8. Put some flux to the joint too. 9. Hold the brazing rod at an angle to 45° against the MS plate, and move the rod, so to pulling it back. 10. Continue to heat the place between the MS plate and brass piece, feeding molten brazing material with blowpipe. 11. Move the blow pipe in an oval form and the filler rod slightly up and down, melting it above the welding line. 12. Attach flux to the brazing rod from time to time, and continue brazing. 13. Kool the work as it being held by grip and clamp. 14. Remove the jelly oxide on the brazed surface with a wire brush or file. 15. Clean the blowpipe removing attached material in the nozzle with a cleaning needle. 	<p><u>Condition (Given):</u></p> <p>Fully equipped workshop with acetylene generator oxygen & welding torch with different sizes of nozzles.</p> <p><u>Tasks (What):</u></p> <p>Braze brass in Mild steel plate.</p> <p><u>Standards (How well):</u></p> <p>The brazing filler rod and flux identified. Gas welding & hard soldering/brazing distinguished. Ferrous and non ferrous metal welded together. Fusion of the brazing filler rod controlled.</p>	<ul style="list-style-type: none"> ➤ Introduction of hard soldering (brazing). ➤ Brazing filler rod. ➤ Flux ➤ Brazing procedure ➤ Safety precautions

Tools Equipments:

Acetylene generator, Oxygen cylinder, Regulators, Manometer, Rubber hose pipe, Gas welding accessories, Filler rod, Flux, Safety equipments, Gas welding torch and Nozzles.

Safety Precautions :

- Refer the safety precautions of the task Run fusion with filler rod.

Module 3

Gas Tungsten Arc Welding (GTAW/TIG)

Description:

This module intends to provide knowledge and skills on Gas Tungsten Arc Welding (GTAW) or Tungsten Inert Gas (TIG) welding. It employs a non-consumable tungsten electrode with an envelope of inert gas (Argon, Helium etc.) to protect both the electrode and the weld pool from the detrimental effects of surrounding atmospheric gases. GTAW includes an all-position welding process and gives the highest quality welds amongst the commonly employed arc welding processes. Aircraft industry, rocket and missile fabricators, chemical and nuclear plant fabricators, stainless steel fabricators are the typical users/industries of this process.

Objectives:

After completion of this module the trainees will be able:

1. To set up TIG welding and safety equipments
2. To carry out GTAW on various joints in different positions
3. To apply the technique of highest quality welding production

Duration: 40 hours

Tasks:

1. Set up TIG welding Machine and shielded gas
2. Prepare safety equipments.
3. Perform fusion in metal surface without filler rod.
4. Perform surface weld with filler rod.
5. Weld square butt with backing bar with filler rod.
6. Weld square butt without backing bar with filler rod.

Task Analysis

1. COMPETENCY: Set up TIG welding Machine and shielding gas

Total Time: 4 hrs
Theory : 1 hr
Practical : 3 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
1 Obtain instruction. 2 Obtain accessories and tools required. 3 Connect argon gas & regulator to machine hose. 4 Select correct filler rod. 5 Set current as per filler rod. 6 Prepare tungsten electrode as per welding current 7 Prepare and set welding table with clamp 8 Insert the tungsten electrode in welding torch 9 Adjust the gas flow rate in manometer.	<p>Condition :</p> <p>Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material.</p> <p>Task :</p> <p>Set up welding equipment.</p> <p>Standards:</p> <p>Hose pipe on gas holder connected.</p> <p>Current and tungsten wire on holder set up.</p>	<ul style="list-style-type: none"> ➤ Introduction of TIG welding ➤ TIG welding tools and equipments. ➤ TIG welding safety equipments. ➤ Setting up procedure ➤ Safety precautions

Tools Equipments:

TIG welding AC/DC rectifier, Argon cylinder, Regulators, Manometer, Rubber hose pipe, TIG welding accessories, Ceramic tipped, Tungsten rod, Filler rod, Safety equipments.

Safety Precautions :

- Avoid using Welding torch with broken ceramic nozzle end torch.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Hose pipe, current supply Grips.
- Always use welding helmet with clear dark glass.
- Wear safety goggles and hand gloves.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.
- Use fume extraction unit.

Task Analysis

2. COMPETENCY: Prepare safety equipments and measure.

Total Time: 4 hrs
Theory : 1 hr
Practical : 3 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain Instruction 2. Obtain safety measure and equipment. 3. Follow safety rules. 4. Check dark and plain glass of helmet. 5. Check connection of hose pipe power supply cable and work clamp 6. Check the leakage of shielding gas with soapy water. 7. Wear safety goggles and mask. 8. Keep the fire extinguisher in working condition. 9. Place the all safety equipment in proper place. 10. Be aware of safety precaution 	<p><u>Condition (Given):-</u> Fully equipped workshop with Ac/DC TIG welding machine, tungsten electrode accessories, shielding gas and different filler material</p> <p><u>Task (What):-</u> Prepare safety equipments and measures.</p> <p><u>Standard (How Well):-</u></p> <ul style="list-style-type: none"> ➤ All safety equipments are inspected ➤ All connections are tightened ➤ Safety equipments and measures are placed proper place 	<ul style="list-style-type: none"> ➤ Introduction of TIG welding safety equipments ➤ Use and application of safety measures ➤ Inspection of safety equipments and measures

Tools Equipment: Safety helmet, goggles, soap-water, fire extinguisher, spanner set, adjustable wrench.

Safety: safety precaution.

Task Analysis

3. COMPETENCY: Perform surface weld without filler rod.

Total Time: 7 hrs
Theory : 1 hr
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Set up welding equipments. 5. Mark straight parallel lines as much as possible. 6. Set a workpiece on welding table. 7. Hold welding torch. 8. Strike on earth line connected plate to check the high frequency arc 9. Melt the base metal by HF arc 10. Move the torch producing an arc in welding wave continuing through line. 11. Repeat the same procedure for rest of all line. 12. Clean the welding beads 13. Restore the tools and equipments. 14. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material.</p> <p><u>Task :</u></p> <p>Perform surface weld without filler rod.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in TIG welding maintained.</p> <p>Procedure of deposition of TIG welding beads kept without filler rod.</p>	<ul style="list-style-type: none"> ➤ Procedure of deposition of TIG welding beads without filler rod. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

TIG welding AC/DC rectifier, Argon cylinder, Regulators, Manometer, Rubber hose pipe, TIG welding accessories, Ceramic tipped, Tungsten rod, Filler rod, Safety equipments.

Safety Precautions :

- Avoid using Welding gun with broken ceramic nozzle end torch.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and Grips.
- Always use welding helmet with clear dark glass.
- Wear safety goggles and hand gloves.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.
- Use fume extraction unit.

Task Analysis

4. COMPETENCY: Perform surface weld with filler rod.

Total Time: 7 hrs
Theory : 1 hr
Practical : 6 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Set up welding equipments. 5. Mark straight parallel lines as much as possible. 6. Set a workpiece on welding table. 7. Hold welding torch by sinehand and another hand 8. Check the high frequency arc 9. Melt the base metal by metal arc. 10. Move the torch and filler rod producing an arc in welding wave continue through line. 11. Repeat the same procedure for rest of all line. 12. Clean the welding beads 13. Restore the tools and equipments. 14. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material.</p> <p><u>Task :</u></p> <p>Perform surface weld with filler rod.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in TIG welding.</p> <p>Procedure of deposition of TIG welding beads kept with filler rod.</p>	<ul style="list-style-type: none"> ➤ Procedure of deposition of TIG welding beads with filler rod. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

TIG welding AC/DC rectifier, Argon cylinder, Regulators, Manometer, Rubber hose pipe, TIG welding accessories, Ceramic tipped, Tungsten rod, Filler rod, Safety equipments.

Safety Precautions:

- Avoid using Welding gun with broken ceramic nozzle end torch.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and Grips.
- Always use welding helmet with clear dark glass.
- Wear safety goggles and hand gloves.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.
- Use fume extraction unit.

Task Analysis

5. COMPETENCY: Weld square butt without backing bar with filler rod.

Total Time: 9 hrs
Theory : 2 hr
Practical : 7 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and w/s drawing. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Set up welding equipments. 5. Set a workpiece on welding table with support needed. 6. Hold welding torch in right hand and filler rod in another hand 7. Perform tack weld with filler rod at both end of plate. 8. Make alignment as necessary to set as per drawing or instruction. 9. Melt the base metal by HF arc 10. Move the torch and filler rod producing an arc in welding wave continue to end of workpiece. 11. Repeat the same procedure for multi run if necessary. 12. Clean the welding beads 13. Restore the tools and equipments. 14. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories and different filler material.</p> <p><u>Task :</u></p> <p>Weld square butt without backing bar with filler rod.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in square butt joint welding maintained.</p> <p>Procedure of deposition of filler rod in TIG welding beads kept with filler rod.</p>	<ul style="list-style-type: none"> ➤ Selection of current. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

TIG welding AC/DC rectifier, Argon cylinder, Regulators, Manometer, Rubber hose pipe, TIG welding accessories, Ceramic tipped, Tungsten rod, Filler rod, Safety equipments.

Safety Precautions :

- Avoid using Welding gun with broken ceramic nozzle end torch.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and Grips.
- Always use welding helmet with clear dark glass.
- Wear safety goggles and hand gloves.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.
- Use fume extraction unit.

Task Analysis

6. COMPETENCY: Weld square butt with backing bar with filler rod.

Total Time: 9 hrs
Theory : 2 hr
Practical : 7 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instruction and w/s drawing. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Prepare a temporary backing bar according to the size of workpiece material. 5. Set up welding equipments. 6. Set a workpiece on welding table with temporary backing bar. 7. Hold welding torch in right hand and filler rod in another hand. 8. Perform tack weld with filler rod at both end of workpiece 9. Make alignment as necessary to set as per drawing or instruction. 10. Melt the base by HF arc 11. Move the holder and filler rod producing an arc in welding wave continuing to end of workpiece. 12. Repeat the same procedure for multi run if necessary. 13. Clean the welding beads 14. Restore the tools and equipments. 15. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with TIG welding AC / DC rectifier, tungsten rod/wire, accessories, pieces of temporary backing bar and different filler material.</p> <p><u>Task :</u></p> <p>Weld square butt with backing bar with filler rod.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in square butt joint welding.</p> <p>Procedure of deposition of filler rod in TIG welding beads kept with temporary backing bar with filler rod.</p>	<ul style="list-style-type: none"> ➤ Selection of filler rod ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

TIG welding AC/DC rectifier, Argon cylinder, Regulators, Manometer, Rubber hose pipe, TIG welding accessories, Ceramic tipped, Tungsten rod, Filler rod, Safety equipments.

Safety Precautions :

- Avoid using Welding gun with broken ceramic nozzle end torch.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and Grips.
- Always use welding helmet with clear dark glass.
- Wear safety goggles and hand gloves.
- Keep away the inflammable material.
- Always place the torch on hanger after welding.
- Keep the workplace dry.
- Use fume extraction unit.

Module 4

Gas Metal Arc Welding (GMAW/MIG)

Description:

This module intends to provide knowledge and skills Gas Metal Arc Welding (GMAW) or Metal Inert Gas (MIG) welding process where a consumable wire, of 0.8 to 2.4mm diameter and wound in spool form, is fed at a preset speed through a welding torch wherein it is provided the electrical connection and shielding gas. Depending upon the work material the shielding gas may be Argon, Helium, Nitrogen, Carbon dioxide, Hydrogen and their mixtures. When inert shielding gas is used the process is more popularly known as MIG welding and when CO₂ is used as the shielding gas it is referred to as CO₂ welding or MAG (Metal Active Gas) welding. GMAW is a very versatile process and can be used for welding all metals for which compatible filler wires have been developed. However, its typical applications include medium-gauge fabrication such as structurals, earth moving equipment, plate and box girders, and automobile bodies. This process has great potentials for use with robotic welding systems.

Objectives:

After completion of this module the trainees will be able:

1. To set up MIG welding and safety equipment
2. To carryout GMAW on varios joints in different positions
3. To appy technique of medium-gas fabrication

Duration: 30 hours

Tasks:

1. Set up MIG welding M/C Machine and shielded gas
2. Prepare safety equipment and measures
3. Perform surface weld in flat position
4. Weld butt joint in flat position
5. Weld "T" joint in flat position

Task Analysis

1. **COMPETENCY: Set up MIG welding M/C and shielding gas.**

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain Instruction 2. Obtain accessories and tools required 3. Set necessary equipments and parts. 4. Set electrode wire spool into MIG welding machine 5. Extrude electrode wire on welding gun 6. Prepare welding table with work clamp. 7. Set up conact tube (tip) and nozzle in gun. 8. Open the co₂ gas cylinder valve and set working pressure ten times of wire diameter. 9. Set the current as per welding material and wire diameter 10. Clean the nozzle apply anty spatter spray inside the nozzle 11. 	<p><u>Condition (Given):-</u> Fully equipped workshop with MIG welding machine, electrode wire spool, cleaning tools, accessories, and work piece.</p> <p><u>Task (What):-</u> Set up MIG welding m/c and shielding gas.</p> <p><u>Standard (How Well):-</u></p> <ul style="list-style-type: none"> ➤ Electrode wire spool set into machine ➤ Wire speed adjusted ➤ Shielding gas (co₂ flow rate adjusted ➤ Electrode wire extruded on welding gun. 	<ul style="list-style-type: none"> ➤ Introduction of MIG welding ➤ MIG welding Tools, equipments and accessories ➤ MIG welding ➤ Safety precautions and rules ➤ Machine setup procedure ➤ Introduction of MIG welding machine

Tools Equipment: MIG welding machine, co₂ gas cylinder, Regulators, Manometers hose pipe, MIG welding accessories, anti spatter spray (gel) wire cutter and safety measures

Safety: safety precaution.

Task Analysis

2. COMPETENCY: Prepare safety equipments and measures.

Total Time: 3 hrs
Theory : 1 hr
Practical : 2 hrs

Performance steps	Terminal Performance Objectives	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain Instruction 2. Obtain Safety measures and equipments 3. follow safety rules 4. Check dark and plain glass of hand shield or helmet 5. Check all connection of hose pipe, power supply and work clamp. 6. Check the leakage of shiet ding gas with soapy water. 7. Wear safety goggles and mask. 8. Keep fire extinguishe and sand bocket in working condition. 9. Place all safety equipments in proper place. 10. 	<p><u>Condition (Given):-</u> Fully equipped workshop with MIG welding machine, MIG wire spool, all accessories shielding gas regulator.</p> <p><u>Task (What):-</u> Prepare safety equipments and measured</p> <p><u>Standard (How Well):-</u></p> <ul style="list-style-type: none"> ➤ All safety equipments into inspected ➤ All connection are tightened ➤ Safety equipments and measures are placed proper place ➤ 	<ul style="list-style-type: none"> ➤ Introduction of MIG welding safety equipments ➤ Use and application of safety measures ➤ MIG welding ➤ Inspection of safety equipments and measurements. ➤

Tools Equipment: welding hand shield/ helmet, safety goggles, personal safety measures, fire extinguishes co₂ gas cylinder, Regulators, Manometers hose pip spanner set, wire cutter soap water, tongs, wire brush

Safety: safety precaution.

Task Analysis

3. COMPETENCY: Perform surface weld bead in Flat position.

Total Time: 6 hrs
Theory : 5 hr
Practical : 1 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instructions. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Prepare welding equipments. 5. Mark straight parallel lines as much as possible in work piece 6. Set a workpiece on welding table. 7. Hold welding torch. 8. Press/push on wire extruding switch. 9. Cut off fusion tipped at wire end. 10. Check earth line by striking 11. Strike on marked line and produce an arc. 12. Move the torch producing an arc in welding wave continue through line. 13. Repeat the same procedure for rest of all line. 14. Clean the welding beads. 15. Restore the tools and equipments. 16. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with MIG welding AC / DC rectifier, MIG filler metal spool and accessories.</p> <p><u>Task :</u></p> <p>Perform surface weld bead in flat position.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in MIG welding maintained.</p> <p>Procedure of deposition of MIG welding kept straight beads in Flat position.</p>	<ul style="list-style-type: none"> ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

MIG welding AC rectifier, Argon/Carbon di oxide cylinder, Regulators, Manometer, Rubber hose pipe, MIG welding accessories, Feeder nozzle, Anti spatter spray (gel), wire cutter and Safety equipments.

Safety Precautions :

- Avoid using torch gun and contact tip with damage feeder nozzle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and wire end.
- Avoid using damp filler wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Always use proper helmet or hand shield.
- Use fume extraction unit.

Task Analysis

4. COMPETENCY: Weld butt joint in Flat position.

Total Time: 5 hrs
Theory : 1 hr
Practical : 4 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instructional drawing. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Set all equipments and parts. 5. Set a workpiece on welding table with support needed. 6. Hold welding torch. 7. Press/push on wire extruding switch. 8. Cut off fusion tipped at wire end. 9. Strike on tack weld with melting filler wire at both end of plate. 10. Make alignment as necessary to set as per drawing or instruction. 11. Strike and produce the arc melting filler wire. 12. Move the torch producing an arc in welding wave continue to end of work piece. 13. Repeat the same procedure for multi run. 14. Clean the welding deposition beads. 15. Restore the tools and equipments. 16. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with MIG welding AC / DC rectifier, MIG filler metal spool and accessories.</p> <p><u>Task :</u></p> <p>Weld butt joint in flat position.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in MIG welding maintained.</p> <p>Procedure of deposition of MIG welding kept straight beads in Flat position.</p>	<ul style="list-style-type: none"> ➤ MIG Wire types and process of loading. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

MIG welding AC rectifier, Argon/Carbon di oxide cylinder, Regulators, Manometer, Rubber hose pipe, MIG welding accessories, Feeder nozzle, Anti spatter spray (gel), wire cutter and Safety equipments.

Safety Precautions :

- Avoid using torch gun and contact tip with damage feeder nozzle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and wire end.
- Avoid using damp filler wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Always use proper helmet or hand shield.
- Use fume extraction unit.

Task Analysis

5. COMPETENCY: Weld 'T' joint in Flat position.

Total Time: 9 hrs
Theory : 2 hr
Practical : 7 hrs

Performance Steps	Terminal Performance Objective	Related Technical Knowledge
<ol style="list-style-type: none"> 1. Obtain instructional drawing. 2. Obtain workpiece material. 3. Obtain accessories and tools required. 4. Set all equipments and parts. 5. Set a workpiece on welding table with support needed. 6. Hold welding gun 7. Press/push on wire extruding switch. 8. Cut off fusion tipped at wire end. 9. Strike on tack weld with melting mig wire at both end of work plate. 10. Make alignment as necessary to set as per drawing or instruction. 11. Strike and produce the arc melting mig wire. 12. Move the torch producing an arc in welding wave continue to end of work piece. 13. Repeat the same procedure for rest of all line. 14. Clean the welding deposition beads. 15. Restore the tools and equipments. 16. Clean the working area. 	<p><u>Condition :</u></p> <p>Fully equipped workshop with MIG welding AC / DC rectifier, MIG filler metal spool and accessories.</p> <p><u>Task :</u></p> <p>Weld 'T' joint in flat position.</p> <p><u>Standards:</u></p> <p>Transverse welding wave in MIG welding maintained.</p> <p>Procedures of deposition of MIG welding kept straight beads for Fillet weld in Flat position.</p>	<ul style="list-style-type: none"> ➤ Transverse welding wave in MIG welding. ➤ Welding procedure ➤ Safety precautions

Tools Equipments:

MIG welding AC rectifier, Argon/Carbon di oxide cylinder, Regulators, Manometer, Rubber hose pipe, MIG welding accessories, Feeder nozzle, Anti spatter spray (gel), wire cutter and Safety equipments.

Safety Precautions :

- Avoid using torch gun and contact tip with damage feeder nozzle.
- Always use Wire brush to clean up the welding beads.
- Always check the connection of Holder, Shield, and wire end.
- Avoid using damp filler wire.
- Use cutting pliers to cut fusion tipped at wire end.
- Keep away the inflammable material.
- Always place the holder on hanger after welding.
- Keep the workplace dry.
- Always use proper helmet or hand shield.
- Use fume extraction unit.

Required Tools and Equipment

Estimated for 24 trainees capacity occupying in rotation basis.

S. No.	Description	Size	Qty	Remarks
1.	Working bench	30"x90"x34" H	12 nos	2 vice in a bench
2.	Bench Vice	5"x6"	24 nos	1 vice per trainee
3.	Flat file rough	12"	24 nos	
4.	Flat file bastard	12"	24 nos	
5.	Flat file medium	10"	24 nos	
6.	Flat file fine	8"	24 nos	
7.	Square file medium	10"	24 nos	
8.	Round file medium	10"	24 nos	
9.	Triangular file medium	10"	24 nos	
10.	Square file fine	8"	24 nos	
11.	Half round file medium	10"	24 nos	
12.	Bevel Protractor	6"	12 nos	
13.	Center punch	6"	24 nos	
14.	Steel Hammer	500 g	24 nos	
15.	Try Square	6"	24 nos	
16.	Hand Hacksaw Frame		24 nos	
17.	Arc Welding table		12 nos	
18.	Welding transformer AC / DC	RS 400	12 nos	ESAB
19.	Electrode holder		12 nos	
20.	Ground Clamps cable lug		12 nos	
21.	Chipping Hammer		12 nos	
22.	Wire brush		12 nos	
23.	Tongs	14"	12 nos	
24.	Welding gloves		24 nos	
25.	Welding Helmet & hand shield		24 nos	
26.	Safety goggles		24 nos	
27.	Leather Apron		24 nos	
28.	Spindle Press	15 ton	1 nos	
29.	Pipe cutter	2"	1 nos	
30.	Hand shear	1.5 Hz	1 nos	
31.	Hand grinder	3" / 7"	6 nos	
32.	Pedestal/Bench Grinder	10"	2 nos	
33.	Pipe vice		6 nos	
35.	V - Blocks		2 set	
36.	Gas Welding Table		6 nos	
37.	Oxygen Cylinder		3 nos	
38.	Acytelene generator	5 kg	2 set	
39.	Oxygen pressure regulators	230 bar service	3 nos	
40.	Acytelene pressure regulators		3 nos	
41.	Cutting torch/nozzles		3 set	
42.	Gas torch (holder)		6 set	
43.	Welding nozzles and Tips		6 set	
45.	Spark Lighter		6 nos	
46.	LPG cylinder	14 kg	2 nos	
47.	Flashback Arrestors		3 nos	
48.	Supply hose pipe	50 meter	3 set	
49.	TIG welding DC rectifier	T 400	3 nos	
50.	Argon cylinder		3 nos	
51.	Argon regulator / manometer		3 nos	

S. No.	Description	Size	Qty	Remarks
52	Ceramic tipped		3 nos	
53	Tungsten electrode	2.5 mm	12 nos	
54	TIG welding feeler rod	MS / SS	10 kg	
55	MIG welding machine		3 set	
56	Argon / CO2 cylinder		3 nos	
57	Regulator / manometer		3 nos	
58	Feeder nozzle		3 nos	
59	Anti spatter spray/gel		2 nos	
60	Wire cutter		3 nos	
61	Hand drill machine		5 nos	
62	Bench drilling machine	12 mm	2 nos	
63	Drill bits	3 to 12 mm	2 Sets	
64	Steel scale	300 mm	24 nos	
65	Measuring tape	3 m	24 nos	
66	Marking scriber		24 nos	
67	Combination pliers		24 nos	
68	Flat chisel	6"	24 ps	
69	Cross cut chisel	6"	24 ps	

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2.	Principal of Welding Technology	L M Gourd	Viva Books Private Ltd.
3.	Welding Principles and Applications	Larry Jeffus	Thomsom Delmar Learning
4.	AWS D1.1/D1.1M:2004 Structural Welding Code-Steel		American Welding Society
5.	Gas Metal Arc Welding Handbook	William H. Minnick	The Good heart-Willcox Company
6	Welder trade manual	Kakkar	
7	Welding skill	Joseph W. Giachino, William Weeks	
8	Welder trade theory		Central Instructional Media Institute, Madras
9	Welding technology fundamentals	William A. Bowditch	
10	Welding and welding technology	Richard L. Little	

Glossary used in the technical and vocational curricula

Competency: A performance capability needed by workers in a specific area.

Curriculum guide: A curriculum guide is a detail resource for teachers to conduct training programs effectively. The guide intends to add the teacher in developing lesson plan, handouts, training manuals, and evaluation criteria etc, which are basic elements in the teaching learning process.

Curriculum: A plan for providing sets of learning opportunity to achieve broad goal and related specific objectives for an identifiable population serves by a single school center.

DACUM: Developing A Curriculum. DACUM is a technique that uses a group consultative process to identify the competencies relevant to a particular occupation. These competencies are then built on to form a vocational curriculum.

Duty: is an arbitrary clustering of related tasks in to broad functional area or general area of responsibility.

Enabling Objective: The Objectives are defined as to set for guiding the teacher and students to attain the end result of the particular unit of work or lesson.

Instructional Guide: is a well-planned and structured document for the instructor to deliver effective instruction so that trainees can attain learning is objectives as per training standards.

Module: A module is defined as a specific learning material. Modules are essentially self-contained. Self-instructional packages, with learning paced by each learner according to his/her individual ability and needs. A module covers either a single element of subject matter content or a group of content elements forming a discrete unit of subject matter or area of skills.

Occupational Analysis: is a process used to identify the duties and tasks that are important to workers in any given occupation. A number of alternative and acceptable approaches to occupational analysis are available.

Program guide: A program guide is a comprehensive resource for teachers, planners, and top-level management for planning and implementation of any training programs.

Program Objectives: The objectives are set in a broad way to target to achieve mastery learning of the complete occupation.

Related Technical Knowledge: Knowledge essential to perform a task/ step in complete, accurate and safe manner.

Skill: The ability to perform on occupational task with the degree of proficiency required for a given occupation

Step: The smallest discrete or observable aspect of a task.

Task Analysis: Task analysis is the process of identifying and writing down the specific skills, knowledge and attitudes that distinguish someone who performs a task competently from someone who cannot perform the task at all.

Task: A unit of work complete in itself that forms a logical part of on occupation. It can be broken down into discrete steps.

Terminal Performance Objective: The objectives set to attain at the end of the training completion. It includes condition, unit of work and standard of teaching and learning.