NATIONAL VOCATIONAL TRAINING INSTITUTE

TESTING DIVISION

TRADE TESTING REGULATIONS AND SYLLABUS

TRADE : WELDING AND FABRICATION

LEVEL: CERTIFICATE TWO

CERTIFICATE TWO

A. INTRODUCTION

i. The review of this syllabus has been generally influenced by the demands of industries due to its continuous change as a result of technological advancement and the changing needs of society.

It was also influenced by the TVET reforms under the directions of the new educational reforms with the view to opening up further education and training opportunities to TVET graduates. The certificate TWO syllabus is designed to respond to the following level descriptors:

QUALIFICATION	KNOWLEDGE LEVEL	SKILLS AND ATTITUDE:
Certificate II	1. To demonstrate broad knowledge base with substantial depth in area(s) of study. 2. To demonstrate a command of analytical interpretation of range of data. 3. To present results of study accurately and reliably.	1. Needs varied skills and competencies in different tasks under various contexts. 2. Require a wide range of technical and supervisory skills. 3. Would be employed in different contexts.

ii. Knowledge in the safe use of welding tools, equipment, materials, pipes, sheet metals, thick metals, fabrication of basic structures. Heat source (Chemical and Electrical) arc and gas welding, TIG, MIG welding and other welding processes, trade drawing, trade science and calculation.

B. THE GENERAL OBJECTIVE

On completion of this course, the trainee should be able to understand and apply;

i) the composition and properties of metals (Ferrous, non-ferrous).
ii) the correct usage and handling of Welding Tools and equipment. (Mig & Tig)
iii) the basic safety regulations to be observed in the Welding environment.
iv) step by step assembling of the MIG welding equipment.
v) the identification and usage of workshop tools and equipment.
vi) the safety precautions to be observed when using TIG/MIG welding equipment.
vii) the principles of the MIG Welding set-up.
viii) the basic principles of Arc Welding operations.
ix) basic principles of lighting the Welding blow pipe and adjusting the various welding flames. That is (Oxidizing, Carburizing, Neutral).
x) the basic principles of starting MIG welding processes.
xi) the principles of edge preparation (MIG and TIG).
xii) basic TIG welding operations.
xiii) trade science and calculations related to welding trades/profession

C. THE COURSE COMPONENTS

Trade Theory
Science and Calculation
Trade Drawing
General Paper
Trade Practical

EXAMINATION: The candidates would be examined in the FIVE components listed in 'C' above.

Practical work must be carefully planned to illustrate application of the theory and to provide maximum opportunity for shop practice, laboratory work and demonstration.

D. KNOWLEDGE AND SKILLS REQUIREMENT

The prime objective of the programme is to provide knowledge and skills of the trade in a manner that will best meet the needs of the trade as well as industries using professional equipments

E. ENTRY TO THE COURSE

Minimum education: Must have passed the Certificate One (I) examination.

F. ELIGIBILITY FOR ENTRY TO EXAMINATION

Candidates may enter for examination only as internal candidates. That is, those who at the time of entry to the examination are undertaking (or have already completed the course at an approved establishment) and has successfully passed the certificate One (1).

G. EXTERNAL EXAMINERS

The practical work of candidates will be assessed by an external examiner appointed by the Testing Commissioner.

H. EXAMINATION RESULTS AND CERTIFICATES

Each candidate will receive record of performance given the grade of performance for the components Taken. These are:

i) Distinction
ii) Credit
iii) Pass
iv) Referred/Failure

Certificates would be issued to candidates who pass in all the components.

NOTE:

All Technical and Vocational trainees who aspire to take advantage of the opportunities opened to them in the educational reforms should NOTE that, for a trainee to progress to certificate Two (2) a pass in Certificate One (1) compulsory.

I. APPROVAL OF COURSE

Institutions or other establishments intending to prepare trainees for the Examination must apply to:

THE COMMISSIONER
TESTING DIVISION
NVTI HEAD OFFICE
P. O. BOX MB 21, ACCRA

K. ACKNOWLEDGEMENT

NVTI wishes to acknowledge the preparatory material done by the team of Experts, which have been incorporated into this syllabus. They are;

Mr. Napoleon Acquaah (C.Ed)
Mr. Thomas Kofi Ahiable (D.Ed)
Mr. Ibrahim Abaari (Licentiateship, Dip)

Government's desire to improve the lot of Technical/Vocational training, which lead to the preparation of this syllabus, is hereby acknowledged.

RECOMMENDED BOOKS:

1. The Science and Practice of Welding, 14th Edition A.C. Davis,
2. Gibson S.W., (1994), Practical Welding Motivate Macmillan Text for Industrial Vocational and Technical Education published by Macmillan Education Limited London
3. Welding and Fabrication Technology by W. Kenyon, Pitman Books Limited.

OXY-FUEL GAS WELDING – TOOLS AND EQUIPMENT

1. Oxygen and fuel gas cylinders
2. Welding blowpipes
3. Nozzles
4. Hoses
5. Tip cleaners
6. Safety glasses
7. Friction lighter
8. Chipping hammer
9. Wire brush
10. Pliers
11. High top boots
12. Leather aprons and jackets

METAL ARC WELDING

1. A.C. and D.C. welding transformers
2. Welding helmet with filter lens and clear lens
3. Safety boots
4. Cables
5. Leather gloves and aprons
6. Chipping hammers

WELDING CERTIFICATE TWO - TRADE THEORY

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
1.0	SAFETY WHEN WELDING IN A CONFINED SPACE	1.1 Observe the safety regulations required when welding in a confined space.	1.2.1 Identify the appropriate procedure required to weld in a confined space such as tanks, containers etc. to avoid dangers to your health.	1.3.1 Discuss with trainers using the appropriate teaching aids.
2.0.	VENTILATION AND FUME EXTRATION	Understand the harmful effect of welding fumes and the reason for ventilation	Explain types of fumes and their harmful effects on the welder, taking into consideration the possible methods of fume extraction	Discuss with trainees using the appropriate teaching aid
3.0.	SAFETY WHEN WELDING CONTAINER WHICH CONTAINED INFLAMABLE SUBSTANCES	Understand the principles governing the welding of containers which contained inflammable substance	Apply the suitable method of cleaning any container which contained any inflammable substances such as petrol, acetylene oil etc.	Demonstrate for trainees to observe and practice the right thing
4.0.	GAS PRACTICE	Gas velocity	Know the importance of the speed of gases during oxy-acetylene operations, taking into consideration the effects of too high or too low gas velocity	Discuss with trainees using the appropriate teaching aid.
5.0.	GAS PRACTICE	Oxy-Fuel gas cutting process	Understand the working principles of the oxy-fuel gas cutting process: • Exothermic reaction • Speed of travel • Preheating flames • High pressure cutting oxygen	Demonstrate to trainees using the appropriate teaching aid

WELDING CERTIFICATE TWO - THEORY

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
6.0.	ARC GAS	Welding of Dissimilar metals	Understand the problems encountered when welding dissimilar metals and identify the possible methods of welding them effectively.	Discuss with trainees using any appropriate teaching aids.
7.0.	ARC GAS	Hard Surfacing	Understand the purpose of hand-surfacing and identify the three (3) types of wear i.e. abrasion, impact and corrosion. And take into consideration the suitable filler metals for welding	Demonstrate to trainees using the appropriate teaching aids.
8.0.	ARC GAS	Welding of Cast Iron	Understand the major problems facing the welding of cast-iron i.e oxidation, cracking and loss of alloying elements. And apply the suitable means of welding them successfully. • Preheating and post heating • Suitable fluxes • Silicon rich fuller metals etc.	Demonstrate to trainees using the appropriate teaching aids
9.0.	GAS PRACTICE	Gouging Process	Understand the purpose of gouging metals and two basic methods of gouging i.e spot and progressive	Demonstrate to trainees using the appropriate teaching aids

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
10.0	GAS/ARC PRACTICE	WELDING OF PIPES	Know the types of pipes • Edge preparations require in pipe welding • Procedure required in pipe welding • Tools and equipment used for marking out, holding and cutting of pipes • Difficulties involved and the types of electrodes used in welding pipes	Demonstrate to trainees using the appropriate medium.
11.0 .	GAS/ARC PRACTICE	Build up of Worn-Out Parts	Apply the suitable technique required to carry out a repair on a worn out machine parts such as shafts etc.	Demonstrate to trainees using the appropriate technology
12.0	TIG/MIG PRACTICE	Set up of TIG/MIG Welding Equipment	Understand the steps-by-step procedure required to assemble the TIG/MIG welding equipment	Discuss with trainees using the appropriate teaching aids

WELDING CERTIFICATE ONE - TRADE THEORY

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
13.0	TIG/MIG PRACTICE	Functions of the TIG?MIG Welding Equipment/Tools and Accessories	State the basic tools and equipment used in TIG/MIG welding operation and explain their functions: • Flow meter • Welding gun • Wire feed unit • Inert gases • Etc.	Discuss with trainees using the appropriate teaching aids
14.0	TIG/MIG PRACTICE	The TIG/MIG Welding Process	Explain how to perform the TIG/MIG welding operation taking into consideration the following; • Heat source • Choice of power source i.e. AC/DC • Choice inert gas • Etc.	Discuss with trainees using the appropriate teaching aid
15.0 .	RESISTANCE WELDING PROCESSES	Understand the working principles of SPOT and SEAM welding processes	Explain the spot and seam welding processes respectively	Discuss with trainees using the appropriate teaching aids

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
1.0.	HEAT AND TEMPERATURE	Understand the basic principles of heat and temperature in metal	Explain heat and temperature and their effect on metal. Taking into consideration the following: • Specific watt • Latent heat • Specific heat capacity etc. • Methods of measuring the temperature of metals • Chills • Segar cones • Indirecting crayons • Pyrometers	Discussion method
2.0.	HEAT EFFECTS ON METALS	Understand the effects of heat on the mechanical properties of a metal	Explain the effects of heat on the grain structure of weld metal. • Heat affected zone • Weld zone • Etc.	Discussion
3.0.	HOT AND COLD WORKING	Understand the effects of hot and cold working on metals	Explain the effects of hot work in the grain structure of the weld metal (Enlarged grains) Explain the effects of cold work on the grain structure of the weld metal • Distorted gains)	Discussions

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

TASK		CRITICAL POINT	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
4.0.	FEROUS METALS	Understand the composition and weldability of ferrous metals	State different types of ferrous metals and their composition and weldability etc. • Stainless steel • Low alloy steel	Discussion with trainees
5.0.	NON FERROUS METAL	Understand the composition and weldability of non-ferrous metals	State, differentiate types of non-ferrous metals and their composition and weldability etc. Aluminium Duralumi Brass etc.	Discussions with trainees
6.0.	COEFFICIENT OF LINEAR EXPANSION	Understand the principles of coefficient of linear expansion	Explain the coefficient of linear expansion • Cubic expansion of solid • Superficial expansion of solid (etc)	Discussions with trainees
7.0.	STRESS AND STRAIN	Understand the principles of stress and strain on metals	Explain the changes which occurs in metals as a result of stress and strain • Stress and strain curves • Curic point • Ultimate tensile stress the yield point etc.	Discussions with trainees

CERTIFICATE ONE - TRADE SCIENCE AND CALCULATIONS

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
8.0	INSPECTION AND TESTING OF WELD	Understand the purpose of inspecting and testing of welds	Identify and explain the various methods of testing welds, their application, advantages and disadvantages Destructive Test:- • Bend test • Microscopic and Macroscpopic • Etc. Non-Destructive test:-	Discussions with trainees
9.0	MECHANICAL ENERGY	Understand the basic principles of mechanical energy in regards to welding	Explain the mechanical principles of the following in relation to welding • Power • Work • Energy	Discussions and Demonstration
10.0	BASIC CALCULATION ON ELECTRICITY	Know how to make simple calculation on electricity	Explain the various aspect of electricity and make simple calculations on them. • Current • Voltage • Amperage	Discussions and Demonstration

CERTIFICATE ONE - TRADE DRAWING

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTION TECHNICAL
1.0	DEVELOPMENT	Understand the principles development of geometrical figures	Construct the development of geometrical figures such as cylinders, prisms, hoppers etc.	Demonstrate to trainees using the appropriate teaching aid
2.0	TRUE SHAPE	Identify the true shape of geometrical objects such as prisms, conical, cylindrical shapes	Construct the true shape of cylindrical, conical shapes, etc.	Demonstrate to trainees using the appropriate teaching aids
3.0	ISOMETRIC PROJECTIONS	Understand the principles of isometric projections	Using the isometric projection to draw the pictorial views of solid objects	Demonstrate to trainees using the appropriate teaching aid
4.0	OBLIQUE PROJECTIONS	Understand the principles of oblique projections	Using the oblique projections to draw the pictorial views of solid objects	Demonstrate to trainees using the appropriate teaching aid
5.0.	ORTHOGRAPHIC PROJECTIONS	Understand t he principles of orthographic projections	Know how to apply each method of orthographic projection to show the three basic views of objects (Front, end and plan) • 1st angle projection • 3rd angle projection	Demonstrate to trainees using the appropriate teaching aid.

CERTIFICATE ONE - TRADE DRAWING

TASK		CRITICAL POINTS	SUB-POINTS	INSTRUCTIONAL TECHNIQUE
6.0.	FREEHAND SKETCHES	Know how to sketch simple fabricated structures	Sketch simple fabricated structures such as tables, balustrade, gates, cylinders etc.	Demonstrate to trainees using the appropriate teaching aid.
7.0.	THREE DIMENSIONAL DRAWING	Understand the principles of three dimensional drawing	Make the three dimensional drawing of different shapes	Demonstrate to trainees using the appropriate teaching aids.

CERTIFICATE TWO - TRADE PRACTICALS

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
1.0.	ARC PRACTICE	Basic metal arc cutting processes	Using any arc cutting equipment available to perform the cutting operation on any thick, mild steel plate	Observe trainees to perform the task
2.0.	ARC PRACTICE	Basic metal arc cutting processes	Using any arc cutting equipment available to perform the cutting operation on any other metal apart from mild steel	Demonstrate for trainees to observe
3.0.	ARC/GAS PRACTICE	Hard Surfacing	Understand the process of hand surfacing taking into consideration the three types of wear • Impact • Abrasion • Corrosion	Discuss and demonstrate for trainees

CERTIFICATE TWO - TRADE PRACTICALS

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
4.0.	MIG/TIG	Identification of basic tools and equipment for MIG/TIG welding	Mention the various tools and equipment use in TIG and MIG welding and their usage Flow meter Gun Tungsten electrode wire feed unit. E.g. Flow meter measure and control the flow of shielded gas.	Demonstrate
5.0.	MIG/TIG	Set up of the MIG and TIG welding set	Apply a step by step procedure in assembling the MIG/TIG welding set	
6.0.	GAS PRACTICE	Oxy-fuel gas cutting process	Perform a simple oxy-fuel gas cutting operation taking into consideration factors that contribute to a good cut edge • Condition of the preheating flame • Irregular cutting speed	

CERTIFICATE TWO - TRADE PRACTICALS

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
7.0.	ARC/GAS PRACTICE	Welding of dis-similar metals	Know how to join two dis-similar metals together e.g copper and steel taking into consideration different methods of joining	Demonstration
8.0.	ARC/GAS PRACTICE	Welding of cast iron	Understand the principles of welding cast iron taking into consideration the procedure which will lead to a successful weld: • Preheating • Post heating • Selecting the suitable filler metal (electrode/filler rod) • Silicon based • Bronze or brass	
9.0.	ARC AND GAS	Build up of worn-out parts	Understand the principles and procedure required to weld worn-out parts bearing in mind the effects of heat build up which causes distortions	Demonstrate for trainees to observe and practice

CERTIFICATE TWO - TRADE PRACTICALS

TASK		CRITICAL SKILLS	SUB-SKILLS	INSTRUCTIONAL TECHNIQUE
10.0	TIG/MIG PRACTICE	Starting and maintaining the arc	Know how to start and maintain the arc using the TIG/MIG equipment and take into consideration, the timing of the trigger which regulates the flow of gas and wire speed.	Demonstrate for trainees to observe and practice
11.0	TIG/MIG PRACTICE	Setting the wire speed and the flow of inert gas.	Mark a straight line on a 5mm mild steel plate and ay a straight bead using the MIG/TIG equipment.	Demonstrate for trainees to observe and practice.
12.0	TIG/MIG PRACTICE	Laying a straight bead on a 5mm mild steel plate.	Know how to select the suitable speed for wire and to regulate the flow of inert gas before welding with MIG equipment.	Demonstrate for trainees to observe and practice.
13.0	TIG PRACTICE	Sharpening the tip and occasional maintenance of the tungsten electrode.	Know how to sharpen tie and occasionally maintain the non consumable tungsten electrode used in TIG welding operations	Demonstrate for trainees to observe and practice.
14.0 .	TIG/MIG PRACTICE	Joining a simple square butt joint on a 2mm mild steel plate by a flat position.	Prepare two pieces of a 2mm mild steel plates and welding in a flat position, using the TIG/MIG equipment.	Demonstrate for trainees to observe and practice.

LEVEL – CERTIFICATE ONE – TEST SPECIFICATION TABLE
TRADE DRAWING

NO	TOPIC	COGNITIVE KNOWLEDGE	AFFECTIVE UNDERSTANDING	PSYCHOMOTOR APPLICATION	TOTAL
1.		1	2	2	4
2.		1		3	3
3.		1	1	2	3
4.		2		2	4
5.		1	2	2	5
6.		1	2	2	6
7.					25