MINISTRY OF EDUCATION

Republic of Ghana

TEACHING SYLLABUS FOR METALWORK
(SHS 1 - 3)

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TEACHING SYLLABUS FOR METALWORK

RATIONALE FOR TEACHING METAL WORK

Development in most countries shows that nations that produce new tools and machinery are leading not only in the production of goods and services, but that their people also have high living standards. The relationship between a nation's ability to develop new tools for work and the living standards of its people indicates that high levels of development could be attained if a major portion of the young people of a nation could progressively be trained in science and technology toward the ultimate aim of increasing the manufacturing capacity of the nation.

Metalwork is a subject that deals with basic elements of Mechanical Engineering. The skills acquired in the subject provide the foundation for developing basic engineering solutions to simple problems in the home, school and community. The subject therefore offers the student the chance to acquire valuable skills that open up a wide range of opportunities for employment and productive work.

GENERAL AIMS:

The subject is designed to help the student to:

- use hand and machine tools in the workshop to produce simple work pieces
- identify simple metalwork/agricultural/industrial problems and suggest possible solutions
- demonstrate knowledge and understanding of materials used in the workshop
- apply the principles of logical planning in the manufacture of items in the workshop
- observe safety precautions in the workshop
- adopt basic processes for the care, repair and preventive maintenance of hand and machine tools.
- apply moral principles in working

SCOPE OF CONTENT

The scope of metalwork provides adequate foundation for students who will pursue further education in the subject. The course also offers enough knowledge and skills for students terminating their education at the end of Senior High School to help them to be able to set up metal work enterprises after some amount of apprenticeship training.

The course covers the following:

i. Safety measures in the workshop
ii. Bench work tools and their uses
iii. Designing and making articles
iv. The use of appropriate materials for selected jobs.
v. Machine tools and their operation.
vi. Methods of joining metals and their fasteners
vii. Casting of items
viii. Surface protection (Finishing)

PRE-REQUISITE SKILLS AND ALLIED SUBJECTS

The metal work course builds on many aspects of the course in Basic Design and Technology offered at the Junior High School level. Students offering the Metal Work option should have had good performance in English, Mathematics and in Basic Design and Technology. Satisfactory literacy and numeracy skills as well as basic knowledge and skills in drawing and designing are important for success in this subject.

ORGANIZATION OF THE SYLLABUS

The syllabus has been structured to cover three years of the Senior High School Programme. Each year's work consists of a number of sections with each section comprising a number of units. The structure of the syllabus is presented below.

STRUCTURE AND ORGANIZATION OF THE SHS METALWORK

SHS 1	SHS 2	SHS 3
SECTION 1: GENERAL SAFETY Unit 1: Potential sources of accidents in the workshop Unit 2: Personal safety in the workshop	**SECTION 1: MATERIALS (II)** Unit 1: Non-ferrous metals Unit 2: Non-ferrous alloys	**SECTION 1: MATERIALS (III)** Unit 1: Plastics Unit 2: Alloy steels
SECTION 2: BENCHWORK AND TOOLS Unit 1: Measuring tools Unit 2: Marking out tools Unit 3: Holding tools Unit 4: Striking tools Unit 5: Removing tools	**SECTION 2: SHEET METALWORK** Unit 1: Basic Tools and equipment for sheet metalwork Unit 2: Joints in sheet metalwork (Seams)	**SECTION 2: HEAT TREATMENT** Unit 1: Heat treatment of plain carbon steel
SECTION 3: CUTTING TOOLS AND THEIR USES Unit 1: Files and filing Unit 2: Hacksaws and sawing Unit 3: Chisels and chiseling	**SECTION 3: BEATEN METALWORK** Unit 1: Tools and equipment for beaten metalwork Unit 2: Processes in beaten metalwork	**SECTION 3: FINISHES** Unit 1: Metal finishes
SECTION 4: METHODS OF JOINING METAL (I) (SOLDERING) Unit 1: Soft soldering Unit 2: Hard Soldering	**SECTION 4: METHODS OF JOINING METAL (I) (RIVETING)** Unit 1: Tools and equipment for riveting Unit 2: Types of riveted joints	

SHS 1	SHS 2	SHS 3
SECTION 5: MATERIALS (I) Unit 1: Ferrous metals	**SECTION 5: METHODS OF JOINING METAL (II) (GAS AND ELECTRIC ARC WELDING)** Unit 1: Tools and equipment for welding Unit 2: Welding operations	
SECTION 6: HAND FORGING Unit 1: Hand forging tools and equipment Unit 2: Hand forging operations	**SECTION 6: FOUNDRY WORK** Unit 1: Sand Casting	
SECTION 7: MACHINE TOOLS (I) Unit 1: Off-hand grinding machine Unit 2: Drilling machines Unit 3: Twist drills	**SECTION 7: SCREW THREADS** Unit 1: Types of screw threads Unit 2: Taps and tapping Unit 3: Dies and diesing	
SECTION 8: COOLANTS Unit 1: Cutting fluids	**SECTION 8: MACHINE TOOLS (II)** Unit 1: Centre Lathe Unit 2: Shaping machine	
	SECTION 9: DESIGN AND MAKING Unit 1: identifying the problem Unit 2: Generating possible solutions (Exploring) Unit 3; Making the artefact Unit 4: Evaluating and Modifying the artefact	

TIME ALLOCATION

Metalwork is allocated Six (6) periods a week in each of the three years of Senior High School. Each period has a duration of 40 minutes.

Year	No. of periods per week	No. of teaching weeks/year	Total periods in a year	Total hours in a year
1	6	36	216	144
2	6	36	216	144
3	6	24	144	96
Total	18	108	576	384

SUGGESTIONS FOR TEACHING THE SYLLABUS

Read this section very carefully to be able to follow the sequence of steps and processes prescribed for effective teaching and learning.
Teachers should identify resource persons who will assist them to teach some of the topics they may find difficult to teach. Classroom activities should be supplemented with field trips to workshops in the community. The school should acquire some vital items for teaching this subject and should also form good relationship with a workshop or industry with machinery in the community where students could be taken periodically for observation and practical work.

General Objectives

General Objectives have been listed at the beginning of each section of the syllabus, that is, just below the theme of the section. . The general objectives specify the skills and behaviours the student should acquire after learning the units of the section. The general objectives form the basis for the selection and organization of the unit topics. Read the general objectives very carefully before you start teaching. After teaching all the units, go back and read the general aims and general objectives again to be sure you have covered both of them adequately in the course of your teaching.

Sections and Units: Each section of the syllabus is divided into units, where a unit consists of a body of knowledge and skills that form a logical aspect of the section.

Column I - Units: The Units in Column 1 provide the major topics of the section. You are expected to follow the unit topics according to the linear order in which they have been presented. However, if you find at some point that teaching and learning of a unit will be more effective if you branched to another unit before coming back to the unit in the sequence you are encouraged to do so.

Column 2 - Specific Objectives: Column 2 shows the Specific Objectives for each unit. The 'specific objectives begin with numbers such as 1.2.2 or 2.2.1. These numbers are referred to as "Syllabus Reference Numbers. The first digit in the syllabus reference number refers to the section; the second digit refers to the unit, while the third digit refers to the rank order of the specific objective. For instance, 1.2.2 means: Section 1, Unit 2 (of Section 1) and Specific Objective 2. In other words, 1.2.2 refers to Specific Objective 2 of Unit 2 of Section 1. Similarly, the syllabus reference number 2.2.1 simply means Specific Objective number 1, of Unit 2 of Section 2.

You will note also that specific objectives have been stated in terms of the students i.e. "*what the student will be able to do after instruction and learning in the unit.* Each specific objective hence starts with the following: "The student will be able to.." This in effect, means that you have to address the learning problems of each individual student. It means individualizing your instruction as much as possible such that the majority of students will be able to master the objectives of each unit of the syllabus.

As has been said already, the order in which the unit topics appear should not necessarily be the teaching order. There should however, be a linkage in the order in which the units and specific objectives are treated. The teacher will have to study the syllabus carefully and plan ahead the activities the students will carry out during a particular lesson. Knowing the requirements of a lesson, the teacher should assemble the tools and materials required for the activities well in advance. The collection of tools and materials must be done by both the teacher and students. Other regular materials may be continually collected and stored to be used when needed. When materials are not available in the school or in the immediate environment, the teacher should try to contact persons in higher institutions and in the community for help.

As students begin work on activities of each lesson, the teacher should serve as a facilitator and motivate the students in various ways to sustain their interest. As much as possible, resource persons may be invited to carry out demonstrations and talk about their work to the class. Field trips may be organized to the community for students to see artisans in metalwork producing different artefacts.

Column 3 - Content: The "content" in the third column of the syllabus presents a selected body of information that you will need to use in teaching the particular unit. In some cases, the content presented is quite exhaustive. In some other cases, you could add more information to the content presented. In any case, try to find more information through reading and personal investigations to add to the content provided. The use of resource persons will in many cases, help to provide your class with more information and skills. The column also suggests tools and materials that can be used for the unit or lesson.

Column 4 -Teaching and Learning Activities (T/LA): T/LA that will ensure maximum student participation in the lessons is presented in Column 4. The teaching of this subject should be activity oriented. The major portion of class work and other assignments should emphasize practice. Group work and other participatory methods should be emphasized in the teaching and learning process. In this particular subject, students are expected to acquire valuable basic practical skills to serve as a foundation for further skill development. Observe and also ensure that students exhibit skills and positive values of honesty, cooperation etc, in their behaviour and in creative activities.

Column 5 - Evaluation: Suggestions and exercises for evaluating the lessons of each unit are indicated in Column 5. Evaluation exercises can be in the form of oral questions, quizzes, class assignments, project work; etc. Try to ask questions and set tasks and assignments that will challenge your students to apply their knowledge to issues and problems, and that will engage them in creating new and original items, and developing positive attitudes as a result of having undergone instruction in this subject. Evaluation should also include observation of processes students go through in performing various activities, and the products students make. Processes and products are both equally important and need observation and correction. The suggested evaluation tasks are not exhaustive. You are encouraged to develop other creative evaluation tasks to ensure that students have mastered the instruction and behaviours implied in the specific objectives of each unit.

Lastly, bear in mind that the syllabus cannot be taken as a substitute for lesson plans. It is therefore necessary that you develop a scheme of work and lesson plans for teaching the units of this syllabus.

PROFILE DIMENSIONS

Profile dimensions describe the underlying behaviours or abilities students are expected to acquire as a result of having gone through a period of instruction. Each of the specific objectives in this syllabus contains an action verb that specifies the type of learning or skill that the student should acquire by the end of the instructional period. A specific objective is as follows: The student will be able to describe …etc. contains an action verb "describe" that indicates what the student will be able to do after teaching and learning have taken place. Being able to "describe" something after the instruction has been completed means that the student has acquired "knowledge". Being able to explain, summarise, give examples, etc. means that the student has understood the lesson taught. Similarly, being able to develop, plan, construct, make etc. means that the student has learnt to create, innovate or synthesize knowledge. Each of the action verbs in the specific objectives of the syllabus describes the behaviour the student will be able to demonstrate after the instruction. "Knowledge", "Application", etc. are dimensions that should be the prime focus of teaching, learning and assessment in schools.

Profile dimensions describe the underlying behaviours for teaching, learning and assessment. Metalwork is a practical subject and the learning required is best achieved by practical application of skills learnt. The profile dimensions required in this subject and their respective weights are as follows:

Knowledge and Understanding	10%
Application of Knowledge	30%
Attitudes and Practical Skills	60%

Each of the dimensions has been given a percentage weight that should be reflected in teaching, learning and testing. The weights, indicated on the right of the dimensions, show the relative emphasis that the teacher should give in the teaching, learning and testing processes. Combining the three dimensions in the teaching and learning process will ensure that metal work is taught and studied not only at the cognitive level, but will also lead to the acquisition of practical skills in the subject.

The explanation of the key words involved in each of the profile dimensions is as follows:

Knowledge and Understanding (KU)

Knowledge	The ability to: remember, recall, identify, define, describe, list, name, match, state principles, facts and concepts. Knowledge is simply the ability to remember or recall material already learned and constitutes the lowest level of learning.
Understanding	The ability to: explain, summarise, translate, rewrite, paraphrase, give examples, generalise, estimate or predict consequences based upon a trend. Understanding is generally the ability to grasp the meaning of some material that may be verbal, pictorial, or symbolic.

Application of Knowledge (AK)

Ability to use knowledge or apply knowledge, as implied in this syllabus, has a number of learning/behaviour levels. These levels include application, analysis, innovation or creativity, and evaluation. These may be considered and taught separately, paying attention to reflect each of them equally in your teaching. The dimension "Use of Knowledge" or “application of knowledge” is a summary dimension of all four learning levels. Details of each of the four sub-levels of the dimension are as follows:

Application	The ability to: apply rules, methods, principles, theories, etc. to concrete situations that are new and unfamiliar. It also involves the ability to produce, solve, operate, plan, demonstrate, discover etc.
Analysis	The ability to: break down materials into its component parts; to differentiate, compare, distinguish, outline, separate, identify significant points etc, recognize unstated assumptions and logical facilities, recognize inferences from facts etc.
Innovation/Creativity	The ability to: Synthesize or put parts together to form a new whole. It involves the ability to combine, compile, compose, devise, suggest a new idea or possible ways, plan, revise, design, organize, create, and generate new solutions. The ability to create or innovate is the highest form of learning. The world becomes more comfortable because some people, based on their learning, generate new ideas, design and create new things.
Evaluation	The ability to: Appraise, compare features of different things and make comments or judgments, contrast, criticize, justify, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some materials, ideas etc., based on some criteria and standards. Evaluation is a constant decision making activity. We generally compare, appraise and select throughout the day. Every decision we make involves evaluation. Evaluation is a high level ability just as application, analysis and innovation or creativity since it goes beyond simple knowledge acquisition and understanding.

Practical Skills (PS)

Practical skills involve demonstration of manipulative skills using tools/equipment and materials to carry out practical operations. The teaching and assessment of practical skills should involve projects and creative practical tasks.

"Attitudes and Practical Skills" is given 60 per cent of the teaching, learning and testing time to emphasize the point that Metalwork is more toward the acquisition of practical skills at the SHS level. The remaining 40 per cent can be used for theoretical aspect involving acquisition of knowledge and understanding.

Skills required for effective practical work are the following:

1. Handling Tools/Equipment/Materials
2. Observation
3. Craftsmanship/Draftsmanship
4. Perception
5. Creativity
6. Communication

Tools/Equipment/Material Handling: Students should be able to handle and use tools/equipment/materials properly for practical work to acquire the needed manual skills.

Observation: The student should be able to use his/her senses to make accurate observation of skills and techniques during demonstrations. The student in this case should be able to imitate the techniques he/she has observed for performing other tasks.

Craftsmanship/Draftsmanship: This involves the skilful and efficient handling of materials and tools for accomplishing specific tasks according to the level of the students.

Perception: The student should be able to respond to his/her environment using all the senses i.e. seeing, hearing, smelling, touching and tasting. The student should be encouraged to apply these senses to every project he/she undertakes.

Originality/Creativity Students should be encouraged to be creative or original and be able to use new methods in carrying out projects. Encourage them to be original in making works of art and not copy existing work. You can help them to be creative and original by encouraging any little creative effort, technique and product they may develop.

Communication: Students should be guided to develop effective oral and written communication skills necessary for group work, reporting and appreciation etc.

The action verbs provided under the various profile dimensions should help you to structure your teaching such as to achieve the set objectives. Select from the action verbs provided for your teaching, in evaluating learning before, during and after the instruction.

Pre-imaging

In design and making, students are required to pre-image their solutions, do an illustrative drawing and specifications before making the artefact or product. Pre-imaging is a process of visualizing alternative product solutions, putting the visual images down on paper in the form of drawings, selecting the most suitable product solution before making. Production of good quality products should always start with the process of pre-imaging.

FORM OF ASSESSMENT

It must be emphasized again that it is important that both instruction and assessment be based on the profile dimensions of the subject. In developing assessment procedures, select specific objectives in such a way that you will be able to assess a representative sample of the syllabus objectives. Each specific objective in the syllabus is considered a criterion to be achieved by the student. When you develop a test that consists of items or questions that are based on a representative sample of the specific objectives taught, the test is referred to as a "Criterion-Referenced Test". In many cases, a teacher cannot test all the objectives taught in a term, in a year etc. The assessment procedure you use i.e. class tests, home work, projects etc. must be developed in such a way that it will consist of a sample of the important objectives taught over a period.

The example on the next page shows an examination consisting of two papers, Paper 1 and Paper 2. Paper 3 will be the School Based Assessment (SBA) which is not shown in the table. Paper 1 will consist of objective-type items, structured questions and drawing and designing. Paper 2 will consist of project work and practical test. The SBA will be based on all three dimensions as indicated. The distribution of marks for the objective test items, structured questions and the practical test should be in line with the weights of the profile dimensions already indicated and shown in the last column of the table on the next page.

The weighting of examination marks will be done in accordance with the suggested table above. Paper 1 will have two sittings. Paper 1A and 1B which will comprise the multiple choice (objectives) and the structured questions respectively and will be taken at one sitting. Paper 1C will comprise the second sitting and will involve Drawing and Designing.

Paper 2 will comprise project work and the practical examination. Paper 1A, 1B and 1C will therefore carry a total of 100 marks which will be scaled down to 40%: 10 marks for the objective test, 10 marks for the structured test paper and 20 marks for Drawing and Designing paper. Paper 2 will comprise the project work and practical test. It will attract a total of 100 marks which will be scaled down to 60%. 20% for project work which will be internally assessed on termly basis whereas the practical examinations will have 40% which will be externally assessed.

WEIGHTING OF EXAMINATION PAPERS

	PAPER 1			PAPER 2		Weights
Dimensions	**A Objectives**	**B Structured/Essay**	**C Drawing and Designing**	**Project**	**Practical**	
Knowledge and Understanding (KU)	10%	-	-	-	-	10%
Application of Knowledge (AK)	-	10%	20%	-	-	30%
Practical Skills (PS)	-	-	-	20%	40%	60%
Total	40%			60%		100%

CRITERIA FOR ASSESSING PRACTICAL PRODUCTS: The marks allocated for practical products should be awarded using these guidelines:

Originality	-	30%
Design	-	30%
Craftsmanship	-	40%

Where a practical product is marked out of 20, 30% of the marks, that is six points, should be allocated to originality, six points to design and the remaining eight points allocated to craftsmanship.

GUIDELINES FOR SCHOOL-BASED ASSESSMENT (SBA)

A new School Based Assessment system (SBA) will be introduced into the school system in 2011. The new SBA system is designed to provide schools with an internal assessment system that will help schools to achieve the following purposes:

- Standardize the practice of internal school-based assessment in all Senior High Schools in the country
- Provide reduced assessment tasks for subjects studied at SHS
- Provide teachers with guidelines for constructing assessment items/questions and other assessment tasks
- Introduce standards of achievement in each subject and in each SHS class
- Provide guidance in marking and grading of test items/questions and other assessment tasks
- Introduce a system of moderation that will ensure accuracy and reliability of teachers' marks
- Provide teachers with advice on how to conduct remedial instruction on difficult areas of the syllabus to improve class performance.

The arrangements for SBA may be grouped in categories as follows: Folio preparation, Project, Mid-Term Examination, Group Exercise, and End of Term Examinations.

1. Folio Preparation: These are tasks assigned to students to be completed in extended time. Folio preparation may include the following:
   i) Specific Designs
   ii) Investigative Study and Field visit reports.

2. Project: This will consist of a selected topic to be carried out by groups of students for a year. Segments of the project will be carried out each term toward the final project completion at the end of the year,

   The projects may include the following:
   i) experiment
   ii) investigative study (including case study)
   iii) practical work assignment

   A report must be written for each project undertaken.

3. Mid-Term Test: The mid-term test following a prescribed format will form part of the SBA

4. Group Exercise: This will consist of written assignments or practical work on a topic(s) considered important or complicated in the term's syllabus

5. End-of-Tem Test: The end –of-term test is a summative assessment system and should consist of the knowledge and skills students have acquired in the term. The end-of-term test for Term 3 for example, should be composed of items/questions based on the specific objectives studied over the three terms, using a different weighting system such as to reflect the importance of the work done in each term in appropriate proportions. For example, a teacher may build an End-of-Term 3 test in such a way that it would consist of the 20% of the objectives studied in Term 1, 20% of objectives studied in Term 2 and 60% of the objectives studied in Term 3.

GRADING PROCEDURE

To improve assessment and grading and also introduce uniformity in schools, it is recommended that schools adopt the following WASSCE grade structure for assigning grades on students' test results.

Grade A1:	80 - 100%	-	Excellent
Grade B2:	70 - 79%	-	Very Good
Grade B3:	60 - 69%	-	Good
Grade C4:	55 - 59%	-	Credit
Grade C5:	50 - 54%	-	Credit
Grade C6:	45 - 49%	-	Credit
Grade D7:	40 - 44%	-	Pass
Grade D8:	35 - 39%	-	Pass
Grade F9:	34% and below	-	Fail

In assigning grades to students' test results, you are encouraged to apply the above grade boundaries and the descriptors which indicate the meaning of each grade. The grade boundaries i.e., 60-69%, 50-54% etc., are the grade cut-off scores. For instance, the grade cut-off score for B2 grade is 70-79% in the example.

When you adopt a fixed cut-off score grading system as in this example, you are using the criterion-referenced grading system. By this system a student must make a specified score to be awarded the requisite grade. This system of grading challenges students to study harder to earn better grades. It is hence a very useful system for grading achievement tests.

Always remember to develop and use a marking scheme for marking your class examination scripts. A marking scheme consists of the points for the best answer you expect for each question, and the marks allocated for each point raised by the student as well as the total marks for the question. For instance, if a question carries 20 marks and you expect 6 points in the best answer, you could allocate 3 marks or part of it (depending upon the quality of the points raised by the student) to each point , hence totaling 18 marks, and then give the remaining 2 marks or part of it for organisation of answer. For objective test papers you may develop an answer key to speed up the marking.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 1

GENERAL SAFETY

General Objectives: The student will:

1. be aware of potential sources of accident in the workshop
2. observe safety rules and regulations in the workshop

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **POTENTIAL SOURCES OF ACCIDENTS IN THE WORKSHOP**	The student will be able to: 1.1.1 identify potential sources of accidents.	<u>Potential sources of accidents</u> - revolving machine parts without guards. - defective tools e.g. loose hammer heads. - slippery floors - exposed, uninsulated electric wires.	Assist students to discuss the various sources of accidents at the workshop.	Students to: identify the various sources of accidents in the metal workshop.
	1.1.2 demonstrate the correct safety measures	<u>Measures to avoid accidents</u> - avoid using machines with revolving parts without guards. - use well fitted hand tools - avoid slippery floors - electric wires must be well insulated and covered.	Guide students to discuss the various ways of avoiding accidents in the workshop Demonstrate the right safety measures for students to observe.	demonstrate the principles for preventing accidents in the workshop.
UNIT 2 **PERSONAL SAFETY IN THE WORKSHOP**	1.2.1. identify personal safety clothing available.	<u>Safety clothing</u> - goggles - apron - gloves - boots with hard toe caps - helmet etc.	Display safety clothing and assist students to identify and use the various safety clothing for workshop activities.	use the personal safety clothing and state relevant uses.
	1.2.2 identify and explain the various general safety rules and regulations in a workshop environment	<u>Workshop safety rules and regulations</u> - do not start any machine at the workshop without permission - do not obstruct the gangways - do not distract your neighbours attention when he/she is working - do not be over-confident when using any machine.	Using charts or illustration assist students to discuss the reasons for various general workshop safety rules.	explain the general workshop safety rules.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 2

BENCHWORK AND TOOLS

General Objectives: The student will:

1. acquire knowledge, skills and attitudes for safe use of bench work tools
2. be aware of the characteristics and uses of different bench work tools and equipment.
3. use the various bench work tools appropriately

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **MEASURING TOOLS**	The student will be able to: 2.1.1 identify types of measuring tools and the uses.	<u>Measuring tools</u> <u>linear measuring tools:</u> - steel rule - depth gauge - tape measure - vernier calipers - micrometer (inside/ outside) - outside and inside calipers <u>Angular measuring tools</u> - vernier protractor - combination set. - sliding bevel.	Show samples of measuring tools and help students to identify and discuss their uses.	Students to: identify types of linear and angular measuring tools.
	2.1.2 sketch and label the measuring tools.	Sketching and labeling the measuring tools.	Assist students to sketch and label measuring tools.	sketch and label metalwork measuring tools.
	2.1.3 apply the right techniques for handling measuring tools.	Using the measuring tools and equipment safely.	Demonstrate the right technique for safe handling and use of the various measuring tools for students to observe and practise	
	2.1.4 care and maintenance of measuring tools.	Maintaining the tools and equipment.	Demonstrate how to care for and maintain the tools for students to observe. Students to clean, oil/grease tools after use.	demonstrate how to care for and maintain the tools.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **MARKING OUT TOOLS**	The student will be able to: 2.2.1 identify the various marking-out tools and their uses.	<u>Marking - out tools</u> - dot punch - steel rule - sliding bevel - angle plate - vee blocks - scribing block - surface gauge - a pair of dividers - centre punch - try square - odd-leg caliper - calipers – inside/ outside - scriber - trammels	Display marking-out tools and assist students to identify and learn their uses.	Students to: identify type of marking out tools.
	2.2.2 sketch and label the parts of marking out tools.	Sketching and labeling the marking-out tools	Assist students to sketch and label the various marking-out tools.	sketch and label the marking-out tools.
	2.2.3 handle and use the marking-out tools	Using the tools and equipment for marking out	Demonstrate the right technique for handling and using the marking-out tools for students to observe. Give students practical exercise to enable them practise uses of the tools.	practise the use of the tools appropriately.
	2.2.4 care for and maintain marking-out tools	Maintaining tools and equipment for marking out	Demonstrate the proper way to care for and maintain marking-out tools for students to practice.	show how to care for and maintain tools and equipment. Clean, grease or oil tools after use.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **HOLDING TOOLS**	The student will be able to: 2.3.1 identify the different types of holding tools.	<u>Holding Tools</u> - bench vice - hand vice - G-clamp - chuck: • lathe chucks • drill chucks	Display holding tools and assist students to identify the various kinds of holding tools. Demonstrate the use of tools for students to practise	Students to: identify various types of holding and cutting tools. practise the uses of the various holding tools.
	2.3.2 sketch and label the holding tools.	Parts of the holding tools.	Assist students to sketch and label parts of holding tools and equipment.	sketch and label parts of the tools.
	2.3.3 handle and use the holding tools correctly. .	Handling and using the holding tools.	Demonstrate the right techniques for handling and using the holding tools and equipment for students to observe and practise.	practise the use of the tools and equipment.
	2.3.4 care for and maintain the holding tools	Maintaining the holding tools and equipment.	Demonstrate how to care for and maintain the holding tools and equipment for students to observe. e.g. i. grind off mushroom head chisel. ii. sharpening of cutting edge of blunt chisels.	practise how to care for and maintain tools and equipment.
UNIT 4 **STRIKING TOOLS**				
	2.4.1 identify the various striking tool and their users.	**Types of striking Tools** <u>Engineers' hammers eg</u> - cross pein hammer - straight pein hammer - ball pein hammer <u>Mallets eg:</u> - raw hide mallet - copper mallet - wooden mallet - lead mallet.	Show samples of striking tools and equipment to students and guide them to identify and learn their uses.	identify various type of striking tools and equipment.
	2.4.2 sketch and label the striking tools.		Sketching and labeling the tools and equipment. Guide students to sketch and label the striking tools and equipment.	Sketch and label the tools and equipment.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (Cont'd)	The student will be able to:			Students to:
STRIKING TOOLS	2.4.3 handle and use striking tools	Handling and using striking tools and equipment.	Demonstrate the right technique for handling and using striking tools and equipment for students to observe. Design a chipping exercise for students to perform by using chisel and hammer.	practise the right way of handling and using striking tools and equipment.
	2.4.4 care for and maintain the striking tools	Maintaining the striking tools and equipment	Demonstrate how to care for and maintain the striking tools and equipment for students to observe and practise. e.g. i. repair or replacing loose hammer head / handle. ii. Remoulding of copper and lead hammers.	practise how to care for and maintain tools and equipment.
UNIT 5 **REMOVING TOOLS**	2.5.1 identify the types of removing tools in metal workshop.	<u>Removing tools</u> - drift - spanners • flat • ring • socket • box - chuck key - allen key - screwdrivers • Philips (Star) • flat - screw extractors	Show samples of removing tools to students and assist them to identify and practise using them.	identify removing tools and equipment.
	2.5.2 sketch and label parts of the various kinds of removing tools.	Sketching and labeling the removing tools and equipment.	Assist students to sketch and label parts of removing tools and equipment.	sketch and label removing tools and equipment.
	2.5.3 use the removing tools correctly.	Removing tools and equipment.	Demonstrate the correct and safe use of the removing tools and equipment for students to observe and practice in the workshop.	demonstrate the correct and safe use of the removing tools and equipment.

SECTION 3

CUTTING TOOLS AND THEIR USES

General Objectives: The student will:

1. recognize various types of cutting tools in the metal workshop
2. select appropriate cutting tools for the job.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
FILES AND FILING	3.1.1 identify types of file.	Types of file - flat file - hand file - square file - triangular file - round file - half round file etc.	Display types of file for students to identify.	describe various types of file
	3.1.2 describe the grades of file.	Grades of file - rough - bastard - second cut - smooth cut - dead smooth	Use actual files to discuss the various grades of file and their uses.	sketch the grades of file.
	3.1.3 describe the cuts of a file.	File cuts - single cut (float) - double cut	Group students to discuss the two cuts on a file. (Emphasize angle of inclinations, i.e. 70^{o} for single cut and 50^{o} for the second cut)	sketch single and double cut files indicating angles of inclination for each cut.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The student will be able to:			Students to:
FILES AND FILING	3.1.4 distinguish between cross and draw filing.	Difference between cross and draw filing	Assist students to distinguish between cross and draw filing	distinguish between cross and draw filing
	3.1.5 file pieces of metal	Filing pieces of metal.	Demonstrate the two filing techniques for students to observe and practise.	perform cross and draw filing processes and sketch the methods in their note books.
	3.1.6 explain the terms 'pinning' and de-burring.	<u>Terminologies used in Files and Fling</u> -pinning -de-burring	Discuss the two (2) terminologies using practical examples, e.g. a. use file on mild steel allowing the filings to remain in the teeth and remove them with file card. b. use file on a piece of metal and allow students to feel the burrs at the edges with their fingers and de-burr with the file.	use file card to remove the pinning use the file to remove burrs.
	3.1.7 select the right type of file for a job in hand.	Using the files for filing.	Teacher to design practical exercises which will necessitate the uses of different files.	show with sketches the uses of various files.
	3.1.8 care and maintain files	Care and maintenance of files	**NOTE**: Let students observe how to care for and maintain the files. a. by cleaning with file card when the file is pinned b. storing on racks.	demonstrate the technique of cleaning file when pinned.
UNIT 2 **HACKSAW AND SAWING**	3.2.1 identify types of hacksaw frame.	<u>Types of hacksaw frame</u> - adjustable frame (tubular) - fixed frame - junior hacksaw	Show types of hacksaw frames and assist students to identify them.	describe with sketches types of hacksaw frame.
	3.2.2 identify types of hacksaw blade and their uses.-	<u>Types of hacksaw blade</u> - all – hard - flexible - bi-metal	Using samples of hacksaw blade, assist students to discuss types of hacksaw blades and their uses.	Sketch and describe hacksaw blades

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	The student will be able to:			Students to:
HACKSAW AND SAWING	3.2.3 examine the teeth of a hacksaw blade.	<u>The teeth of hacksaw blade</u> - pitch of saw teeth - set of saw teeth - number of teeth per 25mm	Show hacksaw blade and group students to discuss the pitch of saw teeth and reasons why the teeth are set.	describe with sketches the pitch and set of saw teeth.
	3.2.4 select hacksaw blade for different metals.	<u>Selection of hacksaw blade</u> Coarse pitch for soft metals; Fine pitch for hard metals etc.	Guide students to select the recommended teeth per 25mm for particular jobs giving reasons.	tabulate the recommended teeth per 25mm for various metals and sections
UNIT 3 **CHISELS AND CHISELLING**				
	3.3.1 identify various types of Chisel and their uses.	Types of chisel and their uses - flat chisel chippin - crosscut chisel - half-round chisel oil graces - diamond-point chisel for corners	Display chisels and discuss the various types of chisel with students. Discuss the uses of the various chisels with students.	describe the various types of chisel. sketch and label parts of the various types of chisel.
	3.3.2 use the various types of chisel to perform a task.	Chiseling process	Demonstrate the correct angle of inclination for students to practice.	demonstrate the skills in chiseling.

SECTION 4

METHODS OF JOINING METALS (I)
(SOLDERING)

General Objectives: The student will:
1. recognise the principles of joining metals using soft and hard soldering.
2. acquire the skills of using soft solder and spelter to join metals.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **SOFT SOLDERING**	The student will be able to: 4.1.1 identify the various tools and equipment for soft soldering.	<u>Tools and equipment for soft soldering</u> - soldering bit • straight type • hatchet type - soldering stove/coal pot - solder (tin, lead and antimony) - fluxes -	Display tools and equipment for soft soldering and assist students to identify and discuss their uses.	Students to: identify soft soldering tools and equipment.
	4.1.2 select type of joint for a particular job.	<u>Soft soldered joints</u> - lap joint - butt joint - folded and grooved seam - grooved seam	Using charts assist students to select samples of soft soldered joints emphasizing their particular uses. Students to discuss types of joint that may be used for particular jobs	select types of soft soldered joints and sketch them.
	4.1.3 describe and apply procedure for making a simple soldered joint.	<u>Soft soldering processes</u> - tinning - sweating - floating - tacking	Assist students to discuss and demostrate the various ways of applying soft solder to artefacts. Demonstrate the steps for applying soft solder for students to observe and practise.	practise the methods of applying soft solder to sheet metal.
	4.1.4 make a simple artefact involving a soft soldered joint.	Making an artefact involving soft soldering.	Assist students to make artefacts using soft soldered joints. (Students to work in groups or individually). **Note:** Ensure that students make the surface developments of artefacts they intend to manufacture.	make an artefact involving a soft soldered joint e.g. whistle or ash tray funnel

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2	The student will be able to:			Students to:
HARD SOLDERING	4. 2.1 identify the various hard soldering tools and equipment.	Tools and Equipment for hard soldering - gas torch - flux (borax) - soldering spelter (copper, zinc and silver) - wire brush - fire brick etc	Show picture or real hard soldering tools and equipment and assist students to identify and discuss their uses.	Identify types of hard soldering tools and equipment.
	4.2.2 select types of hard soldered joints appropriately.	Type of hard soldered joints - lap joint - butt joint - folded and grooved seam	Show samples of hard soldered joint and assist students to select and use them appropriately.	select types of hard soldered joint for use
	4.2.3 describe the processes for making a hard soldered joint.	Steps for making a hard soldered joint - prepare pieces to be joined - apply flux to joints - apply heat - apply solder - rinse the joint BRAZING**:** This is a process of joining metals using copper, and zinc alloy called spelter. The process is similar to hard soldering. The difference however is that the melting point of the spelter is higher in this case. Brazing can also be carried out on cast Iron and steel.	Discuss and demonstrate the steps for making a hard soldered joint and assist students to observe and practice. Students in groups or individually to make a hard soldered joint.	outline the steps for making a hard soldered joint.
	4.2.4 make simple hard soldered joints.	Making an artefact involving a hard soldered joint.	Assist students to make artefacts involving a hard soldered joint. Students are to work in groups.	**Project Work:** design and make artefact involving a hard soldered joint and write a report individually or in groups

SECTION 5

MATERIALS (I)

General Objectives: The student will:

1. be aware of the various methods for producing ferrous metals.
2. know the properties of ferrous metals .

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
FERROUS METALS	5.1.1 define ferrous metals	Ferrous metals **NOTE:** Ferrous metals are metals that contain Iron and varying amounts of carbon.	Group students to discuss and explain the nature of ferrous metals.	examine samples of ferrous metals.
	5.1.2 identify types of ferrous metals.	Types of ferrous metal - pig iron - cast iron - wrought iron - steel	Show samples of ferrous metal for students to observe and discuss their uses.	describe types of ferrous metal.
	5.1.3 identify types of plain carbon and alloy steels.	Types of plain carbon and alloy steel - low carbon steel (dead and mild) - medium carbon steel - high carbon steel. - alloy steels (H.S.S., manganese steel, etc)	Display plain carbon and alloy steels and assist students to identify them by colour, texture,spark test, sound test. etc. Students to describe the various types of plain carbon and alloy steel.	describe the various types of plain carbon and alloy steels and state their carbon content and uses.
	5.1.4 explain the various methods of producing ferrous metals.	Methods of ferrous metal production - steel – bessemer converter - steel – open hearth furnace - pig iron – blast furnace - wrought iron –puddling furnace - cast iron – cupola	With the aid of charts and sketches, explain the uses of the various furnaces to produce types of ferrous metals.	describe the production of different kinds of ferrous metals from different furnaces.
	5.1.5 sketch and label steel making furnaces.	Steel making furnace	Assist students to sketch and label steel-making furnaces.	sketch and label steel making furnaces.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 6

HAND FORGING

General Objectives: The student will:

1. recognize forging as useful skill for producing tools.
2. become aware of various tools for specific forging operations.
3. acquire basic skills for hand forging operations.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **HAND FORGING TOOLS AND EQUIPMENT**	The student will be able to: 6.1.1 explain the term forging	Forging	Assist students to discuss forging as a process of heating and shaping metals with tools.	Students to: state examples of forged tools.
	6.1.2 identify hand forging tools and equipment .	<u>Hand forging tools and equipment</u> - the forge /hearth - the poker - the slice - sledge hammer - flatters - fullers - swages - swage block - tongs - the anvil - rake - contraction steel rule etc.	Show samples of tools and equipment for hand forging and help students to identify them. **<u>NOTE:</u>** Emphasize the various shapes of tongs.	identify types of hand forging tools and equipment.
	6.1.3 sketch and label the hand forging tools.	Sketching and labeling the tools and equipment for hand forging.	Assist students to sketch and label the tools and equipment for hand forging.	sketch and label some of the tools and equipment for hand forging.
	6.1.4 handle hand forging tool correctly	Handling and using the tools and equipment	Demonstrate the technique for handling and using the hand forging tools in the workshop for students to observe and practise: e.g. Upsetting, Drawing down, twisting and flattering	practise the use of tools and equipment for hand forging
	6.1.5 care and maintain maintenance forging tools.	Care and maintenance of tools and equipment.	Demonstrate how to care for and maintain hand forging tools and equipment.	demonstrate how to care for and maintain tools and equipment.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **HAND FORGING OPERATIONS**	The student will be able to: 6.2.1 outline the various hand forging operations	<u>Hand forging operations</u> - upsetting - drawing down - flattering - fullering - swaging - bending - twisting - punching	Using pictures or charts assist students to outline the various hand forging operations.	Students to: outline the various hand forging operation.
	6.2.2 describe the various hand forging operations.	Description of hand forging operations	Assist students to describe the various hand forging operations.	explain the hand forging operations.
	6.2.3 perform hand forging operations.	Performing hand forging operations	Demonstrate the various ways of performing some hand forging operations for students to observe and practise.	perform the various hand forging operations.
	6.2.4 design and make a project involving hand forging operations.	Designing making an artefact involving hand forging operations. e.g crowbar, cold chisel, hook and eye, etc	Group students and assist them to design and make articles using operations listed in content column.	**<u>Project Work:</u>** design and make an artefact involving use of some hand forging operations: e.g. crowbar or hook and eye.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 7

MACHINE TOOLS (I)

General Objectives: The student will:

1. be aware of the basic machine tools in the metal workshop
2. be aware of the functions of the machine parts and take the necessary precautions
3. become aware of basic machine tools for performing simple metalwork operations.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
OFF - HAND GRINDING MACHINES	7. 1.1 identify types of off-hand grinding machines.	Types of off-hand grinding machine - pedestal grinding machine - bench grinding machine	Send students to the workshop and assist them to identify the types of off-hand grinding machines.	identify types of off-hand grinding machine.
	7.1.2 identify parts of the off-hand grinding machine.	Parts of off–hand grinding machine - head - tool rest - wheel - wheel guard - perspex shield - stand - switch etc	Help students to identify the parts of the off-hand grinding machine in the workshop.	identify parts of pedestal grinding machine.
	7 .1.3 state the functions of the various parts of off–hand grinding machines.	Functions of the parts off–hand grinding machine.	Assist students to discuss the functions of the various parts of the pedestal grinding machine identified.	state the functions of the parts identified.
	7.1.4. explain some terms associated with grinding and apply them.	Some grinding terms - grit - grade - structure - glazing - loading - dressing - trueing	Group students to discuss terms associated with grinding and apply them.	describe the terms associated with grinding

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **OFF - HAND GRINDING MACHINES**	The student will be able to: 7.1.4 apply safety precautions to the observed during grinding.	<u>Safety measure to be observed when using the grinding machines</u> - wear safety goggles - wear hand gloves - fold long sleeves to elbow - make sure guards are well positioned etc.	Demonstrate how to observe some of the safety measures for students to practise.	Students to: apply safety measures to be observed when grinding.
	7.1.5 perform grinding operations.	Grinding operations	Demonstrate some grinding operations for students to observe and practice.	perform some grinding operations.
UNIT 2 **DRILLING MACHINES**	7.2.1 identify and describe the uses of the types of drilling machine	<u>Types of drilling machine</u> - sensitive drilling machine - pillar drilling machine - portable hand drilling machine	Visit the industry or workshop and assist students to identify types of drilling machine and their uses.	identify types of drilling machine and state their uses.
	7.2.2 identify parts of the drilling machine	<u>Parts of drilling machine</u> - head motor - pulley - spindles - switch - drill chuck - worktable - vice, etc	Students to identify the various parts of the drilling machine.	students to write group report and discuss in class after visit.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	The student will be able to:			Students to:
DRILLING MACHINES	7.2.3 observe safety during drilling operations	Safety precautions to be observed during drilling operations - wear safety – goggles, gloves, boots, etc. - release pressure/feed occasionally - secure workpiece well - light workpiece must be placed on wooden piece - avoid complacency	Demonstrate the safety measures to be observed when using the various types of drilling machines with students. Students to demonstrate how to observe some of the safety measures.	demonstrate safety measures to be observed when using the various types of drilling machine.
	7.2.4 perform simple drilling Operations	Performing simple drilling operations - drilling through holes - drilling holes - drilling blind holes	Demonstrate basic drilling operations for students to observe and practise.	perform basic drilling operation
	7.2.5 identify faults in drilling	Faults in Drilling - unequal point angle - drill point off centre - unequal point angle and point off centre	Group students to discuss faults in drilling.	explain faults in drilling.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3 **TWIST DRILLS**	The student will be able to:			Students to:
	7.3.1 identify types of drill and state their uses	<u>Types of drill</u> - flat drill - centre drill - countersink drill - counterbore drill - straight – fluted drill - twist drill • taper shank • straight/parallel shank	Show types of drill and assist students to identify each of them. Group students to discuss the uses of the various type of drills.	identify types of drills
	7.3.2 select drills and describe their corresponding speeds.	Drill sizes and their corresponding speeds	Assist students to select drills and their corresponding speeds.	select the right drill and its required speed
	7.3.3 sketch and label twist drills	<u>Sketching and labeling twist drills</u> - taper shank - straight/parallel shank	Guide students to sketch and label the twist drills. Group students to discuss the defects as a result of incorrect point angles.	sketch and label twist drills
	7.3.4 examine the various drill hole defects and state their remedies.	Drill hole defects	Group students to discuss the remedies for the various drill hole defects.	sketch and label drill hole defects.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 8

COOLANTS

General Objectives: The student will:

1. appreciate the use of the cutting fluids (coolant).
2. demonstrate knowledge of various metal cutting fluids for particular operations.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
CUTTING FLUIDS (COOLANTS)	8.1.1 identify types of cutting fluids	Types of cutting fluids (coolants) - chemical solutions - straight minerals oils - straight fatty oils - compounded / blended oils emulsified oil	Show types of cutting fluids with students.	list types of cutting fluid and explain their uses.
	8.1.2 explain the functions of cutting fluids	Functions of cutting fluids	Assist students to discuss the functions of cutting fluids	explain the functions of Cutting fluid
	8.1.3 select appropriate cutting fluid for a particular metal cutting operation	Cutting fluids for ferrous and non- ferrous metals /alloys	Assist students to choose the appropriate cutting fluid for a particular job.	select appropriate cutting fluid for a particular metal cutting operation
	8.1.4 mix soluble oil and water using the appropriate ratio	Mixing soluble oil and water	Guide students to mix soluble oil and water using the appropriately ratio.	mix soluble oil and water appropriately

SENIOR HIGH SCHOOL – YEAR 2

SECTION 1

MATERIALS (II)

General Objectives: The student will:

1. be aware of the range of Non-ferrous metals and their alloys
2. be aware of the composition of Non-ferrous metals and their alloys.
3. use knowledge of the properties of Non-ferrous metals appropriately.
4. justify the choice of non-ferrous alloys for a job.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
NON-FERROUS METALS	1.1.1 identify the various non-ferrous metals.	Types non-ferrous metals - aluminium - lead - copper - zinc - tin	Using charts or samples of items made of non-ferrous metals, help students to identify and discuss the various types.	Identify the types of non-ferrous metals. Identify items made of non-ferrous metals
	1.1.2 describe the properties of non-ferrous metals.	Properties of the Non-ferrous metals Aluminium – soft, ductile, silver white, non-corrosive, light grey in colour, good conductor of heat etc. Lead – heavy, low melting point (330 ^{o}C, blue - grey in colour, resist s corrosion, ductile etc. Copper –brownish pink in colour, high electrical and heat conductivity, resists corrosion, forged, alloys with other metals easily.	Assist students to discuss the properties of various non-ferrous metals using charts or real objects.	describe the properties of types of non-ferrous metal.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The student will be able to:			Students to:
NON-FERROUS METALS		Zinc – bluish - grey in colour, low melting point of 420 ^{o}C, corrosion resistant, coating for galvanized steel. Tin – silvery in colour, ductile, malleable, used for coating sheet metal in tin plate production, low melting point of 232 ^{o}C		
UNIT 2				
NON - FERROUS ALLOYS	1.2.1 identify the various non-ferrous alloys.	Non-ferrous alloys - brass - bronze - soft solder - duralumin - pewter	Using samples of non-ferrous alloys, guide students to identify and discuss the various types.	Identify non-ferrous alloys and describe them
	1.2.2 describe the compositions of the various non-ferrous alloys.	Composition of non- ferrous alloys - brass (Copper + Zinc) - bronze (Copper + tin) - soft solder(Lead + tin + antimony) - duralumin (Aluminium + Copper + Silicon + manganese + magnesium + titanium) - pewter (tin + antimony + copper)	Guide students to discuss the compositions of the various types of non-ferrous alloys.	state the composition of the types of non ferrous alloy
	1.2.3 state the characteristics and uses of non-ferrous alloys	Characteristics of non-ferrous alloys: Soft, malleable, hard, hard and resistant to wear and tear etc. Uses of non-ferrous alloys Brass - musical Instruments - water tap - rim latch - mortice lock - hinges etc.	Using real objects assist students to discuss the characteristics and uses of non-ferrous alloys. Guide students to design and make artefacts using the non-ferrous alloys	state the uses of each of the type of the non-ferrous alloys

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **NON- FERROUS ALLOYS**	The student will be able to:	<u>Bronze</u> - gears and bearing in cars and other machines - worm wheel - church bells etc. <u>Soft Solder</u> - soldering sheet metal parts - soldering electrical components etc. <u>Duralumin</u> - engine casing - aeroplane axles <u>Pewter</u> - decorative tableware - casting figures - drinking mug etc	Using samples of articles made of non-ferrous alloys, assist students to identify and discuss uses of non-ferrous alloys	Students to: **<u>Project Work:</u>** design and make an artefact using any of the non-ferrous alloys. write a short note showing the illustrative drawing of the artefact and giving reasons for choosing the particular alloy.

SECTION 2

SHEET METALWORK

General Objectives: The student will:

1. recognise the appropriate tools and equipment for use on sheet metalwork.
2. demonstrate the right techniques for marking out jobs accurately on sheet metal work.
3. plan the solution of an identified problem using sheet metal.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **BASIC TOOLS AND EQUIPMENT FOR SHEET METALWORK**	The student will be able to: 2.1.1 identify basic tools and equipment for sheet metalwork.	<u>Tools and equipment for sheet metalwork</u> - scriber - steel rule - snips - folding bar - funnel stake - hatchet stake - mallet - blow lamp - creasing stake - pipe stake	Display various sheet metalwork tools and equipment and assist students to identify them.	Students to: state the various sheet metalwork tools and equipment.
	2.1.2 sketch and label some basic sheet metalwork tools and equipment.	Sketching and labeling of tools and equipment for sheet metalwork.	Assist students to sketch and label the tools and equipment for sheet metalwork.	sketch and label tools and equipment.
	2.1.3 handle tools and equipment correctly.	Handling tools and equipment.	Demonstrate the right technique for handling tools and equipment for particular jobs and assist students to use tools to work on given exercises.	practise the use of the tools and equipment.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **JOINTS AND PROCESSES IN SHEET METALWORK (SEAMS)**	The student will be able to: 2.2.1 identify the various joints in sheet metal work.	<u>Self secured joints (seams)</u> - paned down bottom joints - knocked up bottom joints - folded grooved seam joint - lap joint - butt joint	Use a chart to show samples of joints and help students to sketch them.	Students to: Sketch metal work joints
	2.2.2 apply the processes involved in sheet metal work.	Processes in sheet metal work	Group students and demonstrate the various processes in sheet metal work and assist students to make simple artefacts.	**<u>Home Work:</u>** design a dustbin or funnel
	2.2.3 design and make a simple artefact involving sheet metal work joints.	Designing and making an artefact involving self secured joints in sheet metalwork. Making an artefact using any of the joints listed above.	Assist students to make simple artefacts. **<u>NOTE:</u>** Students to work individually or in groups	make a dustbin or funnel using any appropriate joints.

SENIOR HIGH SCHOOL – YEAR 2

SECTION 3

BEATEN METALWORK

General Objectives: The student will:

1. understand the principle of beaten metal work
2. apply the principles of beaten metal work to make simple articles.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **TOOLS AND EQUIPMENT FOR BEATEN METALWORK**	The student will be able to: 3.1.1 identify and use tools and equipment for beaten metalwork	<u>Tools and equipment</u> - sand bag - wooden block -stakes . raising stake . horse and stake heads . mushroom head stake etc. -hammers . raising . sinking . hollowing . planishing . collet - folding bar - mallets (bossing)	Using appropriate tools and equipment assist students to identify them.	Students to: Identify the tools and equipment for beaten metalwork.
	3.1.2 sketch tools and equipment for beaten metal work.	Sketching and labeling tools and equipment.	Using illustrations, assist students to sketch and label tools and equipment for beaten metal work.	sketch tools and equipment for beaten metalwork.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **PROCESSES IN BEATEN METAL WORK**	The student will be able to: 3.2.1 state difficulties encountered in making beaten metalwork articles and solutions to these problems. 3.2.2 describe the processes involved in beaten metal work. 3.2.3 apply safety in beaten metal work 3.2.4 apply the appropriate techniques to design and produce beaten metal articles/items.	Difficulties in beaten metal work. Processes in beaten metalwork - hollowing - seaming - raising - sinking - planishing - polishing Safety in beaten metal work. Beaten metalwork articles (a semi circular bowl).	Group students to discuss difficulties in beaten metal work. Demonstrate the processes in beaten metal work for students to observe. Students to discuss the processes in beaten metalwork as well as the safety measures to be observed. Emphasize the various safety measures to be observed during the various processes. Guide students to design and make beaten metalwork articles.	Students to: explain difficulties in beaten metal work. Identify the various beaten metalwork processes and describe each of them. state safety to be observed in beaten metal work. state difficulties encountered in making beaten metalwork articles and solutions to these problems.

SECTION 4

METHODS OF JOINING METAL I (RIVETING)

General Objectives: The student will:

develop skills in riveting pieces of metal together

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
TOOLS AND EQUIPMENT FOR RIVETING	4.1.1 identify the various tools and equipment for riveting operations.	Tools and equipment for riveting - rivet set - rivets - pop riveter - dolly - ball pein hammer - rivet snap	Using samples of riveting tools and equipment assist students to identify and discuss their uses. Guide students to sketch tools and equipment for riveting	Identify the various tools and equipment for riveting
	4.1.2 explain the process of riveting.	Explanation of Riveting (Process of Riveting)	Through demonstration, assist students to discuss riveting and explain the process of riveting .	explain riveting
UNIT 2 **TYPES OF RIVETS**	4.2.1 identify types of rivet.	Types of rivet - snap or round head - raised countersunk - pan head - mushroom or universal head - flat head - conical head - countersunk head.	Display types of rivet and assist students to identify and discuss their shapes and uses.	Identify type of rivets.
	4.2.2 sketch various shapes of rivet heads.	Sketching shapes of rivet heads	Guide students to sketch shapes of rivet head and label parts.	sketch type of rivet heads.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	The student will be able to:			Students to:
TYPES OF RIVETED JOINTS	4.2.3 identify the types of riveted joint	Types of riveted joints - single riveted joint - double riveted joint - single – strap butt joint - double – strap butt joint	Using samples of riveted joints, assist students to identify and discuss the various riveted joints. Guide students to sketch the cross section of the riveted joints.	Identify type of riveted joints and sketch them
	4.2.4 use the various types of rivet to join pieces of metal together.	Making a riveted joint.	Students in groups to make the various types of riveted joints	make different types of riveted joint.
	4.2.5 design and make an artefact involving riveting	Designing and making an artefact involving riveting	Guide students to design and make an artefact involving riveted joints	prepare sequences of operation and add solutions to problems encountered.

SECTION 5

METHODS OF JOINING METALS II (GAS AND ELECTRIC ARC WELDING)

General Objectives: The student will:

1. be aware of the various tools and equipment for welding (Gas and Electric Arc)
2. acquire the skill in the use of the three machines to perform simple operations.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **TOOLS AND EQUIPMENT FOR WELDING**	The student will be able to: 5.1.1 identify various tools and equipment for welding.	 <u>Welding Equipment</u> <u>Gas Welding</u> - acetylene cylinder and hose. - oxygen cylinder and hose - pressure regulators: acetylene and oxygen. - welding blowpipe and nozzles. - goggles - spark lighter	 Guide students to identify equipment and parts of the various oxy-acetylene equipment and accessories and discuss their uses.	Students to: Identify equipment for gas welding and state the names and functions of their parts.
		<u>Electric Arc-Welding</u> - welding set (transformer) - electrode holder - ground clamp - chipping hammer - wire brush - welding helmet/visor - leather gloves	Display welding equipment and assist students to identify the various Electric arc-welding equipment, their parts and accessories.	identify equipment for electric arc welding and state the names and functions of their parts
	5.2.2 sketch basic welding tools and equipment.	Sketching of tools and equipment for welding (gas and electric arc)	Students to sketch the various tools and equipment for both gas and electric arc – welding and label them accordingly	sketch tools and equipment for welding operations

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **WELDING OPERATIONS**	The student will be able to: 5.2.1 differentiate between gas and electric arc welding and explain situations where each may be used	Difference between gas and electric arc welding and situations for choosing each of the two.	Assist students to differentiate between gas and electric are welding and discuss situations where gas welding or electric arc welding may be used.	Students to: differentiate between gas and electric arc welding.
	5.2.2 identify types of gas welding flames.	<u>Welding flames</u> - oxidising flame - neutral flame - carburising flame	Discuss and set the various types of flame for students to observe and practise.	Identify and set types of gas welding flames.
	5.2.3 apply the safety measures during welding operations.	Safety rules during welding operations.	Guide students to discuss the various safety rules and regulations to be observed during welding operations (gas and arc)	state various safety rules in welding operations.
	5.2.4 differentiate between two types of welding techniques and explain situations where each may be used.	<u>Types of gas welding techniques</u> - the rightward method of welding - the leftward method of welding	Demonstrate the two types of welding techniques and discuss their advantages and disadvantages and when each may be used	Identify types of gas welding techniques, giving situations where each may be used
	5.2.5 perform simple welding operations using gas and electric arc.	Performing simple welding operations (gas and arc welding).	Demonstrate simple gas and electric arc welding operations for students to observe. Guide students to perform simple gas and electric arc welding operations.	**<u>Assignment:</u>** carry out an assignment on both gas and electric welding.

SECTION 6

FOUNDRY WORK

General Objectives: The student will:

1. become aware of the basic principles of foundry work
2. appreciate the importance of foundry work in industry
3. develop skills in making patterns and moulds and casting artefacts

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **SAND CASTING**	6.1.1 identify tools and equipment for sand casting.	<u>Tools and equipment for sand casting</u> - mould box (drag, cope) - moulding board - parting compound - rammer - sprue pin - riser pin - gate cutter - trowel etc.	Using samples of sand casting tools and equipment assist students to identify and discuss the characteristics of sand casting. Students to sketch the various tools and equipment	Students to: sketch tools and equipment for sand casting

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **SAND CASTING**	The student will be able to: 6.1.2 describe processes in sand casting	<u>Processes in sand casting</u> - prepare the pattern - prepare the mould - allow mould to dry - dress mould cavity - pour molten metal - allow the content to solidify - remove the unit from the mould - remove all flashes or projections	Group students to describe the processes used in sand casting. Demonstrate the sand casting processes for students to observe and pratise. **<u>NOTE:</u>** Emphasize safety precautions to be observed when casting.	Students to: write down sand casting sequence of operation. prepare patterns and mould
	6.1.3 apply the principles of sand casting to produce articles	Designing and making of simple sand casting articles **NOTE:** Make students aware of a casting problem like the "blow hole" which does occur accidentally sometimes.	Put students in groups and assist them to design and make articles using sand casting process. **<u>NOTE</u>**: Take students to a local casting industry to observe the processes of sand casting	write group report after going through the practical process of casting a blank wheel.

SENIOR HIGH SCHOOL – YEAR 2

SECTION 7

SCREW THREADS

General Objectives: The student will:

acquire the skill of cutting internal and external screw threads using taps and dies.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
TYPES OF SCREW THREAD	7.1.1 identify the types of screw threads.	<u>Type of screw threads</u> 1. Vee threads - British Association (BA) - British Standard Fine (BSF) - British Standard Whitworth (BSW) - MetricThread 2. Square thread 3. ACME 4. Buttress	Using charts assist students to list types of screw threads and guide them to sketch the various Vee and Square threads and label them.	list types of screw threads.
	7.1.2. state the uses of the various types of screw thread	<u>Uses of screw threads</u> i. Vee Threads - B.A. – instrument - BSF – bolt and nut-fine adjustment - BSW – bolt and nut - Metric thread – conventional ii. Square thread – machine vices, lathe lead screws iii. ACME – machine vices, screw jacks iv. Buttress – bench vices screw	Assist students to discuss the uses of the types of screw thread.	state to the uses of Screw threads.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **TAPS AND TAPPING**	The student will be able to: 7.2.1 identify types of taps.	<u>The set of taps:</u> - taper tap - second (tap) - plug or bottoming tap - tap wrench	Display types of taps and guide students to identify them. Demonstrate the uses of taps for students to practise.	Students to: Identify the 3 types of taps in a set and their handle
	7.2.2 sketch and label taps	Sketching the three (3) taps.	Guide students to sketch and label the three (3) types of tap and their tap wrench. Demonstrate the process of fixing the taps to the tap wrench for students to observe and practise	sketch and label the three (3) taps and their handle.
	7.2.3 produce internal threads using hand taps	Internal threads using the taps.	Demonstrate the production of internal threads using the set of tap for students to observe and practise Guide students in groups or individually to produce internal threads	suggest solutions to difficulties encountered during the use of taps
	7.2.4 apply safety in producing internal threads.	Safety in threads cutting	Demonstrate safety during thread cutting and emphasize the application of lubricant to improve finish.	explain safety involved in threading.
UNIT 3 **DIES AND DIESING**	7.3.1 identify types of dies and their stocks .	<u>Types of dies</u> - circular split die - angular or adjustable dies - die nut - die stock	Demonstrate safety in threads cutting, show types of dies and guide students to identify them.	Identify the dies and their stocks.
	7.3.2 sketch types of dies and their stocks.	Types of dies and their stocks	Guide students to sketch and label types of die and their stocks.	sketch and label the types of dies and their stock.
	7.3.3 produce external threads using dies and stock	Production external threads using the type of dies.	Demonstrate the following: i. techniques for fixing the dies to their stocks. ii. the process of producing external thread using dies and stock. iii. use of die nut to correct damaged threads. Guide students to produce external threads.	design and make a simple practical work involving tap and dies. Emphasize safety measures where necessary.

SECTION 8

MACHINE TOOLS II

General Objectives: The student will:

use the centre lathe and shaping machines to perform simple operations

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
CENTRE LATHE	8.1.1 identify the types of centre lathe	Types of centre lathe	Visit industry with students and help them to identify the types of centre lathe machine.	Identify types of centre lathe machines.
	8.1.2 identify the major parts of the centre lathe and their functions.	<u>Major parts of the centre lathe</u> - the bed - head stock - tail stock - carriage - tool post - compound slide - centre height - lead screw - feed shaft etc	At the workshop assist students to identify the major parts of the centre lathe and discuss their functions.	Identify the major parts of the centre lathe and explain their function
	8.1.3 identify the cutting tools use on the centre lathe and state their functions.	<u>Cutting tools used on the centre lathe</u> - knife facing tool - round nose tool - parting off tool - knurling tool - boring bar - thread cutting tools - tool holder etc	Show samples of cutting tools used on the lathe, assist students to identify them and discuss their functions. Guide students to sketch the lathe turning tools and show the following: side rake, side clearance, front rake and front clearance **<u>NOTE:</u>** Lathe cutting tools and lathe turning tools are the same. The two terms can be used interchangeably.	students to identify the centre lathe cutting tools.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D)	The student will be able to:			Students to:
CENTRE LATHE	8.1.4 perform simple/basic lathe turning operations.	Basic centre lathe operations - facing - parallel turning - parting off - knurling - boring	Demonstrate the various basic lathe turning operations for students to observe and practise (Emphasize safety measures to be observed) Guide students to perform basic lathe turning operations.	select the right tool for the right operation.
	8.1.5 set cutting tools accurately	Tools setting	Guide students to set tools accurately	set tools accurately
	8.1.6 carry out basic Maintenance	Basic maintenance - lubrication - cleaning	Guide students to top-up oil levels in gear box, grease essential parts and carry out basic maintenance	write weekly reports on maintenance.
UNIT 2 **SHAPING MACHINE**	8.2.1 identify the major parts of the shaping machine and describe their functions.	Major parts - the ram - tool slide - the work table - the base - the clapper box - the bull gear - quick return motion	Show the shaping machine and assist students to identify its major parts and their functions send students to the industry where necessary. **NOTE:** Make students aware of the stroke and the danger of standing in its way.	Identify the shaping machine and its major parts.
	8.2.2 sketch quick return motion and the mechanism and the clapper box	Quick return motion and clapper box -	Using illustrations, guide students to sketch the quick return motion mechanism and the clapper box	sketch the quick return motion.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **SHAPING MACHINE**	The student will be able to: 8.2.3 identify the shaping machine cutting tools.	<u>Shaping machine cutting tools</u> - round nose roughing tools - straight nose rouging tool - cranked tool - slot cutting tool - flat nose swan necked finishing tool.	Show shaping machine cutting tools and assist students to identify them and describe their functions. Guide students to sketch shaping machine cutting tools	Students to: Identify the shaping machine cutting tools. Students to sketch shaping machine cutting tools.
	8.2.4 perform simple shaping machine operations.	<u>Basic shaping operation</u> - horizontal shaping - vertical Shaping	Demonstrate the various basic operations for students to observe and practise. (Emphasize Safety measures to be observed) Guide students to perform basic shaping operations. **<u>NOTE:</u>** Remind students of the difference in the size of tools for the lathe and shaping machine: solid tools for shaping and tools bit for lathe machine.	state solution to problems experienced in both vertical and horizontal shaping operations.
	8.2.5 perform basic maintenance on shaping machine.	<u>Basic maintenance</u> - cleaning - lubrication	Students to carry out basic maintenance of shaping machine. **<u>NOTE:</u>** Insist on thorough cleaning and oiling of machine parts.	students to write reports on basic maintenance of shaping machine.

SECTION 9

DESIGNING AND MAKING

General Objectives: The student will:

develop knowledge and skills for solving problems using the designing and making approach

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
IDENTIFYING THE PROBLEM	9.1.1 identify a problem in a given situation.	Problem areas - market - church - classroom - room - lorry park - workshop etc.	Help students to identify design problems at the market and other places from a given situation. Assist them also to describe some design problems in their own situations.	identify a design problem from a given situation.
	9.1.2 define the problem identified.	Problem definition Give the reason why the issue is a problem. State the inconvenience(s) posed by the problem.	Assist students in groups to discuss their design problems.	define their stated problems.
	9.1.3 state the benefits to be derived from the solution of the design problem.	Benefits to be derived from finding solution(s) to the problem identified.	Assist students to discuss the benefit to be derived from finding solution(s) to the design problem(s)	state the benefits to be derived from solving the problem in groups and individually.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2	The student will be able to:			Students to:
GENERATING POSSIBLE SOLUTIONS (EXPLORING)	9.2.1 use appropriate investigation procedures for deriving possible solutions.	Investigation Procedures and Possible solutions - interviews - observation - visits - reading-journals, books etc. - photographs - sketches of solution alternatives etc.	Assist students to conduct various investigations/research to gather pieces of information for generating possible solutions.	students in groups or individually to conduct investigations to generate initial ideas.
	9.2.2 generate at least three possible solutions through pre-imaging	Generation of possible solution and selecting the best/most suitable solution through pre-imaging	Assist students to use pre-imaging technique to generate at least three possible solutions and use pictorial drawings to illustrate each of the three solutions.	generate possible solutions using pictorial drawing.
	9.2.3 select the most suitable solution for a design problem	Selecting the most suitable solution by: simplicity/complexity, availability of materials, cost	Students to consider each of their three solutions by given criteria and select the most appropriate solution	write down operational sequence and prepare cutting list for their projects.
UNIT 3				
MAKING THE ARTEFACT	9.3.1 outline the sequence of operation involved in the making of the artefact.	Making the artefact - operational sequence - cutting list	Assist students to write down the operational sequence of the solution and prepare cutting list	select appropriate tools and materials for making their artefacts.
	9.3.2 select suitable materials and tools	Selection of appropriate tools and materials for making the artefact	Guide students to select appropriate tools and materials for making their artefacts	
	9.3.3 produce the artefact	Making the artefact.	Guide students to construct their artefacts. **NOTE**: Pay occasional visits to the workshop apart from the normal time-table to assess students' progress of work.	make their projects.
UNIT 4				
EVALUATING AND MODIFYING THE ARTIFACT	9.4.1 evaluate the functionality or appropriateness of their artefacts	Evaluation of the completed artefact.	Guide students to evaluate the functionality/appropriateness of their completed artefacts and modify where necessary	evaluate their artifact

SENIOR HIGH SCHOOL – YEAR 3

SECTION 1

MATERIALS (III)

General Objectives: The student will:

1. be aware of reasons for choosing plastics material as an alternative to wood or metal for a job.
2. recognize the range of alloy steels available and reasons for selecting any of them for a specific use.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 **PLASTICS**	The student will be able to:			Students to:
	1.1.1 identify types of plastics	Thermoplastics and thermosetting plastics.	Show types of plastics and assist students to identify.	describe parts of a plastic.
	1.1.2 differentiate between thermoplastic and thermosetting plastics.	Difference between thermoplastic and thermosetting plastic	Assist students to differentiate between Thermosetting plastic and Thermoplastic materials.	differentiate between thermosetting and thermoplastics.
	1.1.3 state the uses of both thermoplastics and thermosetting.	<u>Examples of thermosetting plastics.</u> - phenol formaldehyde (bakelite) and formica - urea formaldehyde - polyester resin (glass fibre materials) <u>Example of thermoplastic materials</u> - polypropylene - low density polyethylene - high density polyethylene - polyvinylchloride - polystyrene - nylon	Using samples of products made from plastics, assist students to observe and discuss their differences and uses.	list examples of the 2 types of Plastics.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **PLASTICS**	The student will be able to: 1.1.4 state properties of thermoplastic and thermosetting plastics.	Properties and uses of the to types of plastics <u>Thermoplastics</u> - polypropylene (PP) - low density Polyethylene (LDPE) - high density polyethylene (HDPE) - polystyrene (PS) - nylon <u>Thermosetting plastics</u> - phenol formaldehyde (PF) - urea formaldehyde (UF) - polyester resin	Assist students to discuss the properties of the two types of plastics and the uses of the two types of plastics. Guide students to distinguish between the two types. i.e recyclable and non-recyclable.	Students to: give the properties and uses of the two types of plastics.
UNIT 2 **ALLOY STEELS**	1.2.1 identify common alloy steels.	Identification of alloy steels	Display alloy steels and assist students to identify.	identify types of alloys, steels.
	1.2.2 state the uses of the common alloy steels	<u>Uses of common alloys steels</u> - nickel steel - chromium steel - molybdenum steel - vanadium steel - cobalt steel - manganese steel - tungsten steel	Show samples of alloy steels and help students to do the following: i. discuss the various alloying elements for the plain carbon steel ii. identify their properties and uses.	explain alloy steels and describe their uses (Students can use the internet to find out the uses of common alloy steels)

SECTION 2

HEAT TREATMENT

General Objectives: The student will:

1. be aware of the behaviour of plain carbon steels when heated.
2. become aware of heat-treatment processes
3. apply the appropriate heat-treatment in making artefacts.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
HEAT TREATMENT OF PLAIN CARBON STEELS	2.1.1 explain heat treatment of plain carbon steels.	Meaning of heat treatment of plain carbon steels.	Group students to discuss heat treatment of plain carbon steels.	explain heat-treatment of plain carbon steel.
	2.1.2 describe the heat - treatment processes.	<u>Heat-treatment processes</u> - annealing - normalizing - case hardening - hardening - tempering - carburizing	Guide students to describe the heat treatment processes and practice them	describe the heat treatment processes.
	2.1.3 use the iron-carbon equilibrium diagram to explain the behaviour of plain carbon steel when heated and cooled	Behaviour of plain carbon steel when heated and cooled.	Assist students to use the iron carbon equilibrium diagram to explain the behaviour of plain carbon steel when heated and cooled.	explain the behaviour of steel when heated and cooled using the iron carbon equilibrium diagram.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **HEAT-TREATMENT OF PLAIN CARBON STEELS**	The student will be able to: 2.1.4 quench a plain Carbon steel after heating during hardening and tempering.	<u>Quenching a heated Plain Carbon Steel</u> - pick the heated plain carbon steel and dip it immediately in to a quenching medium (water/oil) - stir the heated steel in the medium.	Demonstrate the technique for quenching a plain carbon steel when heated for students to observe. Guide students in groups or individually to practise the quenching technique.	Students to: describe the process of quenching. give reasons why it was necessary to move the abject being heat treated about in the quenching medium. write on how they strengthened the work piece by heat treatment.
	2.1.5 apply heat treatment processes in making artefacts	Application of knowledge in heat-treatment to artefacts.	Guide students to apply heat treatment processes to strengthen and modify their practical work piece for assessment. **<u>NOTE:</u>** Ensure that students demonstrate heat treatment application to a high level in their project.	

SECTION 3

FINISHES

General Objectives: The student will:

1. be aware of the basic finishes for metal work and the methods of applying them.
2. recognize the need for applying finishes to projects

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The student will be able to:			Students to:
METAL FINISHES	3.1.1 identify types of metal finishes	Type of metal finishes - enamelling - polishing - electroplating - lacquering - painting - varnish - buffing - pickling - metal spraying - lapping - blueing	Show metal finishes and assist students to identify them.	Identify types of metal finishes.
	3.1.2 mix some finishes correctly.	Mixing some of the metal finishes - oil Paint + turpentine - lacquer + thinner - varnish + thinner	Demonstrate how to mix the following finishing media - oil paint with turpentine - lacquer with thinner - varnish with thinner	mix some of the finishes correctly.
	3.1.3 apply finishes correctly.	Applying some of the metal finishes correctly - oil paint - lacquer - blueing	Demonstrate how to apply some of the metal finishes correctly for students to observe and practise.	apply finishes correctly.

RECOMMENDED TOOLS AND EQUIPMENT	
1. Steel rule 2. Depth gauge 3. Tape measure 4. Vernier caliper 5. Micrometer 6. Vernier protractor 7. Combination Ste 8. Sliding bevel 9. Angle plate 10. Vee block 11. Scribing block 12. Surface gauge 13. A pair of dividers 14. Center punch 15. Try square 16. Odd-leg caliper 17. Inside caliper 18. Outside caliper 19. Dot punch 20. center punch 21. engineer's bench vice 22. hand vice 23. G-clamp 24. lathe chuckles 25. Drill chuck 26. Flat chisel 27. Crosscut chisel 28. Diamond point chisel 29. Half-round chisel 30. Hacksaw	31. Cross pein hammer 32. Straight pein hammer 33. Ball pein hammer 34. Sledge hammer 35. Raw hide Mallet 36. Copper mallet 37. lead mallet 38. drift 39. Spanners 40. Chuck key 41. Allen Key 42. Screwdrivers 43. Screw extractors 44. Flat File 45. Hand file 46. Square file 47. Triangular File 48. Round file 49. Half round file 50. Scriber 51. Snips 52. Folding bar 53. Funnel Stake 54. Hatchet stake 55. Creasing Stake 56. Pipe stake 57. Soldering bit 58. Furnaces 59. Solder 60. Fluxes

RECOMMENDED TOOLS AND EQUIPMENT

61. Gas torch
62. Soldering spelter
63. Wire brush
64. Wire brush
65. The forge
66. The slice
67. Flatters
68. Fullers
69. Swages
70. Swage block
71. Tongs
72. The anvil
73. Flat drill
74. Center drill
75. Counter sink drill
76. Counter bore drill
77. Straight-Fluted drill
78. Twist drill
79. Mould box (Flask)
80. Mold board
81. Parting Compound
82. Rammer
83. Sprue pin
84. Riser pin
85. Gate Cutter
86. Trowel
87. Sand bag
88. Wooden block
89. Raising Stake
90. Horse and Stake heads
91. Mushroom head stake
92. Bossing mallet
93. Rivet set
94. Rivets
95. Pop Riveter
96. Dolly
97. Ball pein hammer
98. Snap or round head rivet
99. Raised Countersunk rivet
100. Pan head
101. Mushroom or Universal head
102. Flat head
103. Conical head
104. Countersunk head.
105. Acetylene cylinder and hose
106. Oxygen Cylinder and hose
107. Pressure regulators
108. Welding blowpipe
109. goggles
110. Spark light
111. Welding set
112. Electrode holder
113. Ground clamp
114. Welding helmet
115. Leather sloves
116. The bed
117. Head stock
118. Garriage
119. Compound slide
120. Centre height
121. Knife facing tool
122. Round nose tool
123. Parting off tool
124. Boring bar
125. The worktable
126. The clapper box
127. Tool slide
128. The ram
129. The bull gear
130. Cranked tool
131. Slot cutting tool
132. Straight nose roughing tool
133. Round nose roughing tool
134. Flat nose swan necked finishing tool
135. Tilting head
136. Knee
137. Knee evaluating handle
138. Cross traverse handle
139. Side and face cutter
140. Slab mill

RECOMMENDED TOOLS AND EQUIPMENT	
141. Face cutter 142. Slotting Cutter 143. Taper tap 144. Second tap 145. Plug or bottoming tap 146. Tap wrench 147. Circular Split dies 148. Angular or adjustable dies 149. Die nut 150. Die stock	

RECOMMENDED MATERIALS

1. Low Carbon Steel
2. Medium Carbon Steel
3. High Carbon steel
4. Chemical Solutions
5. Straight Mineral oil
6. Straight fatty oil
7. Compounded / blended oil
8. Emulsified oil
9. Aluminium
10. Lead
11. Copper
12. Zinc
13. Tin
14. Brass
15. Bronze
16. Soft Solder
17. Duralumin
18. Pewter
19. Sand
20. Thermosetting Plastics
21. Thermoplastic materials
22. Alloys-steels
23. Oil paint
24. Lacquer
25. Varnish
26. Thinner
27. Sheet metal
28. Cast iron
29. Soldering Sheet
30. Formica
31. Nylon
32. Perspex
33. Polyesteresin
34. Bakelite

RECOMMENDED BOOKS

1. Workshop Processes and Materials Level 1 (Second Edition) - R. L. Timings
2. Metal Technology - CESAC
3. Design Technology in Metal and Plastic - G.H. Thomas, John Murray.
4. Welding Technology - Gourd
5. Metalwork - R. Sandham F.R. Willmers.
6. The Theory and Practice of Metalwork, 3rd Edition - G. Love
7. Metalwork Technology - J.K. N. Sackey and S.K. Amoakohene
8. Metal work for Schools and Colleges - J.M. Green
9. Materials, Tools and Processes, and Methodology - S.K. Amoakohene et.al
10. Metalwork Theory, Books 1, 2, 3 & 4 (Metric Edition) - P.E. Lye – Harrap, Lon.
11. Basic Engineering processes - S. Crawford

SUGGESTED PRACTICAL EXERCISES

1. I inch x 12 inch rule stand
2. A dustbin for the school or home
3. A scoop/rubbish collector
4. Bread/cake pan
5. A builders trowel
6. A cold chisel hardened and tempered
7. A screw driver with the tip hardened and tempered
8. A table tennis bracket
9. A tower bolt
10. A barrel bolt
11. Shower rose
12. Engineer's try square
13. Tool makers clamp
14. 'G' clamp

NOTE: Teachers to develop other creative exercises and artefacts for students to practice and acquire high level skills.