GENERAL INFORMATION

GOAL:

This programme is designed to produce skilled craftsmen with good knowledge of the application of the equipment, materials, techniques and safety practices in Fabrication and Welding of metal projects.

OBJECTIVES:

On completion of the programme, the student should be able to:-

(1) Carry out gas welding and cutting jobs on all types of metals.

(2) Produce simple finished structural steel work projects with safety, using relevant equipment and techniques.

(3) Apply protective wetting against corrosion on finished metal projects.

(4) Market finished metal projects.

ENTRY QUALIFICATION:

The minimum entry qualification into the National Vocational Certificate in Fabrication and Welding programme is Post basic Education Certificate (Post JSS).

STRUCTURE OF PROGRAMME:

The national Vocational Certificate (NVC) Fabrication and Welding programme is in flexible modular form, and is structured to have three parts (i.e. NVC Part I, NVC Part II, and NVC Final) each taken in a span of one year. Each part shall have a cogent and flexible structure and content that would allow the trainee a practical working skill unit and the possibility to exit at that level.

Each part incorporates six months intensive training in the school and three months of supervised industrial work experience (SIWES).

In a 14 weeks term, 12 weeks will be for academic activities while 2 weeks will be for registration and evaluation.

For a 40hrs week, 6hrs will be for core theory courses; 2hrs General education courses and 32 hrs will be for practical.

EVALUATION SCHEME:

The National Vocation Certificate Examination must be externally moderated. In grading the awards; theory shall constitute- 20%, practical- 50% and SIWES- 30%.

CURRICULUM TABLE

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

S/No	Subject/Module Code	Subject/Module	Year I						Year 2						Year 3						Total Duration (Hours)
			Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		Term 1		Term 2		Term 3		
			T	P	T	P			T	P	T	P			T	P	T	P			
1.	VMT *	Mathematics	2	-	2	-	-		2	-	2	-			2	-	2	-			180
2.	CSK*	English Language and Communication Skills	2	-					2	-	2	-			2	-	2	-			150
3.	ENT*	Entrepreneurship Development Skill	2	-	2	-			2	-	2	-			-	-	2	-			150
4.	TD*	Technical Drawing	-	3	-	3	-		-	3	-	3			--	3	-	3			270
5.	CAV*	Computer Appreciation							1	2	1	2			1	2	1	2			180
6.	VFW 11	Gen. Metal Work1 1	2	4	2	4			-	-	-	-			-	-	-	-			180
7.	VFW 12	Gen. Metal Work1 11							2	4	2	4			-	-	-	-			180
8	VFW 13	Sheet Metal Work							2	4	2	4									180
9.	VFW 14	Gas Welding and Cutting	2	4	2	4			2	4	2	4			2	4	-	-			450
10	VFW 15	Metal Arc Welding	2	4	2	4			2	4	2	4			-	-	2	4			450
11.	VFW 16	Structural Steel Work									2	4			2	4					180
	TOTAL		12	15	10	15			18	18	20	22			7	9	11	13			2550

INDUSTRIAL ATTACHMENT

INDUSTRIAL ATTACHMENT

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NOTE: *

The foundation and GNS courses are available in the parent course syllabus.

NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

COURSE: GENERAL METAL WORK I

COURSE CODE: VFW 11

DURATION: 6 HOURS PER WEEK (2 HOURS LECTURE; 4 HOURS PRACTICALS)

Goal: This module is designed to introduce the student to basic Principles and processes of Metal work and appropriate safety regulations

General Objective: On completion of this module the student will be able to:

1. Understand workshop safety rules and their application in machine shop.

2. Know the physical properties, manufacturing process and application of ferrous and non-ferrous metals in common use

3. Know how to Select and use common measuring, marking out, cutting and striking tools.

4. Understand the basic working principles of drilling machine and be able to use it for various types of screws threads rivets, and be able to rivet and cut screws by hand.

5. Understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand.

6. Understand the ISO system of tolerances and fits, and their application in engineering production.

7. Know how to produce simple engineering components on the bench.

8. Understand the essential features and working principles of the centre lathe and carry out basic operations such as turning, stepped turning facing, taper turning. Knurling, chamfering and undercutting.

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING						
COURSE: : General Metal Work I			**COURSE CODE: VFW II**		**CONTACT HOURS: 6hrs/wk, 2L: 4P**	
GOAL: This course is designed to introduce the students to basic principles and processes of metal work and to the appropriate safety regulations						
COURSE SPECIFICATION: Knowledge Requirement				**Practical Contents:**		
	General Objective: 1.0 Understands workshop safety rules and application in machine shop. **General Objective:**					
WEEK	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**	**Specific Learning Objective**	**Teachers Activities**	**Learning Resources**
1.	1.1 State sources of hazards in the workshop and how to prevent them e.g a. handling and using hand tools, portable power tools and machines: b. stepping on or striking obstructions left on floors or benches: c. lifting, moving and storing materials or jobs; d. using inflammable or corrosive liquids and gases; e. inhaling vapours or fumes;	* State sources of hazards in the workshop. * Show a film on industrial safety.	Classroom facilities. * Safety posters, * Television, video machine.	1.1 Use hand tools, portable power tools and machines in lifting, moving and storing materials or job. 1.2 Demonstrate first aid application in cases of minor cuts, electric shock, burns.	* Demonstrate safe ways of handling basic hand tools. *Show a film on industrial safety. * Demonstrate how to treat emergency like artificial respiration cold compress, etc. * Assess student understanding of the topics using questions / answers and practice.	* Hand tools and files, hacksaw. * Television, video machines Posters on artificial respiration, cold compress etc. goggles, gloves, safety boots, head shield fire extinguisher.

	1.2 Explain the application of factory safety regulations in the machine shop. 1.3 Name safety equipment and wears essential in the machine shop, and state their application in working situations. Example: Eye goggles, gloves, safety boots, helmet, fire extinguishers, etc.	* Explain appropriate procedures to be taken in the event of workshop accidents.				
2	1.4 Outline safety rules and regulations relating to:- a. clothing and health hazards; b. workshop hygiene; c. movement and other behaviour of workers in the workshops; d. materials handling; e. tool handling, storage and usage; f. machine operation; g. fire protection. 1.5 Outline appropriate procedures to be adopted in the event of workshop	* Explain safety rules and regulations in the workshop, highlighting a-g in 1.4. * Explain				

	accidents Example: - a. application of first aid to the victim; b. removal or rectification of the accident; c. reporting the accident to the appropriate authority; d. keeping a record of accidents for management use.	appropriate procedures to be taken in the event of workshop accidents.				
	General Objective**: 2.0 Know the physical, properties, manufacturing processes and application of ferrous and non-ferrous metals in common use.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
3	2.1 Explain the meaning of the following general physical properties of metals: Ductility, malleability, strength, toughness, brittleness, elasticity, plasticity. 2.2 Describe the basic composition and properties of plain carbon steels, cast iron and alloy steel and state their application in the	* Give detailed explanations on the meaning of the following general physical properties of metals: ductility, malleability, strength, toughness, brittleness, elasticity, plasticity. Give the composition and specific examples of tools and equipment made from the	Class room facilities Textbooks. * Video and television including cassettes on production processes.			

	engineering industry e.g.: Steel: plain carbon steels, dead mild steels, mild steel, medium carbon steel, high carbon steel. Cast irons – gray cast iron malleable cast iron, iron carbide, alloy cast irons (spherical and acicular) Alloy Steels – High speed steels, high tensile steels, tungsten, stainless steels, satellite.	various steels and cast iron E.g.				
4	2.3 Describe the following processes. a. copula process of manufacture of cast iron; b. blast furnace process of manufacture of pig iron; c. direct reduction process of manufacture of steel. 2.4 Describe the physical properties and applications of non-ferrous metals given below:	* Give notes and explanation on the cupola process, the blast furnace and the direct reduction process of manufacture of steel. Give detail notes and explanations describing the physical properties				

	Copper, tin, zinc, aluminium and aluminium alloys brass (muntz metal, cartridge brass, gilding etc) metal, bronze (manganese bronze tunmetal, bell metal, aluminium bronze, phosphor bronze and lead.	and applications of the following non-ferrous metals: listed in 2.4. Assess the students understanding through questions and answers.				
	General Objective**: 3.0 Know how to select and use common measuring, marking out, cutting and striking tools.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
5	3.1 Explain with examples the difference between "line" and "end" measurement.. 3.2 Explain the use of datum points, datum lines and datum faces in marking out. 3.3 Describe, the functions and application of the following instruments used in metal-work, steel rule, dividers, callipers (inside, outside and odd-legs), trammel,	Prepare notes that will clearly differentiate between "line" and "end" measurement.. Prepare notes and examples that will explain the use of datum points, datum lines, and datum faces in marking out. Give explanations regarding the functions and application of: steel rule, dividers, callipers (inside, outside and odd leg)	Class room facilities Posters on the tools listed in 3.3 – 3.4 textbooks.	3.1 Use the following items in the workshop: a. micrometer b. vernier calliper c. venier height gauge d. combination set 3.2 Maintain and care for the instruments listed above. 3.3 Perform marking out exercise on plane surfaces including profiles. 3.4 File a piece of metal to	Demonstrate how to use micrometer, venier calliper, vernier height gauge, combination set. Demonstrate the maintenance and care of the instruments listed above. Perform marking out for the students to learn and practice till they become competent. Demonstrate how to	Micrometer, vernier callipers, vernier height gauge, combination sets. Steel rules, dividers, punches, trammel, scribe angle place, vee block center square. Flat file, hand file, try square. File card, flat file. Ball pein hammers, mallet.

	scriber angle plate, vee-block, centre square. 3.4 Describe the various types of files, stating their grades and applications. Types of files include: flat, square, round, half round, three square, warding polar, mill and rasp. 3.5 Classify the common files use in metal work and state their composition of material used for their manufacture. 3.6 Sketch the bench vice, explain its clamping power and demonstrate the technique of holding work in the vice for filing, tapping and designing operations. 3.7 Describe the function of the various parts of a bench vice, its holding power while performing	trammel, scriber, angle plate, vee block, centre square. Prepare notes that will describe the various types of files, stating their grades and applications. Prepare detail notes that will classify the common files used in the metal work as well as staffing the composition of materials used for their manufacture. Demonstrate how to sketch a bench vice. Prepare detailed notes that will describe the functions of the		given specifications using any of the following: Cross filing, draw filing, filing square and flat surfaces. 3.5 Test surface for flatness using surface plate and try square and state precautions to be taken to avoid pinning. 3.6 Maintain files in good working conditions. 3.7 Use various hammers and mallets e.g. ball pein, rubber mallets, etc for engineering purposes. 3.8 Select and insert hacksaw blade correctly. 3.9 Cut metal and other engineering materials to give specifications using the adjustable hacksaws, junior hacksaws, piercing saw, etc drills and Drilling.	file a piece of metal. Demonstrate how flat surface can be tested using surface plate and try square. Demonstrate how files are cleaned and state the precautions to be taken against pinning. Demonstrate the application of hammers and mallets for engineering purposes. Demonstrate how a hacksaw blade can be inserted correctly. Demonstrate how to use adjustable hacksaw, junior hacksaw piercing.	Hacksaw blade, hacksaw frame.
6						

	various operations on its, such as filing, tapping sawing etc.	various parts of a bench vice, its holding power while performing various operations such as:				
	3.8 Describe the use the following tools: a. cold chisels (flat, cross, cut half round, diamond-point) b. centre punch and dot punch. c. Scrappers (flat, triangular, half round) d. Power hack saw.	Prepare detailed notes that will describe the uses of: cold chisels, centre punch dot punch, scrapers and power hacksaw.				
	3.9 Describe the various parts of a hack saw and their function..	Prepare notes that will describe the various parts of a hacksaw and their functions.				
	3.10 Describe the common types of hacksaw blades, their range of pitches and their applications.	Prepare notes that will describe the common types of hacksaw blades, their range of pitches and their applications.				
	3.11State the safety precautions to be observed	Prepare detailed notes and				

	when using a hand hacksaw.	explanation, stating the safety precautions to be observed when using a hand hacksaw. Assess the students understanding using questions and answers.				

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	General Objective**: 4.0 Understand the working principles of a drilling machine and its applications**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
7	4.1 Identify the various types of drilling machines. 4.2 Describe, with sketches, the main features of a bench or pillar drilling machine. 4.3 Describe with sketches and state where each of the following types of drills is best suited. e.g. twist drill (taper shank, parallel shank and jobbers drill, and their relative merits), flat drill, countersink	.Make notes and drawings that will identify the various types of drilling machines. Prepare detailed notes and drawings that will describe the main features of a bench or pillar drilling machine. Prepare notes and drawings that will describe where each of the following drills are best suited	Class room facilities Textbooks Posters showing the tools and machines described in 4.1 – 4.3 and 4.9.	4.1 Set up and operate a drilling machine in given situations. Examples: a. change of spindle speed. b. adjustment of drilling table to required height and angle, holding of work on drilling table to required height and angle, holding of work on drilling table using appropriate clamping device. c. installation of the drill bit in chuck. 4.2 Sharpen a twist drill correctly to manufacturers' specification. 4.3 Carry out with relevant equipment the following operations:	Demonstrate how to set up and operate a drilling machine in given situations. Demonstrate how a twist drill can be sharpened correctly. Demonstrate with the appropriate facility how to	Bench drill pillar drill, drill bits. Bench drill, pillar drill, twist drill, flat drill, counter sink drill, counter bore drill, center drill. Drills, taps, tap wrench, die and die stock. Rivets and sets of drill bits. Surface table, surface plate, marking solution, centre/dot punches, scribing block.

8	drill, counter bore drill, combination centre drill.. 4.4 Explain the effects of the following faults in a ground twist drill bit: a. point angle too acute; b. point angle too obtuse; c. cutting edges at unequal angles; d. insufficient lip clearance; e. excessive lip clearance. 4.5 Calculate spindle revolution or cutting speed for specified size of drill using the formulae:- N = 1000S/n S = ndN/1000 Where S = cutting speed (m/min) N = revolution/minute D = diameter of drill (mm) N = 3.142 4.6 State the causes and remedy of drilling faults such as:-	Prepare notes that explaining the effects of faults described in 4.4 Prepare detailed notes to explain 4.5-4.10 Assess the student's understanding of the topic through questions and answers.		a. drilling blind holes b. drilling round stock c. counter boring and counter-sinking d. drilling large diameter holes. 4.4 And cut internal (through and blind) and external threads by hand method to be taken when taping on the bench. 4.5 Rivet metals together in any given situations. 4.6 Mark out only given bench work using datum points, datum lines, datum faces, chalk or marking solution centre or dot punch, scribing block or measurement transfer. 4.7 Ream to given specification by hand and machine method.	perform all the drilling operations. Demonstrate the operation sequence in cutting internal (through and blind) and external threads by hand method. Demonstrate how riveting can be done and let the students practice same till they become competent. Demonstrate the marking out procedures on bench working using datum lines datum faces, etc. Demonstrate how to ream to specifications by	

	a. drill breaking; b. drill coloured blue; c. walls of drilled hole left rough; d. chipped cutting lips. 4.7 State the safety precautions to be observed when using a drilling machine. 4.8 Explain the purpose of reaming and describe different types of hand and machine reamers.				hand and machine method. Guide students to practise till they become competent and assess their understanding through questions and answers.	
	General Objective: **5.0 Understand the applications of various types of screw threads rivet and cut screws by hand.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
9	5.1 Sketch the thread forms below and state their applications:- - the ISO metric thread - the unified thread - Whitworth and British fine threads - British Association (BA) thread - British Standard pipe - Square thread - acme thread	Give detailed notes with diagrams that will show the various forms of thread and their uses.	Class room facilities Diagrams/charts of thread forms			

	- buttress thread. 5.2 State the functions of:- a. taps (taper tap, second tap, plug) b. tap wrench c. die and die stock. 5.3 Explain the meaning of tapping size or tapping drill and estimate its value in given situations using formulae such as:- T =D – P Where T = tapping diameter D = thread top diameter P = pitch. 5.4 State precautions to be taken when taping on the bench.	State the functions of taps, tap wrench, die and die stock. Give detailed notes that will explain the meaning of tapping size or tapping drill and estimate its values using the formula: stated in 5.3 Prepare notes that will state precautions to be taken when tapping on bench.				
10	5.5 Describe and differentiate types of rivets. e.g. Snap and pan head, mushroom and counter-sunk head, flat head, dod rivet, etc.	Give notes and diagrams that will describe and differentiate types of rivets, rivet sets, and its uses and guide them to calculate the diameter of rivet and				

	5.6 Sketch the rivet set and state its use. 5.7 Calculate the diameter of rivet and riveting allowance in given situations.	riveting allowance as required in 5.5-5.7. Assess the student's understanding through questions and answers.				
	General Objective: 6.0 Understand the ISO tolerances and their application in engineering production.					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
11	6.1 Differentiate between the following:- a. nominal size b. limits (upper and lower) c. tolerance (unilateral and bilateral) d. fit (clearance, transition interference). 6.2 Explain the importance of tolerance and fit in engineering production and describe briefly the ISO system of limits and fits.	- Give detailed notes that will differentiate between nominal size, limits, tolerance and fits. Prepare detailed note and diagrams that will explain the importance of tolerance and fits in engineering production as well as	Class room facilities - Charts on tolerances, limits and fits.			

	6.3 Determine by calculation the amount of tolerance and types of fit in given situations.	describe the ISO systems of limits and fits. Give notes and explanations that will guide in calculating the amount of tolerance and types of fits in given situations. Assess the student's understanding through questions and answers.				
	General Objective: 7.0 Know how to produce simple Engineering Components on the bench production.					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
12	7.1 Explain layout procedures from working drawing of simple engineering components or tools such as:- a. open ended spanner b. engineer's try square c. tool maker's clamp d. plate bracket or gusset (involving rounds, angles,	- Prepare notes and explanations to guide the students in producing simple engineering components as in 7.1-7.3 Assess the student's understanding through questions and answers.	Class room facilities Text books Diagrams and charts			

	holes) e. centre square. 7.2 Explain how to produce any simple engineering component to given specifications including dimensions, tolerance and finish. 7.3 Explain how to carry out simple precision fitting project. e.g. hexagonal mild steel bar making push fit through a mild steel plate.	- do -				
	General Objective: 8.0 Understand the essential features and working principles of the centre lathe highlight and use it to carry out basic operations such as plain turning, stepped turning, facing taper turning, chamfering, and undercutting.					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
13	8.1 Describe the essential features of a centre lathe and state their functions. e.g. lathe bed, headstock, tailstock, saddle or carriage, etc. 8.2 Explain the working principles of the centre lathe.	With the aid of a diagram explain the essential features of a lathe machine. Explain the working principles and basic operations of a lathe	Class room facilities Charts on centre lathe and capstan lathe. Charts on round site finishing,	8.1 Set up the lathe and carry out basic turning operations between centres while observing necessary safety rules and regulations. 8.2 Sharpen cutting tool for plain turning, shouldering, parting off and facing operations.	Guide students to set up the lathe machine and carryout required operation Guide the students to sharpen cutting tool for plain turning shouldering, parting	Point tools, grinding machine, lathe machine. 3-jaw chuck and lathe machine. Point tools and lathe

		machine.	knife tool, form tool, parting off tool, and boring tool.		off and facing operations and allow students to practice till competent.	machine. Lathe machine and accessories.
	8.3 Identify and state the functions of centre lathe accessories such as: catch or driving plate, face place, lathe dog or carrier, lathe centres, fixed and travelling steadies.	Prepare detailed notes that will describe the essential features of centre lathe and their functions.		8.3 Set up rough and turned stock in 3-jaw-chuck.	Demonstrate how to set-up rough and turned stock in a 3-jaw-chuck and operate lathe. Allow students to practice till competent.	Centre lathe and accessories like catch plate, face plate, dog lather, lathe centres fixed steady and travelling steadying.
	8.4 Explain the difference between the centre lathe, capstan lathe, in terms, of their main features and functions.	Give explanations that will show the difference between centre lathe and capstan lathe in terms of their main features and functions.		8.4 Select appropriate cutting tool and set them up to centre height for turning or facing operations.	Guide the students to select appropriate cutting tools and set them up to centre height for lathe work (turning or facing) and allow them to practice till they become competent.	Round nose turning tool, fine finishing tool, form tool, parting off tool, boring tool, bar of good length and 4mm diameter, live/dead centres catch plates.
	8.5 Name types of cutting fluids used for lathe turning operations and state their composition and purposes.	Prepare notes that will list types of cutting fluid use for lathe turning operations and their compositions and purposes.		8.5 Carryout chuck work involving facing, step turning, undercutting radiusing, chamfering, parting off and knurling.		Standard exercises.
	8.6 Outline safety precautions to be observed when working on the lathe.	Prepare detailed notes and explanations that will outline safety precautions, common tools and materials used in marking them.		8.6 Produce simple components involving taper turning using the compound slide to specified tolerance and finish.	Prepare simple exercises that will guide students to produce components involving taper turning using the compound slide.	

	8.7 Sketch and describe common tools: e.g. butt-brazed tool, tipped tool, bit and holder such as plain carbon steel, high speed steel, satellite, cemented carbide, diamond. 8.8 Explain with sketches the functions of tool angles rake, clearance and state their values for different metals to be machined. 8.9 Differentiate between various tool shapes and state their uses e.g. round nose rougher, fine finishing, side finishing, knife tool, form tool, parting off tool, boring tool, etc. 8.10 Explain with sketches the effects of wrong setting of cutting tool: e.g. vibration and chatter, tool rubbing against or digging into the job.	Give detailed notes and diagrams that will explain the functions of too langles (rake, clearance) stating their values for different metals to be machined. Give notes and diagrams of various tool shapes and their uses. Prepare detailed notes and explanations to cover 8.10 to 8.14. Solve many problems as required in items 8.12 and 8.13 for the students to practise.	Charts on tool height. Charts and diagrams of different machining operations.	8.7 Set up the lathe and carry out basic turning operations between centres.	Assess the student's understanding through questions and answers. Demonstrate how to set up the lathe and operate it . Ask students to practise it.	Lathe machine.

	8.11 Define cutting speed with respect to lathe operation. 8.12 Calculate the cutting speed and feed for given turning operation. 8.13 Estimate the rate of metal removal and time required for carrying out specified turning operations. 8.14 State precautions to be Observed when turning between centres. 8.15 Compute required taper dimensions from given data using taper artic angle formulae i.e.. Taper Ratio = [d2 – d1}/L OR $\frac{\text{Tan}\theta}{2} = \frac{d_2 - d1_1}{2}$	Assess the student's understanding through questions and answers. State precautions required. Calculate required taper dimensions	Appropriate data			

	Where θ = taper angle D1 – small and diameter D2 = large end diameter L = length of taper					

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

MODULE: GENERAL METAL WORK II

MODULE CODE: VFW 12

DURATION: 6HOURS PER WEEK(2 HOURS LECTURE 4 HOURS PRACTICAL)

GOAL: **The module is designed to further enhance trainee‘s knowledge in basic metal work processes in fabrication and welding engineering such as forging, sheet-metal work and welding.**

GENERAL OBJECTIVES**:**

On completion of this module, the trainee should be able to:-

1. Understand the basic principles and processes of heat treatment of metal in the workshop.
2. Know how to produce simple engineering components by forging.
3. Understand the basic principles and techniques of gas and metal arc welding and apply them in fabricating simple metal components.

PROGRAMME: **NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING**		
MODULE: **GENERAL METAL WORK II**	MODULE CODE: **VFW 12**	CONTACT HOURS: **6HRS/WEEK/2L/4P**
GOAL: **The module is designed to further enhance the trainee's knowledge in basic metal work processes in Fabrication and Welding engineering such as forging, sheet-metal work and welding.**		

COURSE SPECIFICATION: Theoretical Contents:				Practical Contents:		
	General Objective: **1.0 Understand the basic principles ands processes of heat treatment of metal in the workshop.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
1-5	1.1 Explain briefly the structural behaviour of plain carbon steel as it is heated from room temperature to about 1000°C. a. hardening b. tempering c. annealing d. normalising e. case-hardening 1.2 Explain the meaning of hardening in metal work.	Prepare detailed notes that will explain the structural behaviour of plain carbon steel as it is heated from room temperature to about 1000°C Prepare detailed notes that will explain the meaning of hardening, in	Class room facilities Recommended text books	1.1 Carry out the following heat treatment processes: Hardening, tempering, annealing, normalizing, case-hardening on given plain carbon steel, engineering components or tool. 1.2 Anneal copper, brass and aluminium for various purposes.	- Demonstrate heat treatment processes and explain the stages. Demonstrate the annealing process on brass, copper and aluminium for various purposes.	- Furnace - Forge tongs

		metal work.				
	1.3 Outline safety precautions relating to heat treatment processes and apply them in given situations.	- Prepare notes that will outline safety precautions relating to heat treatment processes.		1.3 Select appropriate forging tools and produce to specification given engineering components by forging processes:- a. upsetting - drawing down b. setting down – twisting c. forge welding (scarf and spice welds) d. bending, turning closed ring e. forming an eye.	Demonstrate with appropriate forging tools how to produce some engineering components and let students practise till they become competent. Assess the student's understanding of the topics through practise, questions and answers.	Anvil, swage block, leg vice, forging hammers, hot set cold set, sets of hammer, punchers, drifts, filers top swage, bottom swage, flatter, open tongs, hollows bit.
	1.4 Explain with outline sketch the main features and the working principles of the black smiths' forge.	- Prepare detailed notes and diagrams that will explain the main features and working principles of the black smiths forge.				
	1.5 Describe and state the functions of common forging tools e.g. anvil, swage block, leg vice, forging hammers, hot and cold sets, set hammer, punches and drifts, handle, fullers, top and bottom swages flatter, tongs (open mouth, closed mouth hollow bit	- Prepare notes and diagrams that will describe the functions of common forging tools.				

	etc.) 1.6 Describe with sketches the following forging operations:- a. upsetting b. drawing down c. setting down d. twisting e. forge welding (scarf and splice welds) f. bending g. forming closed ring h. forming an eye	Prepare detailed notes that will describe the operations: listed in 1.6. Assess the student's understanding of the topics through questions and answers.				
General Objective: 2.0: Know how to produce simple engineering components by forging						
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
6-10	2.1 Explain with outline sketch the main features and working principles of the black smith's forge. 2.2 Describe and state the functions of common forging	* Prepare detail notes and diagrams that will explain the main features and working principles of the black smith's forge. * Prepare notes and diagrams that will	Classroom facilities Recommended text books.	2.1 Select appropriate forging tools and produce to specification given engineering components by forging processes. a. upsetting – drawing down b. setting down – twisting c. forge welding (scarf and spice welds)	*Demonstrate with appropriate forging tools how to produce some engineering components and let the student practice till they become component. * Assess the	* Anvil, swage block, leg vice, forging hammers, hot set cold set, sets of hammer, punchers, drifts, fillers, top swage, bottom swage,

	tools, e.g. anvil, swage block, leg vice, forging hammers, hot and cold sets, set hammer, punches and drifts, hardie, fullers, top and bottom swages flatter, tongs (open mouth, closed mouth, hollow bit, etc.). 2.3 Describe with sketches the following forging operations: a. upsetting b. drawing down c. setting down d. twidting e. forge welding (scarf and spice welds) f. bending g. forming closed ring h. forming an eye	describe the functions of common forging tools. * Prepare detail notes that will describe the following forging operations: upsetting, drawing down, setting down, twisting, forge welding, beding, forming closed ring, forming an eye. * Assess the students' understanding using questions and answers.		d. bending, turning closed ring e. forming an eye black smith's forge.	students understanding through practice.	flatter, open tongs, hollaw bit.

General Objective**: 3.0 Understand the basic principles and techniques of gas and metal arc welding and apply them in fabricating simple metal components.**						
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
	3.1 Describe the equipment and explain the basic principles and application of gas and metal arc welding. 3.2 State the safety precautions to be observed and apply them in given welding situations	Prepare detailed notes and diagram that will describe the equipment and explain the basic principles and application of gas and metal arc welding.	Class room facilities * Recommended textbooks.	3.1 Set up and operate gas or metal arc welding equipment in given situations. 3.2 Prepare joints for welding in given situations. 3.3 Weld given components by arc or gas welding methods and state safety precautions to be observed.	- Demonstrate the use of both gas and metal arc welding equipment; and allow all the students to practice. - Demonstrate to the students how to prepare joints for welding purposes. - Guide students to weld various components using both gas and arc welding processes while applying all the safety precautions.	- Oxygen and Acetylene Cylinders and regulators, Arc welding set, goggles. - shield, electrodes, diagrams and charts of various welding joints.

NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

MODULE: **SHEET METAL WORK**

MODULE CODE: **VWF 13**

DURATION: **6 HOURS / WEEK: (2 HOURS THEORY, 4 HOURS PRACTICAL)**

GOAL: **This module is designed to acquaint the trainee with a good knowledge of sheet metal**

GENERAL OBJECTIVES:

On completion of this module, the trainee should be able to:-

1. Know how to apply appropriate workshop processes, techniques and tools to mark out and form projects in sheet metal work.
2. Know the various solders used for sheet metal projects.
3. Know how to produce finished sheet metal project involving: edge stiffening, beading, finishing either as part of the corporate production process or an independent process.
4. Understand how to draw, develop and produce templates for production of sheet metal projects.

PROGRAMME: **NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING**		
MODULE: **SHEET METAL WORK**	MODULE CODE: **VFW 13**	CONTACT HOURS: **6 HOURS PER WEEK 2L; 4P**
GOAL: **This module is designed to acquaint the trainee with good knowledge of sheet metal work.**		

COURSE SPECIFICATION: Theoretical Contents:				Practical Contents:		
	General Objective: **1.0 Know how to apply appropriate workshop Processes, Techniques And Tools To Mark Out, And Form Projects in Sheet Metal Work.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
1-2	1.1 Calculate the allowance for joint using the formula: grooved seam = 11/2x width of groover panned down and knock-up joints.	- Calculate allowance for joint using the give formula: grooved seam = 11/2x width of groover,	Class room facilities. Textbooks	1.1 Mark out the following projects on sheet metal materials applying appropriate tools, techniques and safety practices: a. rectangular container b. funnels c. cylindrical container	- Demonstrate the marking out of projects on sheet metal by applying the appropriate techniques and safety practices.	Sheet metals - Steel rule divider, scriber, compass
1 – 2	1.2 Name common rivets used in metal work and state their properties. 1.3 State common faults in riveting e.g. a. overlapping	- List and explain types of rivets used in sheet metal and their properties.		1.2 Cut sheet metals to given sizes using appropriate tools/machines 1.3 Form sheet metal to given shapes using appropriate tools, machines and	- Demonstrate sheet metal cutting to given sizes using appropriate tools and machine. - Demonstrate the formation of sheet metal	Cutting machine, steel rule gas cutting nozzles

	b. cracked rivet c. Uneven ends, etc.			techniques.		. Straightening machine.
				1.4 Sketch the joint allowances on the materials and notch the joints.	Sketch joint allowances on the materials and notch.	Bending roller wheeling machine.
3-4				1.5 Make the following joints in sheet metal; solid corner joint grooved seam joint panned down joint knocked up joint	Demonstrate the process of making the following joints: Solid corner Groove seam Panned down Knock-up	Drilling machine Swaging machine Compasses, dividers Protractors, Goggles
				1.6 Drill and punch holes on joints for riveting making sure that burrs, are removed.	- Demonstrate drilling and punching of holes on sheet including removal of burrs.	Drilling machine Punching machine.
				1.7Rivet joints satisfactorily using correct sets.	- Demonstrate riveting by using appropriate rivet	Rivets Riveting machine

					sheets	
	General Objective**: 2.0 Know the solders used for sheet metal projects.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
5	2.1 Identify the types of solders used in sheet metal work and state their compositions e.g. - tin man's solder, grades - self-flux solder - resin-core solder, etc.	- List and identify types of solders - Show various types of solders used in sheet metal work and state their composition.	Class room facilities. - charts of various types of solders			
	General Objective**: 3.0 Know how to produce finished metal projects involving edge stiffening, beadting, finishing, either as part of the corporate production process or as an independent process.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
6-7	3.1 State the meaning of the following terms:- a. edge stiffening b. beading c. work hardening d. beating e. annealing f. hollowing i. work hardening g. raising h. blocking	Explain the meaning of the terms listed in 3.1 (a-p) Give details note on the above Show samples to students.	Class room facilities.	3.1 Mark out for edge-stiffening using calculated allowance. 3.2 Produce projects involving edge stiffening such as: a. beading b. swaging	Demonstrate the marking out edge-stiffening. Demonstrate projects involving edge stiffening after sample demonstration.	Swage block Hammer Mallet Scriber Scriber Swing Compass Polishing machine

	i. planishing j. sand blasting k. picking l. lacquering m. galvanizing n. plating o. painting p. other items used 3.2 Outline the mechanical properties of the following materials used in beating metal work: a. Brass b. copper c. aluminium d. low carbon steel	Explain the mechanical properties of materials used in beating sheet metal work.		3.4 Develop discs for making bowls using workshop method. 3.5 Estimate size of blank for raising and polishing sheet metal work in copper or brass.	Demonstrate the development of discs for making bowls using workshop method. Draw the size of blank for raising and polishing sheet metal work in copper or brass.	Copper Brass Grinding machine Cutting machine Open forge Chisel Tongs Wire brush. **Drawing instruments**
8-9	3.3 Describe the process of raising, sinking, hollowing, and polishing sheet metal work in copper or brass	- Explain the process of raising, sinking, hollowing planishing and polishing sheet metal work in copper and brass.		3.6 Layout and cut out blanks for raising, sinking ort hollowing process. 3 7 Select appropriate tools and equipment and apply correct procedures listed below to produce to specifications by raising, sinking or hollowing, given metal forming job.:- a. blank size estimation b. blank preparation c. heat treatment (annealing)	Demonstrate the laying out and cutting out blanks for raising, sinking or hollowing. Demonstrate and explain process of producing bowls by raising, hollowing and blocking using necessary tools.	

	3.4 Calculate allowances for edge stiffening which include: a. helming' wiring using the formula for wiring allowance: 2D + 4T (where D is the diameter of wire and T is the thickness of metal)	- Solve problems involving calculation of allowances for edge –stiffening using the given formula for wiring .		d. application of appropriate forming process e. cleaning f. polishing; and g. edge truing 3.8 Produce bowls by the following process applying all the necessary safety rules. a. raising using oval head wooden mallet and repeated beating and annealing; b. hollowing, using a hollowed pipe or cylinder, hollowing hammer and a bossing mallet; c. blocking using wooden block, bossing mallet and blocking hammer.	Give student project/assignment to produce bowl while apply necessary safety rules.	

10-12				3.9 Remove dents from metal surface such as bowls, car fenders, metal boxes and other containers using the following tools:- a. wheeling machine b. dent eraser c. planishing hammer and dollies	Demonstrate removal or dents bowl from metal surface.	Tongs Pliers Grinding machine
				3.10 Prepare surfaces for finishing by applying the following process:- a. sand blasting the surface b. picking with acid c. sanding	Demonstrate preparation of surfaces for finishing using appropriate tools and equipment.	Tongs Pliers Grinding machine
				3.11 Finish sheet metal projects by using the following techniques:- a. lacquering b. galvanizing c. plating d. painting	Demonstrate finishing of projects using the techniques listed in 3.11 Ask students to practice the activities listed in 3.1-3.11	

	General Objective**: 4.0 Know how to draw, develop and produce templates for the production of projects.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
13-15	4.1 State materials used for templates a. wood b. cardboard etc c. light-gauge metals	- Explain materials used for making templates	Class room facilities. Recommended textbooks	4.1 Produce and read-blue - prints (which include working drawings) of sheet metal projects. 4.2 Develop templates by using the following methods for the indicated items:- a. Parallel line method – for elbows and T-pieces, square and rectangular trays etc. b. Radial line method – for right cone, oblique cone etc. c. Triangulation method – for transition piece and ducting. d. Cutting plane method – for inclined plane, branch 'T' pieces. e. Development of complicated irregular shape.	- Demonstrate production and reading of blue-prints of sheet metal projects. - Develop templates using the methods in listed for indicated items in 4.2 (a-e).	- Charts Technical drawing instruments Drawing papers

				4.3 Produce various sheet metal items, e.g. ductings to central air-conditioning systems, buckets for water, drawer cabinets (furniture), etc. 4.4 Produce at least two projects in sheet metal work.	- Produce various sheet metal project using templates methods. - Demonstrate the production of various sheet metal projects. - Test and evaluate the trainee in production process. Ask students to practice the activities listed in 4.1-4.4	- Metal sheets - Steel rule - Scriber - Wing compass - Bending machine - Grinding machine - Cutting machine - Electrical - Protective weirs. - .

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

MODULE: GAS WELDING AND CUTTING

MODULE CODE: VWF 14

DURATION: 6HOURS/WEEK; 2 HOURS THEORY; 4 HOURS PRACTICALS

GOAL: **This module is designed to equip the trainee with knowledge, attitude and skills to carryout gas welding and cutting jobs most common metals.**

GENERAL OBJECTIVES**:**

On completion of this module, the trainee should be able to:-

1. Understand and apply the general safety precautions related to gas welding.
2. Know how to apply successfully various gas welding processes/operations including the oxy-fuel gas cutting processes.
3. Know how to weld together basic types of non-ferrous and ferrous metals.
4. Understand the process of building up worn metallic shafts or surfaces
5. Know the basic welding defects and how to rectify them.

PROGRAMME: **NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING**		
MODULE: **GAS WELDING AND CUTTING**	**MODULE CODE: VFW 14**	**CONTACT HOURS: 6HOURS/WEEK/2 L /4 P**
GOAL: **This module is designed to equip the trainee with knowledge, attitude and skills to carryout gas welding and cutting jobs on all types of Metals.**		

COURSE SPECIFICATION: Theoretical Contents:				Practical Contents:		
	General Objective: **1.0 Understand and apply the general safety precautions related to gas welding.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
1				1.1 Carry transport and store full and empty gas cylinders safely using appropriate equipment.	- Demonstrate how to carry, transport and store full and empty gas cylinder safety using appropriate equipment.	Double cylinder trolley Gas cylinders. Filled oxygen and acetylene cylinders/regulators.

				1.2 Apply appropriate safety precautions while carrying out the following:- a. Gas welding operations on containers which have been emptied of chemicals, inflammable or explosive liquids. b. Gas welding near containers with inflammable materials e.g. petrol tank; and c. Gas welding in confined spaces.	Demonstrate appropriate safety precaution while carrying out the operation in 1.2.	Gas welding goggles. Blow pipes welding shields. Welding gloves Welding boots etc. Gas welding machine.
3				1.3 Select, use and care for protective wears for carrying out gas welding operations, e.g.:- a. welding goggles b. cover all c. gloves d. boots, etc.	Identify, use and care for protective wears for carrying out gas welding operations e.g.	Gas welding goggles. Blow pipes welding shields. Welding gloves Welding boots etc. Gas welding machine.

	General Objective**:** 2.0 **Know how to apply successfully various gas welding processes /operations including the oxy-fuel gas cutting processes.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
4	2.1a Differentiate between the following types of generators, stating their merits and demerits. a. water-to-carbide generator b. carbide –to-water generator c. purifiers 2.2 State the composition of Calcium carbide.	- Explain the difference between the two types of generators stating advantages and disadvantages. - Explain the composition of calcium carbide.	Class room facilities.	2.1 Identify the following gas welding equipment, describing their features, functions, applications and care:- b. generators c. regulators d. blow pipes e. nozzles f. hoses g. gas cylinders and their colours h. economizers i. check valves	- Show the students items listed in 2.1. - explain their features and functions and applications listed in 2.1.	Items listed in 2.1
5	2.3 Identify the following flames and describe how they are derived in the oxy-acetylene welding processes:- a. oxidizing flame b. carbonizing flame c. neutral flame 2.4 State the instances of the application/uses of the type of flames	- Explain the three types of flame in gas welding:- oxidizing, carbonizing and neutral . - Describe uses of the types of flame named in 2.3	sketches /charts	2.2 Identify the main parts of the generators e.g. hydraulic back pressure valve purifiers, carbide trays etc.	Show the students the main part of generator, e.g. hydraulic back valves, purifiers, carbide trays etc.	Items listed in 2.2

6-7	named in 2.3 above. 2.5 Distinguish between high and low pressure systems of welding. 2.6a Differentiate between generated acetylene and dissolve acetylene stating the impurities present in crude acetylene 2.7 State the functions of backing bars and strips 2.8 Explain the preparation of plate surfaces for i. butt ii. fillet and iii. lap joints	above. - State the difference between low and high pressure systems of gas welding. - Explain the functions of backing bars and strips.		2.3 Generate acetylene using calcium carbide guiding against danger of over-charge. 2.4 Identify types of welding rods stating their properties, compositions and uses. 2.5 Differentiate between welding and cutting torches. 2.6 Light the welding torch and adjust the flame to each of the types named in 2.3 above under theory. 2.7 Prepare plate and run beads:- a. with filler rods b. without filler rods	- Demonstrate how to generate acetylene using calcium carbide. - Show and explain the types of welding rods to students stating their properties, composition and uses. - Show students the different types of torches. Demonstrate the lighting and setting up the flames named in 2.3 under theory. Demonstrate plate surface preparation for running beds, with and without filler rods	Calcium carbide motor and generator different types of welding rods - Welding and cutting torches. Welding torch oxygen and acetylene cylinders with regulated. Plates etc.

8		Give detailed notes on the plate edge preparation	Charts/posters. Diagrams etc.	2.8 Make neat labelled sketches indicating the conventional symbols for the welded joints e.g.:- a. butt joint b. fillet joint c. lap joint 2.9 Prepare plate surfaces for the following welding joints and tack weld:- a. butt joint b. fillet joint c. lap joint 2.10 Weld metals together in down-hand or flat position. 2.11 Apply backing bars and strips according to instructions on the back side of the weld	- Show students labelled sketches showing the conventional symbols for welded joints:- i. butt ii. fillet iii. lap etc and ask them to draw - Demonstrate task welding and joints listed in 2.9. - Give detailed notes. Demonstrate how to weld metal together in down-hand or flat position. Demonstrate the use of backing bars and strips for	Drawing instruments - Sample of weld joints Plates etc.

				to control penetration. 2.12 Set up and tack weld the prepared pieces of metals.	controlling penetration. Demonstrate how to set-up gas welding machine and tack weld prepared pieces of metals.	 Pieces of metal.

	General Objective**: 3.0 Know how to weld together basic types of non-ferrous and ferrous metals.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
9	3.1 Describe the general characteristics of materials used in Fabrication and welding engineering including simple consideration of physical properties such as:- a. strength b. ductility c. malleability d. hardness e. tenacity f. fusion g. distortion h. toughness and resistance to impact in relation to uses and common manufacturing processes, and weldability of materials.	Explain the characteristics listed in 3.1.	Class room facilities. Recommended textbooks.	3.1 Identify the following types of non-ferrous and ferrous metals <u>Non-ferrous</u> copper aluminium brass bronze tin zinc lead iconet and monet <u>Ferrous</u> wrought iron mild steel stainless steel cast iron	Show students samples of metals listed in 3.1 and Explain their composition.	Ferrous and non-ferrous metals listed in 3.1.
10	3.2 State the common fabrication engineering uses of cast iron, mild steel, high yield steel, cast steel,	State the common uses of the materials listed in 3.2 in fabrication.		3.2 Prepare and weld non-ferrous metal using appropriate fluxes.	Demonstrate the welding of ferrous ands non-ferrous metals using appropriate fluxes.	Samples of ferrous and non-ferrous Gas – welding equipment oxygen and acetylene gases.

	austenite stainless steel, copper and common copper, alloys, aluminium and common aluminium alloys, common forms or supply and the general limitations of cast forms.			3.3 Identify cast-iron in terms of:- a. types b. its composition c. its properties	Show students the different types of cast iron	Different types of cast iron.
	3.3 State the properties and composition of fluxes used for welding non-ferrous metals.	Explain the properties and composition of fluxes used for ferrous and non-ferrous metals.		3.4 Prepare cast-iron for welding by: a. chamfering or beveling of edges to specification b. pre-heating to specification	Demonstrate preparation of cast iron for welding.	
	3.4 Enumerate two functions of fluxes in the welding of non-ferrous metals.	Give two functions of fluxes used in the welding of ferrous and non-ferrous metals.		3.5 Fusion weld cast iron components.	Demonstrate the fusion welding of cast iron components.	Gas welding equipment and accesses - cast iron
				3.6 Identify suitable flux for bronze welding and state its composition.	Show the students suitable flux for bronze welding.	
11	3.5 State reasons for post – heating welds.	Give reasons for welding of bronze to specification.		3.7 Prepare bronze to specifications.	Demonstrate preparation of bronze components	Brush File Bronze

	3.6 Explain the effect of welding together two different metals. 3.7 Identify dissimilar metals such as:- a. copper and brass b. steel and cast-iron c. aluminium and steel, etc. 3.8 State the effect of dilution in welding 3.9 Explain the principles of the following welding processes:- a. cladding b. stelliting c. hard surfacing d. brazing	State effects of welding together two different metals. Explain dissimilar metal listed in 3.7 (a – c) Explain the effect of dilution in welding. Explain the principles of the welding process in 3.9 (a-d) giving examples.		for welding, avoiding sharp edges 3.8 Weld bronze to specifications. 3.9 Identify ands state the types, composition and properties of common stainless steel used in m metal work. 3.10 Prepare stainless steel components for welding. 3.11 Weld stainless steel using appropriate welding rods and techniques and observing safety practice.	Demonstrate to students the welding bronze to specification. Show the types of common stainless steels. Demonstrate the preparation of stainless steel components welding. Demonstrate the welding of stainless steel using appropriate welding rods and observing safety practices.	Gas welding machine Welding rods
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		Assess students understanding of the topic discussed using questions and answers.		3.12 Apply appropriate treatment to the welded joint e.g. washing in soapy water, brushing off lux residue, etc to avoid weld decay. 3.13 Prepare and weld dissimilar metals using correct techniques and observing the correct safety practice.	Demonstrate the appropriate treatment to the welded joint to avoid weld decay. Demonstrate as required in 3.13 Ask the students to carryout projects involving all of the above.	Soap cold water Warm water ,wire brushes. Dissimilar metals Gas welding machine Gas cylinders Protective wears.

	General Objective**: 4.0 Understand the process of building up worn metallic shafts or surfaces.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
13	4.1 Identify the composition of given worn metallic shafts or other worn metallic objects. 4.2 Explain the properties of the metal used for given worn metallic shafts or other objects.	- Explain the composition of given worn metallic shaft or objects. - Describe the properties of the metal used for given worn metallic shafts or other objects.	Classroom facilities Recommended textbooks	4.1 Build up given worn metallic surfaces to specifications using suitable filler rods and applying the correct techniques/sequence of operation.	- Demonstrate how to build up worn metallic surfaces to specification, using suitable techniques and filler rods.	Filler rods Worn out metallic parts or shafts.
	General Objective**: 5.0 Know the various welding defects and how to rectify them.**					
WEEK	Specific Learning Objective	Teachers Activities	Learning Resources	Specific Learning Objective	Teachers Activities	Learning Resources
14	5.1 Describe the following defects in gas welded joints:- a. undercut b. lack of fusion (side, root, inter-run) c. porosity d. slag inclusion e. unequal leg length (uneven alignment)	- Explain the defects in gas welded joints listed in 5.1 (a – f).	Classroom facilities Recommended textbooks	5.1 Apply the following defects tests in welded joints:- (i) Destructive test such as bend test, macro and micro examination sulphur prints, mick and tee fillet test.	Demonstrate how to use tests to detect defects in welded joints: destructive and non-destructive tests.	Test pieces

	f. lack of reinforcement g. warpage and etc			(ii) Non-destructive tests such as visual inspection, X-ray test, gamma ray test, ultrasonic tests.		
	5.2 State how the welded defects in (5.1) above can be avoided in oxy-acetylene welding.	Explain how the weld defects in (5.1) above can be avoided in oxy-acetylene welding.	- films - video tapes - industrial visit/execution etc.	5.2 Rectify welded joints defects enumerated in 5.1 above under theory.	Demonstrate correction of welding defects enumerated in (5.1) above under theory.	Defective welded joints Gas welding machine Filler rods Oxygen and Acetylic gas cylinders (filled)
15	5.3 Explain the following tests in welded joint. (i) Non destructive test such as visual inspection, x-ray test, gamma ray test, ultrasonic tests (ii) Describe test such as bend test, macro/micro examination, sulphur prints, mick and tee fillet test.	Describe each test mentioned in 5.3 above.		5.3 Fabricate projects involving ferrous and nonferrous metal welding, observing all the necessary precautions and rectifying all observed joint defects.	Evaluate the students in production process.	Metallic materials Gas welding machine Fluxes Gas cylinders. (filled).

NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

MODULE: **VFW 15 METAL ARC WELDING**

MODULE CODE: VFW 15

DURATION: 6 HOURS / WEEK- 2 HOURS THEORY, 4 HOURS PRACTICAL

PREREQUISITE VFW 12

GOAL: **This module is designed to equip the trainee with the knowledge, and skills to carry out Metal Arc Welding jobs involving various ferrous and non ferrous metals.**

GENERAL OBJECTIVES:

1. Understand and Apply Safety Precautions Related to Metal Arc Welding.

2. Understand the features and working principles of arc welding machines and accessories.

3. Know how to make different types of welded joints in all positions.

4. Know the properties of various types of ferrous and non-ferrous metals.

5. Know how to build up worn metallic shafts, and surfaces using metal arc welding.

6. Know how to cut Metals to various specifications using metal Arc Cutting process.

7. Know the basic welding defects and how to rectify them.

Course: METAL ARC WELDING	**COURSE CODE: VFW 13**	**CONTACT HOURS: 6hrs per week -2L; 4P**
GOAL: This course is designed to equip the trainee with the knowledge and skills to carryout metal Arc Welding jobs involving various ferrous and non ferrous metals.		
Course Specification: Theoretical Contents:		

	Theoretical content			**Practical Content**		
	General Objective : 1.0: Understand and apply safety precautions related to metal Arc welding.					
WEEK	**Specific Learning Outcome**	**Teacher's Activities**	**Learning Resources**	**Specific Learning objective**	**Teachers Activities**	**Learning Resources**
1	1.1 List and explain the hazards related to metal arc welding, e.g a) Arc eye b) Burning c) Radiation d) Electric shock e) Toxic fumes, etc .	• Explain the hazard related to metal Arc welding as listed in 1.1	Classroom facilities. Recommended textbooks	1.1 Select, use and care for protective wears required while carrying out metal arc welding operations, e.g a) Head and hand shield b) Hand gloves c) Apron d) Spats e) Boots and leggings, etc. 1.2 Apply appropriate safety precautions while carrying out: a) Arc welding in confined	Demonstrate the use and care for protective wears while metal Arc welding. Show the items listed in 1.1 to students and give detailed notes Explain Safety precautions while carrying out operations in 1.2	• Items listed in 1.1 Arc welding Equipment Protective wears e.g. boots, apron,

				spaces b) Arc welding empty vessels or drums that had contained inflammable or toxic materials c) Arc welding near inflammable materials	Ask students to demonstrate the appropriate safety precaution while carrying out arc welding as listed in 1.2	goggle, shield etc.
	General Objective**: 2.0 Understand the features and working principles of Arc Welding and accessories.**					
Week	**Specific Learning Outcome**	**Teacher Activities**	**Resources**	**Specific Learning Outcome**	**Teacher Activities**	**Resources**
2	2.1 Know the working principles of A.c and D.c welding machines 2.2 List and state the functions of the welding accessories, e.g 1. welding load 2. earth load 3. electrode holder 4. chipping hammer	Explain the differences between a.c and d.c arc welding machines and state the working principles. Explain the functions of welding accessories as listed in 2.2	Classroom facilities. Recommended textbooks	2.1 Differentiate between <u>a.C and d.C Arc welding Machines</u> 2.2 Set up and use the a.c and d.c welding machines for specified voltage/amperage operation, observing safety precaution necessary	Show students the different features in the construction of the arc welding machines Demonstrate the use of a.c and d.c welding machines for specified voltage and amperage observing safety precautions necessary	Arc Welding Equipment Electrodes welding machine Arc welding machine

	5. wire brush, etc. 6. welding cables 7. welding shield		.			
	2.3 Explain the advantages and disadvantages of a.c and d.c welding machines.	List and explain the advantages and disadvantages of a.c and d.c welding.		2.3 Select electrode materials according to parent system	Explain the selection of electrode materials according to parent metals	Electrodes.
3	2.4 Explain the following processes of manufacturing electrodes a. Solid extrusion process b. extruded with re-enforcing coating c. dipped process	Describe the processes of electrode manufacturing as listed in 2.4.		2.4 Strike metal arc and maintain the arc	Demonstrate how to strike and maintain the arc Ask students to practice striking metals arc and maintaining the arc	Welding machine Electrodes
	2.5 Describe with sketches the material composition of electrodes.	Explain with sketches, material composition of different types of electrode		2.5 Carry out with proficiency the following arc welding techniques/operations: a. weaving b. laying of multi-runs, etc	Demonstrate with proficiency he arc welding techniques/operations listed in 2.5.	Arc welding machine. Protective wears
	2.6 State electrode classification.	Explain the conventional electrode classification system		2.6 Applying the basic methods of Electrode care described in 2.7 under the theory take care of given electrodes.	Demonstrate the care of electrodes and ask students to do so	Electrodes Drying oven Arc welding machine.
	2.7 State the basic methods	Explain the basic				

	of electrode care, e.g a. dry storage b. oven storage c. safe handling	method of electrode care as listed in 2.7				
	General Objective 3.0: Make different types of welded joints in all positions					
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**	**Specific Learning Outcome**	**Teacher Learning**	**Resource**
4	3.1 Describe with sketches the application of the following joints in metal fabrication: a) square butt b single vee c) double vee d) single U box e) open corner, etc	Explain with sketches the application of the joints listed in 3.1 in metal fabrication:	Classroom facilities. Diagrams Recommended textbooks	3.1 Prepare edges for welding the following joints: a. square butt b. single vee c. double vee d. single U e. double U f. open corner	Demonstrate preparation of edges for welding joints in 3.4 (e.f) Give students projects that require the joints listed in 3.1 (a-f)	Wire brush
	3.2 Out line the factors that govern the selection of joints to be used for a project e.g a) type of metal b) thickness of metal c) Type of joint d) position of joint.	Explain the factors that govern the selection of joint to be used for a project with reference to 3.2 (a-d)		3.2 Weld the prepared joints in (3.1) above in flat positions observing necessary safety precautions.	Demonstrate welding of joint in 3.1 above in flat position observing necessary safety precautions and Ask students to practice it	Arc welding machine Protective wears.
	3.3 Interpret the various arc welding symbols and conventions used in engineering working	• Show and explain the various arc welding		3.3 Prepare metal surfaces for: a. Multi –run welds b. weaving welds	Demonstrate preparation of metal surfaces for the welds listed in 3.3.	Wire brush

	drawings	symbols use in engineering working drawing		3.4 Make multi –run welds 3.5 Make weaving welds 3.6 Weld joints in the following positions: a. vertical position b. horizontal position c. overhead position 3.7 Weld pipes and flanges in various fixed positions 3.8 Weld pipes and flanges in rotated position 3.9 Weld pipes using the store pipe method	Demonstrate the making of multi-run welds Demonstrate making weaving welds. Demonstrate the welding of joint in the following position: i vertical ii horizontal and iii overhead. Demonstrate the welding pipes and flanges in various fixed positions listed in 3.6. Demonstrate the welding of pipes and flanges in rotated positions Demonstrate the welding of pipes using the store pipe methods. Give students projects involving the welding processes above.	Arc welding machine Electrodes Protective wears Arc welding machine Electrodes Protective wears Welding machine Electrodes Protective wears. Ditto

	General Objective: 4.0 Know the properties of basic types of ferrous and non-ferrous metals and how to weld them together					
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**	**Specific Learning Outcome**	**Teacher Learning**	**Resource**
	4.1 list four physical properties of cast iron	Explain four physical properties of cast iron.	Classroom facilities.	4.1 Identify by inspection various types of ferrous metals e.g cast iron steel, etc.	Demonstrate by inspection various types of ferrous metals: cast iron, steel, stainless steel, etc	Various type of ferrous metals.
	4.2 state the behaviour of the following types of cast iron <u>when welded</u> a. grey cast iron b. white cast iron c. malleable cast iron.	Explain the behaviour of the types of cast iron when welding as in 4.3 (a-c) above	Recommended textbooks	4.2 Carryout the following processes:- a) Pre-heating b) Post-heating c) Pining d) Fixed – free end welding etc.	Demonstrate the procedures listed in 4.2 and ask students to do so.	Gas welding equipment and lighted.
	4.3 State the use of the following procedures:- a) Pre-heating b) Post-heating c) Pining d) Fixed – free end welding etc.	Explain the uses and demonstrate the following procedures listed in 4.3 (a.d).		4.3 Prepare cast iron pieces by chamfering and preheating etc. and weld them satisfactorily, sing the following techniques: a) Fusion b) Bronze c) Studying d) Buttering	Demonstrate the preparation of cast iron pieces by chamfering and preheating and weld satisfactorily as listed in 4.3 (a-d)	Pieces of cast iron Wire brush
9-10	4.4 Identify various types of non-ferrous metals, e.g a. copper b. aluminium c. brass d. inconel e. monel	Outline various types of non-ferrous metals as in 4.4 (a-e)		4.4 select suitable electrodes and machines for welding various types of given non-ferrous metals	Demonstrate the selection of suitable electrode and machines for welding various types given non-ferrous metals	Arc welding machine and accessories. Different sizes of electrode and welding machine.

	4.5 Describe the composition and state the mechanical properties of the non- ferrous metals named in 4.4 above, to include: a) Ductility b) Malleability c) Hardness d) Tenacity e) Fusion f) Fatigue g) Effect of heat h) Distortion 4.6 Outline appropriate heat treatment method for finished welding of non-ferrous metal.	Explain the composition and state mechanical properties of non-ferrous metal in listed in 4.5. List the appropriate heat treatment methods as required in 4.6.		4.5 Weld the following non-ferrous metals and apply the appropriate heat treatment: a) Copper b) Bronze c) Aluminium d) Brass e) iconelmonel	Demonstrate the welding of non-ferrous metals and apply the appropriate heat treatment method as in 4.5 (a-c)	Arc welding machine. Pieces of iron ferrous metals Electrodes
	General Objective 5.0: know how to Build up worn metallic shafts and surfaces using metal arc welding					
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
11	5.1 Identify the composition of given worn metallic shafts or other worn metallic parts. e.g. gear teeth that can be restored by arc welding .	Describe the composition of a given worn metal shafts or parts e.g gear teeth that can be restored by arc welding	Classroom facilities. Recommended textbooks	5.1 Build –up given worn metallic parts to specification using appropriate techniques including controls against distortion	Demonstrate the building up of worn metal parts to specification, using appropriate techniques and control against distortion.	Welding machine and accessories. Worn metallic shaft and gear teeth.

	5.2 Explain the properties of given worn metallic parts to be restored by arc welding.	Give detailed explanation on the properties as required in 5.2.				
	General Objective 6.0: Know how to cut Metals to basic specifications using metal Arc Cutting processes.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teacher Learning	Resource
12-13	6.1 Explain the principles and application of the following arc cutting methods in metal fabrication: a) Air arc method b) Carbon arc method c) Oxy arc method 6.2 Identify Arc cutting electrodes and state their compositions and uses	• Explain the principles and application of the following arc cutting methods listed in 6.1 in metal fabrication. Explain arc cutting electrode stating their composition and uses	Classroom facilities. Recommended textbooks	6.1 Cut metals with facility using the different cutting methods named in 6.1 under theory.	Demonstrate the cutting of metals using the different cutting method named in 6.1 above and ask students to practise same.	Arc Cutting Electrode and welding equipment.
	General Objective 7.0 Know basic welding defect s and how to rectify them					
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**	**Specific Learning Outcome**	**Teacher Learning**	**Resources**
14-15	7.1 Describe major defects in arc welded joints including undercut; lack of fusion (side, root , interrun); porosity; slag inclusion oxide entrenchment unequal leg length uneven	Explain major defects in arc welded joint as in 7.1.	Classroom facilities. Recommended textbooks. .	7.1 Apply the following tests to detect defects in arc welded joints: a) non-destructive tests such as visual inspection, x – ray test, gamma, ray test,	Show students samples of defects and demonstrate the application of the tests to detect defects in arc welded joints.	Instruments (x-ray, equipment, Ignitron etc)

	alignment and lack of reinforcement and distortion. 7.2 Explain how the weld defects in 7.1 above can be avoided.	Explain how weld defects in 7.1 above can be avoided.		ultrasonic test, magnetic track detector penetrate; b) destructive tests such as bend test, macro and micro examinations sulphur print, izod and fatigue. 7.2 Rectify welded joint defects named 7.1 above 7.3 Produce project involving the application of: a) General safety precaution b) both ac and dc machines c) ferrous and non-ferrous metals d) Different type of joints in all positions and defect etc.	Demonstrate the rectification of defects and ask students to practise. Evaluate the students in the production process.	Arc and welding machines Electrodes Ferrous and non-ferrous metal Various types of joints. Arc welding machine and accessories.

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATE IN FABRICATION AND WELDING

MODULE: VFW 16 STRUCTURAL STEEL WORK

MODULE CODE: VFW 16

DURATION: 6 HOURS/WEEK: 2 THEO RY: 4 HOURS PRACTICALS

GOAL: **This module is designed to provide the trainee with knowledge and skills to enable him produce simple finished structural steel work projects with safety.**

GENERAL OBJECTIVES:
On completion of this module the trainee should be able to:

1. Understand the safety rules as applicable to structural steel work
2. Understand the basic process of manufacturing iron and steel
3. Know how to use and care for Tools and Equipment used in Structural Steel Work
4. Know the structural properties of materials used in structural steel work and make simple calculations related to their strength
5. Know how to produce simple structural steel projects on the shop floor
6. Know how to assemble simple structural steel components
7. Know the effect of corrosion on structural steel materials and how to apply to protective coating against it.

PROGRAMME: NATIONAL VOCATIONAL CERTIFICATION IN FABRICATION AND WELDING						
MODULE: STRUCTURAL STEEL WORK MODULE		COURSE CODE: VFW 16		**CONTACT HOURS: 6 hrs per week -2L: 4 P**		
Course Specification:						
Theoretical content				**Practical Content**		
	General Objective: 1.0: Understand the safety rules as applicable to structural steel work.					
WEEK	**Specific Learning Outcome**	**Teacher's Activities**	**Learning Resources**	**Specific Learning objective**	**Teachers Activities**	**Learning Resources**
	1.1 State the uses and care for the following protective wears used in structural steel work: a. gloves b. aprons c. boots d. goggles, etc 1.2 Explain safety rules for the following operations in structural steel work: a) rules for storage of full and empty gas cylinders b) rules for lifting of structure c) rules for transporting of structures, etc.	State uses and care of the items listed in 1.1. Explain the safety rules for operations in structural steel work and give detailed notes.	Classroom facilities.	1.1 Apply the safety rules in carrying out operations named in 1.2 under theory.	Demonstrate the application of safety rules in carrying out operations mentioned in 1.2 under theory.	Full and empty gas cylinders - structures - Protective wears.

	General Objective 2.0: Understand the basic process of manufacturing iron and steel					
WEEK	**Specific Learning Outcome**	**Teacher's Activities**	**Learning Resources**	**Specific Learning objective**	**Teachers Activities**	**Learning Resources**
	2.1 Sketch a blast furnace and describe its working principles 2.2 Give the name of fuel and state the composition of charge used in blast furnace 2.3 Explain the working principles of Bessemer process with the aid of a sketch 2.4 Outline the characteristics of pig iron, cast iron and low carbon steel.	Sketch and label a blast furnace and explain the working principles and ask students to do so. Explain the types of fuel and the composition on charge used in blast furnace Explain the working principles of a Bessemer process with the aid of a sketch List the characteristics of pig iron, cast iron and low carbon steel.	Classroom facilities. Recommended textbooks Drawing instruments and papers	2.1 Visit an iron and steel industry factory to see a typical blast furnace.	Take students to iron and steel industry/factory to see a typical blast furnace.	Iron and steel industry/ factory .

	General Objective 3.0: Know how to use and care for Tools and Equipment used in Structural Steel Work.					
WEEK	**Specific Learning Outcome**	**Teacher's Activities**	**Learning Resources**	**Specific Learning objective**	**Teachers Activities**	**Learning Resources**
				3.1 Select and use common hand tools used in structural steel work e.g a) Hammers (assorted) sheers b) Spanners (assorted) dog c) Drills (assorted) dice d) Punches dollies, etc. e) Chisels f) Screw drivers g) Pliers h) Strips 3.2 Identify and use with safety the following <u>Power</u> <u>tools</u> used in structural steel work: e.g a) Riveting hammer (assorted) b) Holder on c) Impact wrenches d) Grinder	Show students the tools and ask them to sketch the tools. Show the student the tools listed in 3.1. Demonstrate the use of the tools.	Tools listed in 3.1 Drawing papers Drawing instruments. Guillotine Bending machine Power saw cutting Power operated drilling machine.

				e) Torque spanners f) Straight edge etc. 3.3 Identify the use and care for the following structural steel working equipment e.g (a)Cranes (assorted) (b)Straightening machine ©Circular sewing machines (d)Lofty platform (e)Cropper (f)Shearing machine (g)Punching machines (h)Drilling machine (i)Guillotine (j)Bending machine\Rolling	Show the students each of this equipment physically where available. lif not show them the pictures.	Structural sheet working equipment listed 3.3. Various pictures of the structural steel sroking equipment Drawing papers Drawing instruments.

	General Objective 4.0: Know the structural properties of materials used in structural steel work and make simple calculations related to their strength					
WEEK	**Specific Learning Outcome**	**Teacher's Activities**	**Learning Resources**	**Specific Learning objective**	**Teachers Activities**	**Learning Resources**
	4.1 Describe with sketches the following forms of structural steel materials e.g a) Plates (various thicknesses) b) Universal channel c) Universal beams d) Rolled steel joist e) T-bar f) Angle bar g) Check plates (assorted) h) Bridge beams, etc	Sketch and explain forms of structural steel materials Give detailed notes on each of the equipments Asked students to sketch the equipment.	Classroom facilities. Posters Charts. Recommended textbooks	4.1 Apply standard specifications, e.g Nigerian standard (where available)- American or British standards to structural steel work design.	Apply standard specifications used in structural steel work design.	Standard specifications
	4.2 Interpret conventional symbols and abbreviations used for representing structural steel sections	Explain conventional symbols and abbreviations used in representing structural steel section		4.2 Apply Hooke's Law in the design of given simple structural elements.	Apply Hooke's Law in the design of simple structural elements	

	4.3 State the use and limitations of the structural steel materials named in 3.1 above 4.4 Distinguish between the following stresses in structural steel – work a. tensile stress b. compressive stress c. shear stress 4.5 Carry out simple calculations involving Practical applications of tensile, compressive and shear stresses, e.g riveted and welded joints.	Explain the use and limitations of the structural steel materials in 4.1 Explain and state the difference of stresses in structural steel work Explain simple calculations involving practical application of stresses in riveted joint, welded joints etc. Solve some problems and ask students to practise.		4.3 Read structural steel work drawing and sketch simple structural steel work details.	Draw and interpret structural steel work drawing and sketches of simple structural steel work details	Drawing papers and instruments

	General Objective 5.0: Know how to produce simple structural steel projects on the shop floor					
Week	**Specific Learning Outcome**	**Teacher Activities**	**Resource**	**Specific Learning Outcome**	**Teacher Activities**	**Resource**
	5.1 Calculate allowances for forming thick metal or angle bar rings using the following methods: a. mainline method b. neutral line method	Explain calculations of allowances for forming thick metal or angle bar rings using mainline and neutral line method Solve some problems and ask students to practise them.	Classroom facilities. Recommended textbooks	5.1 Produce simple projects in structural steel work e.g stanchion bar plate rafter hunches, etc 5. 2 Develop templates with regular surfaces 5.3 Cut out templates from the following materials: a. wood b. cardboard c. any other suitable materials 5.4 Reproduce simple jobs on structural steel materials using templates cut in 5.3 above	Give students projects to demonstrate the production of simple projects in structural steel work Demonstrate how to develop templates with regular surfaces. Demonstrate how to cut templates from various materials. Ask student to cut out template on wood, cardboard etc. Give student Project to demonstrate how to reproduce simple jobs on structural	Welding machine Steel bar Electrode Flux etc Wood, cardboard Razor blade Power sad Cutting machine Riveting machine Hammer Grinder

					steel materials using templates in 5.4 above	Torque Spanner Crane Cropper Sheer machine
				5.5 Sketch and produce simple working jigs, e.g jig for mass production of stanchions, rafters, etc on the shop floor	Demonstrate how to sketch and produce simple working jigs. Ask students to do the same.	Drilling machine Guillotine Bending machine rolling machine. Drawing instruments
	General Objectives: 6.0: Know how to assemble simple structural steel components.					
WEEK	**Specific Learning Outcome**	**Teacher Activities**	**Resource**	**Specific Learning Outcome**	**Teacher Activities**	**Resource**
	6.1 Explain the uses of fixtures and bolts in the assembly of structural components e.g bolting, riveting and welding	Explain the uses of fixtures and bolts in the assembly of structural components Give detailed notes and assess understanding of the topics.	Class room facilities. Recommended textbooks	6.1 Assemble simple structural components such as rafter bracing, simple canopy, simple roof trusses, etc using basic jointing operations.	Demonstrate how to assemble simple structural components, using bolts, rivets and welding operation. Show samples of some of the assemblies	Welding machine Bolts Rivets Files etc

	General Objective 7.0 Know the effect of corrosion on structural steel materials and how to apply protective coating against it.					
Week	**Specific Learning Outcome**	**Teacher Activities**	**Resource**	**Specific Learning Outcome**	**Teacher Activities**	**Resource**
	7.1 Name some common causes of corrosion on steel e.g a. atmospheric b. chemical such as electrolytic action etc	List some common causes of corrosion on steel	Class room facilities. Recommended textbooks	7.1 Prepare the surfaces of structural steel components for finishing with the following methods: b. brushing c. de-greasing d. de-scaling	Demonstrate how to prepare the surfaces of structural steel components for finishing Ask the student to perform the operation above	Grinding machine Fillers Specimen
	7.2 Describe the effect of corrosion on structural steel, e.g a. weakening of structure b. defacing of steel	Explain the effects of corrosion on structural steel	Ditto	7.2 Apply suitable undercoat to structural steel components. e.g red oxide metallization and observe necessary safety precautions.	Demonstrate the application of suitable undercoat to structural steel components and observe safety precautions.	Brush Paint etc
	7.3 Explain the purposes for applying undercoat to structural steel components	Explain the purposes for applying undercoat to structural steel components		7.3 Produce project while applying the safety rules in structural steel work.	Evaluate the students in the process of the production of project.	Materials, tools and equipment listed in 7.1 and 7.2 under practicals.

	7.4 state the composition of common undercoat used for structural steel work	List and explain the composition of common undercoat used for structural steel work.				

RECOMMENDED TEXTBOOKS FOR NATIONAL VOCATIONAL CERTIFICATE IN WELDING AND FABRICATION

S/NO.	BOOKS	AUTHORS
1.	BASIC WELDING AND FABRICATION	W. KENYON
2.	THE GEOMETRY OF SHEET METAL WORK FOR STUDENTS AND CRAFTSMEN	BOURBOUSSON & ASHWORTH
3.	THE CALCULATION SHEET METAL WORK FOR STUDENTS AND CRAFTSMEN	A. DICKSON
4.	METAL: DESIGN AND CONSTRUCTION	A. C. DAVIS - Tenth Edition
5.	(a) THE SCIENCE AND PRACTICE OF WELDING Vol.1 Cambridge V. Press, 1992 (b) Volume 11 above	A.C. DAVIS
6.	WELDING SCIENCE AND METALLURGY	J. CARDENER
7.	FABRICATION AND WELDING TECHNOLOGY	A. SMITH
8.	WELDING CRAFT PRACTICE – Part 1 Volume 1 Oxy-acetylene Gas Welding and Related Studies	N. PARKIN & C.R. FLOOD
9	WELDING CRAFT PRACTICE – Part 1. Volume 2: Electrical Arc Welding and Related Studies	N. PARKIN & C.R. FLOOD

List of Tools and Equipment for National Vocational Certificate In Welding and Fabrication

(FOR 30 STUDENTS/TRAINEES)

S/NO		MINIMUM QUANTITY REQUIRED
1.	Power guillotine of capacity 10swg x 36 in length	1
2.	Swing beam folder 10swg x 3'-6' capacity	1
3.	Bending roller capacity 40"x2" diameter	1
4.	Bench mounted cone roller	2
5.	Power bench grinding machine	2
6.	Double-ended buffer and polisher	1
7.	Universal beading and swaging machine	1
8.	Power-operated drilling machine maximum capacity 3/8"	1
9.	Fly Press	1
10.	Hand nibbling Machine	2
11.	Left and right hand snips	5 each
12.	Straight snips	5
13.	A "kit" of tools consisting of hammer, mallet, steel rule, scriber and wing compass, etc.	2
14.	Power saw cutting machine 10mm	1
15.	Disc cutting machine	1
16.	Profile cutting machine with gas cutting nozzles	2

17.	Piller drilling machine	2
18.	Straightening machine	2
19.	Cropping machine	2
20.	Straight edge	10
21.	Trammels dividers (set)	10
22.	Hammers	10
23.	Chisels	10
24.	Punches	10
25.	Try-squares	10
26.	Steel rules	10
27	Smith open forge	1
28.	Vee blocks	10
29.	Electrode holders and clamps	10
30.	Electrode drying oven	1
31.	Heavy duty grinding machine	1
32.	Bench-type grinding machine	2
33.	CO_2 cylinders	5
34.	Transformers With rectifiers (with all Instruments)	10
35.	Aprons (assorted)	20
36.	Hand gloves	20
37.	Hand shields and head caps	10
38.	Wire brushes	10
39.	Electrical beaters	1

40.	Pliers – assorted	5
41.	Gas welding goggles	10
42.	Oxygen regulators	5
43.	Acetylene regulators	5
44.	Hoses and clips and all attachments set	
45.	Blowpipes (low and high pressure	5
46..	Tongs	5
47.	Power operated profile cutter with turntable	2
48.	D.C generators with all connections	5
49.	A.C transformer (Argon) with all the connections	10
50.	Argon cylinders	5
51.	Regulators with flow meters	3
52.	Hacksaw and blades	24
53.	Water to carbide generators	4
54.	Carbide to water generators	4
55.	Overhead projector	1
56.	Computer set	1
57.	Anvil	2
58.	Oxy-acetylene welding blow pipe (High pressure & low pressure)	5
59.	Gas cutting torch	2
60.	Set of welding and cutting nozzles	
61.	Swage block	2
62.	Chipping hammers	20

63.	Plain goggles	20
64.	First aid box	2
65.	Sledge Hammer	2
66.	G. Clamps - assorted	10
67.	Self grip pliers - assorted	6
68.	Magnetic clamp	3
69.	Flatters	2
70.	Molegrip	2

CURRICULUM AND COURSE SPECIFICATIONS FOR NATIONAL VOCATIONAL CERTIFICATE IN WELDING AND FABRICATION

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