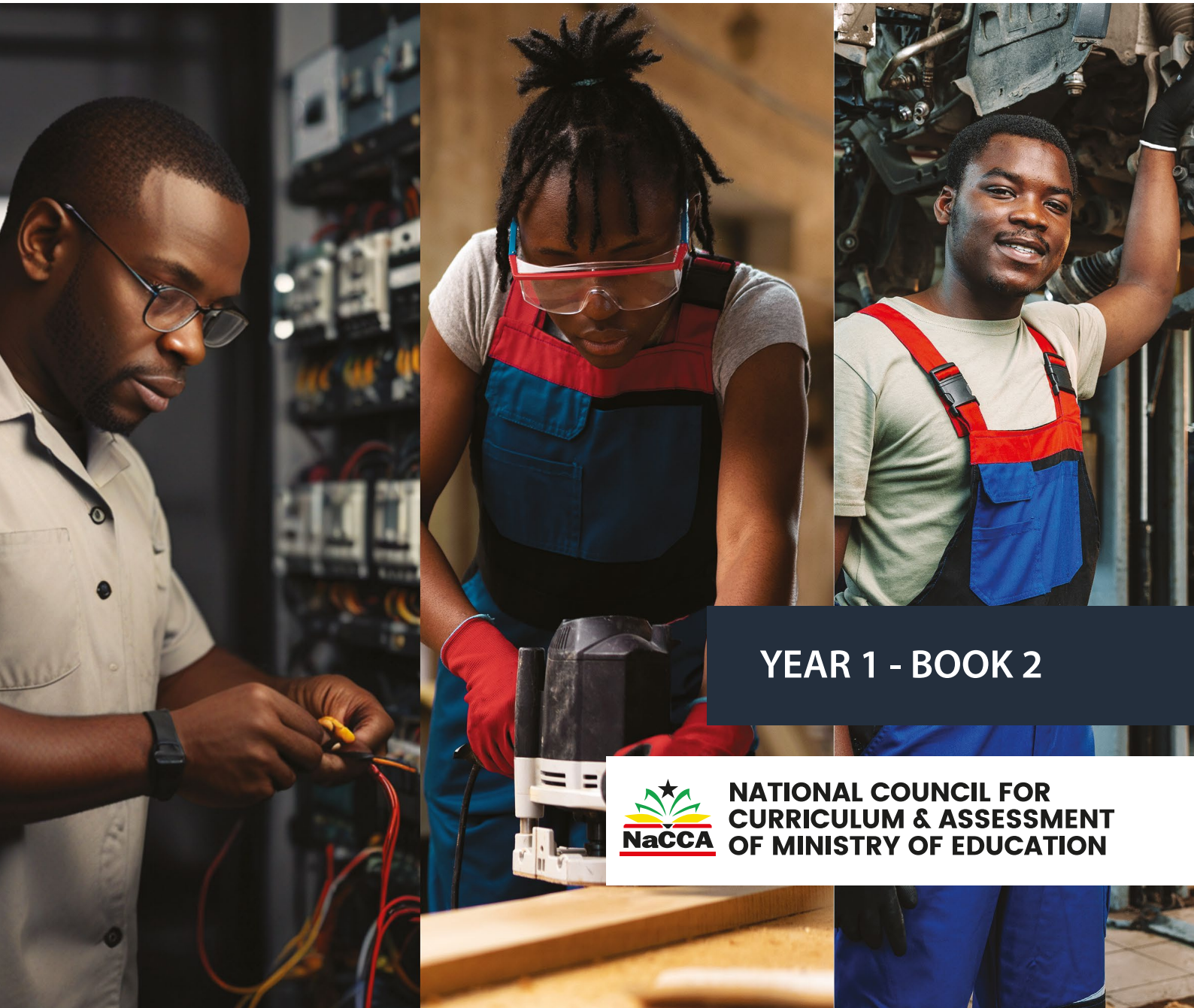
MINISTRY OF EDUCATION

APPLIED TECHNOLOGY

For Senior High Schools

TEACHER MANUAL



YEAR 1 - BOOK 2

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

MINISTRY OF EDUCATION

REPUBLIC OF GHANA

Applied Technology

For Senior High Schools

Teacher Manual

Year One - Book Two

NATIONAL COUNCIL FOR CURRICULUM & ASSESSMENT OF MINISTRY OF EDUCATION

APPLIED TECHNOLOGY TEACHER MANUAL

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INTRODUCTION

The National Council for Curriculum and Assessment (NaCCA) has developed a new Senior High School (SHS), Senior High Technical School (SHTS) and Science, Technology, Engineering and Mathematics (STEM) Curriculum. It aims to ensure that all learners achieve their potential by equipping them with 21st Century skills, competencies, character qualities and shared Ghanaian values. This will prepare learners to live a responsible adult life, further their education and enter the world of work.

This is the first time that Ghana has developed an SHS Curriculum which focuses on national values, attempting to educate a generation of Ghanaian youth who are proud of our country and can contribute effectively to its development.

This Book Two of the Teacher Manual for Applied Technology covers all aspects of the content, pedagogy, teaching and learning resources and assessment required to effectively teach Year One of the new curriculum. It contains information for the rest of Year One. Teachers are therefore to use this Teacher Manual to develop their weekly Learning Plans as required by Ghana Education Service.

Some of the key features of the new curriculum are set out below.

Learner-Centred Curriculum

The SHS, SHTS, and STEM curriculum places the learner at the center of teaching and learning by building on their existing life experiences, knowledge and understanding. Learners are actively involved in the knowledge-creation process, with the teacher acting as a facilitator. This involves using interactive and practical teaching and learning methods, as well as the learner's environment to make learning exciting and relatable. As an example, the new curriculum focuses on Ghanaian culture, Ghanaian history, and Ghanaian geography so that learners first understand their home and surroundings before extending their knowledge globally.

Promoting Ghanaian Values

Shared Ghanaian values have been integrated into the curriculum to ensure that all young people understand what it means to be a responsible Ghanaian citizen. These values include truth, integrity, diversity, equity, self-directed learning, self-confidence, adaptability and resourcefulness, leadership and responsible citizenship.

Integrating 21st Century Skills and Competencies

The SHS, SHTS, and STEM curriculum integrates 21st Century skills and competencies. These are:

- **Foundational Knowledge:** Literacy, Numeracy, Scientific Literacy, Information Communication and Digital Literacy, Financial Literacy and Entrepreneurship, Cultural Identity, Civic Literacy and Global Citizenship
- **Competencies:** Critical Thinking and Problem Solving, Innovation and Creativity, Collaboration and Communication
- **Character Qualities:** Discipline and Integrity, Self-Directed Learning, Self-Confidence, Adaptability and Resourcefulness, Leadership and Responsible Citizenship

Balanced Approach to Assessment - not just Final External Examinations

The SHS, SHTS, and STEM curriculum promotes a balanced approach to assessment. It encourages varied and differentiated assessments such as project work, practical demonstration, performance assessment, skills-based assessment, class exercises, portfolios as well as end-of-term examinations and final external assessment examinations. Two levels of assessment are used. These are:

- Internal Assessment (30%) – Comprises formative (portfolios, performance and project work) and summative (end-of-term examinations) which will be recorded in a school-based transcript.

- External Assessment (70%) – Comprehensive summative assessment will be conducted by the West African Examinations Council (WAEC) through the WASSCE. The questions posed by WAEC will test critical thinking, communication and problem solving as well as knowledge, understanding and factual recall.

The split of external and internal assessment will remain at 70/30 as is currently the case. However, there will be far greater transparency and quality assurance of the 30% of marks which are school-based. This will be achieved through the introduction of a school-based transcript, setting out all marks which learners achieve from SHS 1 to SHS 3. This transcript will be presented to universities alongside the WASSCE certificate for tertiary admissions.

An Inclusive and Responsive Curriculum

The SHS, SHTS, and STEM curriculum ensures no learner is left behind, and this is achieved through the following:

- Addressing the needs of all learners, including those requiring additional support or with special needs. The SHS, SHTS, and STEM curriculum includes learners with disabilities by adapting teaching and learning materials into accessible formats through technology and other measures to meet the needs of learners with disabilities.
- Incorporating strategies and measures, such as differentiation and adaptative pedagogies ensuring equitable access to resources and opportunities for all learners.
- Challenging traditional gender, cultural, or social stereotypes and encouraging all learners to achieve their true potential.
- Making provision for the needs of gifted and talented learners in schools.

Social and Emotional Learning

Social and emotional learning skills have also been integrated into the curriculum to help learners to develop and acquire skills, attitudes, and knowledge essential for understanding and managing their emotions, building healthy relationships and making responsible decisions.

Philosophy and vision for each subject

Each subject now has its own philosophy and vision, which sets out why the subject is being taught and how it will contribute to national development. The Philosophy and Vision for Applied Technology is:

Philosophy: The present and future generations of learners will apply technology to solve problems in their environment through creativity and innovative application of concepts for the production of artefacts. This will be done through the support of skilled and innovative teachers who are to prepare learners for life-long learning as well as introducing them to the world of work and adult life.

Vision: Equips the learners with 21st century skills: critical thinking, creativity, collaborations and innovation as well as good citizenship and competencies to identify increasingly complex societal problems and use appropriate technological skills to solve them. Thus, it prepares learners for life-long learning and introduces them to world of work and adult life.

Applied Technology Summary

S/N	STRAND	SUB-STRAND	YEAR 1		
			CS	LO	LI
1.	Automotive Technology	Introduction to Engine Technology	1	1	3
		Introduction to Vehicle Technology	1	1	3
2.	Building Construction Technology	Pre –Construction Activities	2	2	7
		Substructure and Superstructure	-	-	-
3.	Electrical And Electronics Technology	Electrical Systems Design	1	1	3
		Electronic Devices and Circuits	1	1	3
4.	Metal Technology	Engineering Materials, Tools and Machines	1	1	3
		Welding Technology	1	1	4
5.	Woodwork Technology	Tools and Machines in Woodwork	1	1	1
		Materials and Artifact Production in Ghana	2	2	5
Total			**11**	**11**	**32**

Overall Totals (SHS 1)

Content Standards	**11**
Learning Outcomes	**11**
Learning Indicators	**32**

YEAR TWO AND THREE SCOPE AND SEQUENCE APPLIED TECHNOLOGY SUMMARY – AUTOMOBILE AND METAL TECHNOLOGY (OPTION ONE)

S/N	STRAND	SUB-STRAND	YEAR 2			YEAR 3		
			CS	LO	LI	CS	LO	LI
1.	Automotive Technology	Introduction to Engine Technology	1	1	6	1	1	6
		Introduction to Vehicle Technology	1	1	6	1	1	6
2.	Metal Technology	Engineering Materials, Tools and Machines	1	1	6	1	1	6
		Welding Technology	1	1	6	1	1	6
Total			**4**	**4**	**24**	**4**	**4**	**24**

Overall Totals (SHS 2 – 3)

Content Standards	**8**
Learning Outcomes	**8**
Learning Indicators	**48**

APPLIED TECHNOLOGY SUMMARY – BUILDING CONSTRUCTION AND WOOD TECHNOLOGY (OPTION TWO)

S/N	STRAND	SUB-STRAND	YEAR 2			YEAR 3		
			CS	LO	LI	CS	LO	LI
1.	Building Construction Technology	Pre –Construction Activities	-	-	-	-	-	-
		Substructure and Superstructure	2	2	12	2	2	12
2.	Woodwork Technology	Tools and Machines in Woodwork	1	1	4	1	1	3
		Materials and Artifact Production in Ghana	2	2	8	2	1	10
Total			**5**	**5**	**24**	**5**	**4**	**25**

Overall Totals (SHS 2 – 3)

Content Standards	**10**
Learning Outcomes	**9**
Learning Indicators	**49**

APPLIED TECHNOLOGY SUMMARY – ELECTRICAL AND ELECTRONIC TECHNOLOGY (OPTION THREE)

S/N	STRAND	SUB-STRAND	YEAR 2			YEAR 3		
			CS	LO	LI	CS	LO	LI
1.	Electrical And Electronics Technology	Electrical Systems Design	1	1	12	1	1	12
		Electronic Devices and Circuits	1	1	12	1	1	12
Total			**2**	**2**	**24**	**2**	**2**	**24**

Overall Totals (SHS 2 – 3)

Content Standards	**4**
Learning Outcomes	**4**
Learning Indicators	**48**

YEAR ONE 24-WEEK PLAN

Week	Unit	Strand	Sub-Strand	Name Of Learning Indicator	Page Number
SECTION 1					***BOOK 1***
1	1	Woodwork Tech	Tools & Machines in Woodwork	Explain the meaning of personal safety, workshop safety and materials safety.	**13 - 15**
2	2	Auto. Tech	Intro. to Eng. Tech	Identify types of engines and describe the main parts of the engine	**16 - 24**
	3	Building Const. Tech	Pre- Construction Activities	Explain the stakeholders involved in a building construction project	**25 - 27**
3	4	Elect. & Electronic Tech	ESD/Electronic Dev. & Circuits	Discuss safety in the use of electricity	**28 - 33**
	5	Metal Tech	Eng. Materials, Tools & Machines	Explain the uses of various types of measuring, marking out, holding, striking and cutting tools	**34 - 47**
SECTION 2					***BOOK 1***
4	1	Woodwork Tech	Tools & Machines in Woodwork	Classify the two main types of timber	**46 - 52**
	2	Auto Tech	Intro. to Eng. Tech	Explain the constructional and operational differences between petrol and diesel engines	**53 - 58**
5	3	Building Const. Tech	Pre- Construction Activities	Describe the roles of stakeholders in a building construction project	**59 - 61**
	4	Elect. & Electronic Tech	ESD/Electronic Devices. & Circuits.	Describe the process of electrical power generation, transmission and distribution	**62 - 77**
6	5	Metal Tech	Eng. Materials, Tools & Machines	Explain ferrous and non-ferrous metals with engineering applications and state the uses of non-metallic materials.	**78 - 82**
	1	Woodwork Tech	Tools & Machines in Woodwork	Classify the two main types of timber	**46 - 52**

Week	Unit	Strand	Sub-Strand	Name Of Learning Indicator	Page Number
7	2	Auto. Tech	Intro. to Eng. Tech	Explain the constructional and operational differences between petrol and diesel engines	**53 - 58**
	3	Building Const. Tech	Pre- Construction Activities	Describe the roles of stakeholders in a building construction project	**59 - 61**
8	4	Elect. & Electronic Tech	ESD/Electronic Device. & Circuits	Describe the process of electrical power generation, transmission and distribution	**62 - 77**
	5	Metal Tech	Eng. Materials, Tools & Machines	Explain ferrous and non-ferrous metals with engineering applications and state the uses of non-metallic materials	**78 - 82**
SECTION 3					***BOOK 1***
9	1	Woodwork Tech.	Tools & Machines in Woodwork	Outline the processing phases of timber in the woodwork industry	**83 - 91**
	2	Auto. Tech	Intro. to Eng. Tech	Demonstrate safety measures applied to servicing, repair and maintenance of engine systems	**92 - 96**
10	3	Building Const. Tech	Pre- Construction Activities	Explain the professionals involved in building construction project	**97 - 100**
	4	Elect. & Electronic Tech.	ESD/Electronic Devices. & Circuits.	Apply the concept of power transmission and distribution in electricity supply.	**101 - 107**
11	5	Metal Tech	Eng. Materials, Tools & Machines	Identify and explain the use of various tools and equipment for gas welding	**108 - 113**
	1	Woodwork Tech	Tools & Machines in Woodwork	Outline the processing phases of timber in the woodwork industry	**83 - 91**
12	2	Auto Tech	Intro. to Eng. Tech	Demonstrate safety measures applied to servicing, repair and maintenance of engine systems	**92 - 96**
	3	Building Const. Tech	Pre- Construction Activities	Explain the professionals involved in a building construction project	**97 - 100**

Week	Unit	Strand	Sub-Strand	Name Of Learning Indicator	Page Number
13	4	Elect. & Electronic Tech	ESD/Electronic Devices. & Circuits.	Apply the concept of power transmission and the distribution in the electricity supply	**101 - 107**
	5	Metal Tech	Eng. Materials, Tools & Machines	Identify and explain the use of various tools and equipment for gas welding	**108 - 113**
SECTION 4					***BOOK 2***
14	1	Woodwork Tech	Mat. & Artefact Pro. In Ghana	Explain the types of manufactured boards made from wood and non-wood residues	**11 - 16**
	2	Auto. Tech	Intro. to Vehicle. Tech	Identify the components of the vehicle transmission system and explain their functions	**17 - 23**
15	3	Build. C. Tech	Pre- Construction Activities	Describe the roles of professionals in building construction projects.	**24 - 28**
	4	Elect. & Electronic Tech	ESD/ Electronic Devices. & Circuits.	Explain the concept of electrical and electronic circuits	**28 - 32**
16	5	Metal Tech	Eng. Materials, Tools & Machines	Describe various tools and equipment for electric arc welding	**33 - 39**
	1	Woodwork Tech	Mat. & Artefact Pro. In Ghana	Explain the types of manufactured boards made from wood and non-wood residues	**11 -16**
17	2	Auto. Tech	Intro. To Vehicle. Tech	Identify the components of the vehicle transmission system and explain their functions	**17 - 23**
	3	Building Const. Tech	Pre- Construction Activities	Describe the roles of professionals in building construction projects.	**24 - 28**
18	4	Elect. & Electronic Tech	ESD/ Electronic Devices. & Circuits.	Explain the concept of electrical and electronic circuits	**28 - 32**
	5	Metal Tech	Eng. Materials, Tools & Machines	Describe various tools and equipment for electric arc welding	**33 -39**

Week	Unit	Strand	Sub-Strand	Name Of Learning Indicator	Page Number
SECTION 5					***BOOK 2***
19	1	Woodwork Tech	Mat. & Artefact Pro. in Ghana	Discuss the advantages of manufactured boards over solid wood	**40 - 43**
	2	Auto. Tech	Intro. to Vehicle Tech	Evaluate the components of the braking system and state their functions	**44 - 49**
20	3	Building Const. Tech.	Pre- Construction Activities	Discuss the reasons for mobilisation	**50 - 53**
	4	Metal Tech	Welding Tech	Indicate the various applications of gas and electric arc welding	**53 - 63**
21	5	Elect. & Electronic Tech	Electronic Devices. & Circuits.	Describe the principles and operation of the various Diodes.	**64 - 75**
	6	Auto Tech	Intro. To Vehicle. Tech	Differentiate between mechanical, hydraulic and pneumatic braking systems	**75 - 81**
SECTION 6					***BOOK 2***
22	1	Building. Const. Tech.	Pre- Construction Activities	Identify and state functions of plants and equipment for construction works	**82 - 90**
	2	Woodwork Tech	Mat. & Artefact Pro. in Ghana	Outline the uses of manufactured boards made from wood and non-wood residues	**91 - 94**
23	3	Elect. & Electronic Tech	Electronic Devices & Circuits	Apply the principles of diodes in designing circuits	**95 - 100**
	4	Metal Tech	Welding Tech.	Compare the advantages and disadvantages of gas and electric arc welding	**100 - 104**
24	5	Building Const. Tech	Pre- Construction Activities	Explain the specific locations of temporal structures, services, welfare facilities and equipment at the new construction site to ensure order, safety, progress of work and security.	**105 - 110**

The section covers the following unit (strands); woodwork technology, automotive technology, building construction technology, electrical and electronic technology, as well as metal technology.

In this section, learners will acquire knowledge and understanding of the utilisation of manufactured boards from wood residues. Learners will also be able to detect problems in the transmission and braking systems of vehicles. In the building construction technology unit, learners are expected to gain knowledge and understanding of the roles of Building Construction Personnel**.** Within electrical and electronic technology, learners are expected to acquire an understanding of diodes as electronic devices and apply them in designing electronic circuits. Knowledge and understanding of the use of tools and equipment for welding will also be acquired under the metal technology unit. All the above are treated from Unit 1 to Unit 5.

UNIT 1

Strand: **Woodwork Technology**

Sub-Strand: Material and Artefacts Production Woodwork Industry in Ghana

Content Standard: Demonstrate knowledge and understanding of the utilisation of manufactured boards from wood residues.

Learning Outcome: *Demonstrate knowledge and understanding of manufactured boards from wood and non-wood residues to describe their types and uses.*

INTRODUCTION AND UNIT SUMMARY

This unit will help learners discover the types of manufactured boards made from wood and non-wood residues. Manufactured boards play a pivotal role in providing versatility, durability, and cost-effectiveness in various projects. These engineered wood products are created by binding together wood fibres, particles, or veneers to form strong and reliable boards.

The unit covers only weeks 14 & 16: ***Explain the types of manufactured boards made from wood and non-wood residues.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

For the objectives of this unit to be accomplished, learners must participate in explaining the types of manufactured boards made from wood and non-wood residues. The teacher should employ pedagogies such as critical thinking and talk for learning, group work/collaborative learning and experiential learning. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individual learning. All learners, irrespective of their learning abilities, should be encouraged to participate fully in investigations, as well as the presentation of findings. The teacher should implement differentiation strategies to accommodate diverse learning needs.

ASSESSMENT SUMMARY

The concepts under this unit require learners to demonstrate conceptual understanding, including their real-life applications. Hence, the assessments should largely cover levels 1, 2 and 3 of the DoK. Teachers should employ a variety of formative assessment strategies, such as oral/written presentations, pair tasks, reports, home tasks, etc. to collect information about learners' progress and give prompt feedback. Precisely, teachers should administer assessments, such as class exercises (including individual worksheets) after each lesson, homework, scores on practical group activities on the various types of manufactured boards and document learners' results in continuous assessment records.

WEEK 14 AND 16

Learning Indicator(s): *Explain the types of manufactured boards made from wood and non-wood residues.*

Theme or Focal Area: Types of Manufactured Boards

Manufactured Boards/Engineered Wood: These are made by binding pieces of real wood, scrap wood, shredded wood fibres and/or sawdust with adhesives. Engineered wood is designed to look and act like wood but is stronger and more durable. It is constructed from multiple layers of wood called ply that run in different directions, which makes it very stable. Can be used in construction, furniture and other fitments.

1. **Plywood:** An odd number of **veneers** are glued such that the grain of adjacent veneers is at right angles to each other. The veneer is a thin piece of wood cut from logs by rotary cut and flitches by slicing method.

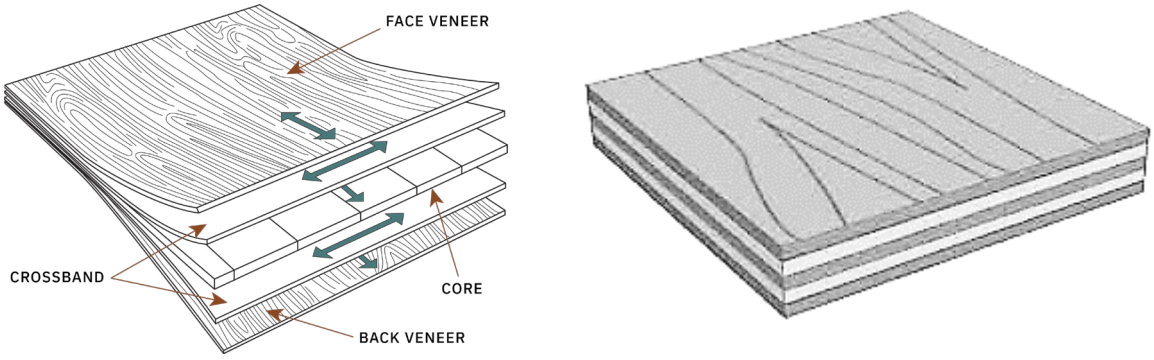

Fig 4.1: *Plywood*

2. **Laminboard:** This material has two elements, the centre part (core) is made of about 10mm thick strips of softwood of lower grade. The outer part has a veneer applied with the grain at right angles to the strips of the core.

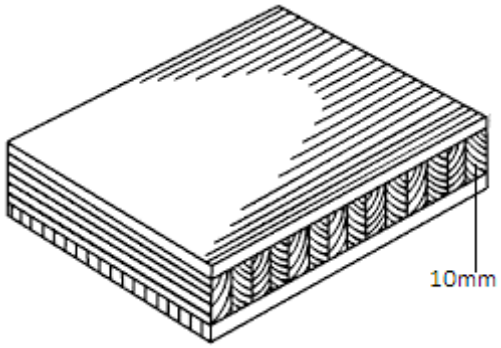

Fig 4.2: *Laminboard*

3. **Blockboard:** This is made up of a core of wood strips placed edge to edge and sandwiched between veneers of hardwood. It is formed by combining a solid timber core with two outer-facing veneers such that their grain is at right angles and forms a solid, strong product.

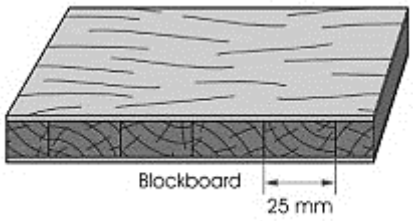

Fig 4.3: *Blockboard*

4. **Battenboard:** This is the same as both laminboard and blockboard but with even wider core strips.

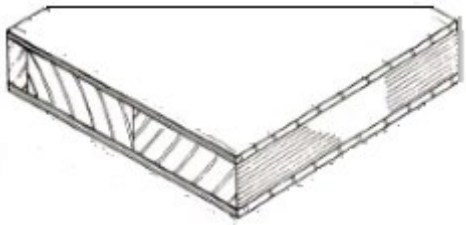

Fig 4.4: *Battenboard*

5. **Chipboard:** This material is made up of fine particles of wood or chips, which have been compressed together and bonded by a synthetic resin adhesive.

Fig 4.5: *Chipboard*

6. **Particleboard:** This is similar to chipboard, but the chippings used in the manufacture are much smaller.

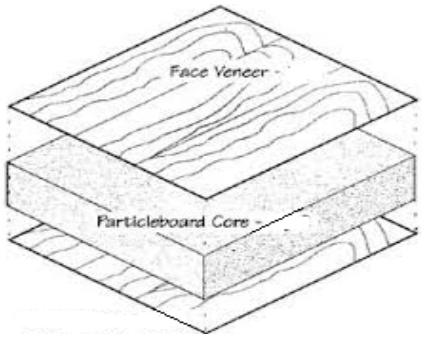

Fig 4.6: *Particleboard*

7. **Hardboard/Insulation board:** This is made of **wood pulp** in place of veneers or chips. The wood pulp is mixed with resin, heated and then compressed into a flat sheet.

Fig 4.7: *Hardboard*

8. **Oriented strand board (OSB):** OSB is made from wood strands or flakes (shavings) that are arranged in layers and bonded together using adhesives and wax.

Fig 4.8: *Oriented strand board*

Learning Tasks

1. Identify at least two features of veneers in plywood.
2. Explain three features of veneers in plywood.
3. Differentiate between laminboard, blockboard and battenboard.

Pedagogical Exemplars

The teacher should consider the following activities:

Critical Thinking and Talk for Learning Approaches: Guide learners, through a video demonstration of the types of manufactured boards made from wood and non-wood residues, and brainstorm the meaning of the manufactured boards with open-mindedness. To push thinking, the teacher should target questions to learners as they discuss with one another. The teacher should pull all learners back in for whole-class feedback and collect meaningful explanations from learners.

Group work/Collaborative Learning /Digital Literacy learning: Place learners into small mixed-ability groups. Ask learners to discuss the types and characteristics of manufactured boards. The teacher should circulate the classroom ensuring all learners are supported and participating in the discussion. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Experiential learning: Take learners on a trip to a manufactured board industry to observe activities involved in the manufactured board process. Task learners in mixed-ability groups to identify and explain the types and characteristics of manufactured boards. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Key Assessment (DoK)

1. **Level 1**: Identify at least three types of manufactured boards made from wood and non-wood residues.
2. **Level 2**: Sketch the structure of at least three types of manufactured board.
3. **Level 3**: Discuss the uses of engineered wood in the Ghanaian infrastructure industry.

Unit 1 Review

Unit 1 of weeks 14 and 16 exposed learners to the types of manufactured boards made from wood and non-wood residues. The pedagogical exemplars used in this section included talk for learning, group work/collaborative learning, digital learning and experiential learning, which helped to meet the varied needs of all learners. These strategies enable learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies, such as oral/written presentations, class exercises, homework, and practical group activities, are structured to cater for all the varied activities of learning. These assessments were classified under the DoK level 1, 2 and 3.

Resources

Pictures, videos, real objects (woods species)

Reflection

Are learners able to differentiate between the various types of manufactured boards?

References

1. Oriented Strand Board (OSB). APA - The Engineered Wood Association. Retrieved from https://www.apawood.org/oriented-strand-board-osb
2. Walton, J., (1970). Woodwork Theory in and Practice (metric edition).
3. www.booktopia.com.au
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UNIT 2

Strand: **Automotive Technology**

Sub-Strand: Introduction to Vehicle Technology

Learning Outcomes: *Detect problems in vehicle transmission and braking systems.*

Content Standard: Demonstrate knowledge and understanding of vehicle technology subsystems.

Learning Indicators: *Identify the components of vehicle transmission systems and explain their functions.*

INTRODUCTION AND UNIT SUMMARY

This unit introduces learners to the components of vehicle transmission systems and explains their functions**.** A vehicle transmission system is a device that transfers the engine's power to the road wheels, allowing the car to move. During this procedure, the engine produces enough power to turn the wheels, requiring the engine and transmission to be connected. The teacher will guide learners to define vehicle transmission systems, list the types of vehicle transmission systems, identify components of vehicle transmission systems and explain the function of the components of vehicle transmission systems.

The unit covers only weeks 14 & 17: ***Identify the components of vehicle transmission systems and explain their functions***

SUMMARY OF PEDAGOGICAL EXEMPLARS

For this unit to be achieved, learners must fully participate in the definition of vehicle transmission systems, list types of vehicle transmission systems, identify components of vehicle transmission systems and explain the function of the components of vehicle transmission systems. The teacher should employ pedagogies such as group work/collaborative learning, experiential learning and project-based learning. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individual learning. All learners, irrespective of their learning abilities should be encouraged to participate fully in the definition of vehicle transmission systems, listing the types of vehicle transmission systems, and identifying the components and functions of vehicle transmission systems. However, make considerations and accommodations for the different groups. Offer below-average/approaching proficiency learners the opportunity to make oral presentations and use samples of real objects in the definition of vehicle transmission systems, listing the types of vehicle transmission systems and identifying the components and functions of vehicle transmission systems. Extend activities for the above-average/highly proficient learners.

ASSESSMENT SUMMARY

To demonstrate conceptual understanding of the ideas covered in this unit, learners must show how they apply the concepts in practical settings. Levels 1, 2, and 3 of the DoK should, therefore, be thoroughly addressed in the evaluations. Teachers should use a variety of formative assessment techniques, including reports, oral and written presentations, home assignments and pair-work

activities, to collect information about students' progress and give timely feedback. Teachers should administer the following assessments and document learners' results in continuous assessment logs:

1. Class exercises (including individual worksheets) after each lesson
2. Homework
3. Scores on practical group activities

WEEK 14 AND 17

Learning Indicator(s): *Identify the components of the vehicle transmission system and explain their functions.*

Theme or Focal Area: Components of Vehicle Transmission System

Introduction

The mechanism that transmits the power created by a vehicle engine to the driving wheels is called the Transmission System (or Drive Train). In some regions, the term transmission system refers to the whole drive train such as engine, clutch, gearbox, propeller shaft, differential, and final drive shafts. Apart from a vehicle, it is used in other applications to provide speed and torque conversion from a rotating power source to another device.

Layout of vehicle conventional transmission system

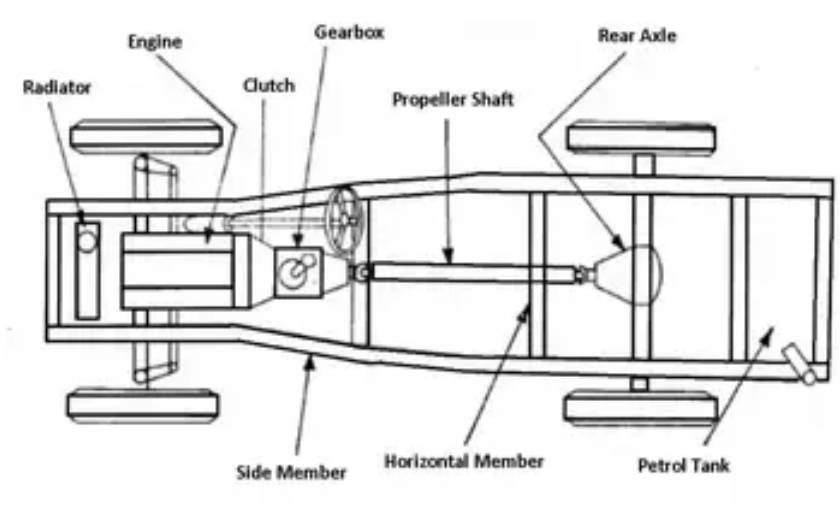


Fig 4.9: *Transmission system.*

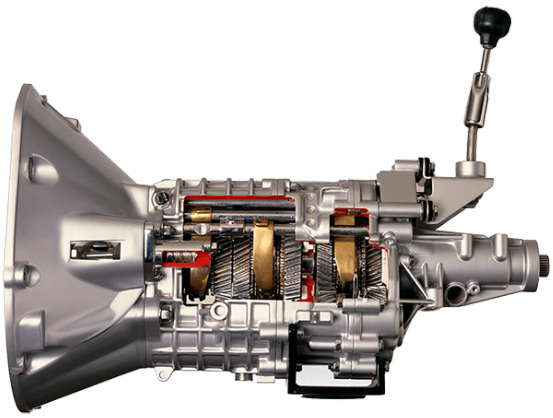
Types of transmission systems

The following transmission systems are used in motor vehicles:

1. Manual Transmission System (MT)
2. Automatic Transmission System (AT)
3. Automated Manual Transmission System (AM)
4. Continuously Variable Transmission System (CVT)

Identification of components of the vehicle transmission system

Table 4.1: *Components of the vehicle transmission system.*

S/N	COMPONENT	NAME
1		Clutch
2		Gearbox
3		Propeller shaft
4		Universal joint
5		Rear axle

S/N	COMPONENT	NAME
6		Wheel
7		**Tyre**

Transmission system component functions:

1. **Clutch**
   i. The clutch is used to disengage the engine from the drive train while the vehicle is stationary.
   ii. It enables the changing of gears without damaging the gearbox.

2. **Gearbox**
   i. **Change gear ratio:** The gearbox changes gear ratio to match driving conditions. It allows the driver to manually change the gear ratio as per the speed and road conditions.
   ii. **Transfer power to the wheels:** The gearbox transfers the required amount of power from the engine to the wheels at different speeds. This allows for optimising fuel efficiency and performance.
   iii. **Control the speed:** The gearbox controls the car›s speed by allowing the driver to slow down or speed up the car by selecting the appropriate gear and moving in either direction.
   iv. **Offers torque:** The gearbox multiplies the engine›s torque output to offer more power to the wheels, enabling the vehicle to drive through steep inclines.

3. **Propeller shaft**

   The function of the propeller shaft is to transmit torque between the transmission, the transfer case and the driving axles. The propeller shaft makes it possible to connect two axes of rotation, which are not exactly in the same plane.

4. **Universal joints**

   Universal joints allow drive shafts to move up and down with the suspension while the shaft is moving so power can be transmitted when the drive shaft isn't in a straight line between the transmission and drive wheels. Rear-wheel-drive vehicles have universal joints (or U-joints) at both ends of the drive shaft.

5. **Rear axle**
   i. Transmits power from the differential to the wheels.
   ii. Carries the weight of the vehicle.

6. **Wheel**

   The car wheel is one of the essential parts of a vehicle. It produces a rotatory function and moves the car from one point to another.

Tyre functions

1. Carries the weight of the vehicle.
2. Propels the vehicle without skidding.
3. Provides cushioning to the vehicle against road shock.
4. Enables the vehicle to change direction and turn without slipping.
5. Transmits acceleration, braking and cornering forces to the ground.

Learning Tasks

1. Create a definition for vehicle transmission systems.
2. List types of vehicle transmission systems.
3. Identify the components of a vehicle transmission system.
4. Explain the function of the components of a vehicle transmission system.

Pedagogical Exemplars

The teacher should consider the following activities:

Problem-Based Learning: Place learners in groups to define and list types of vehicle transmission systems. To induce students to participate in the discussion, the teacher should ask the group questions whilst they are discussing amongst themselves. When the class is back together, the teacher should collate feedback from all groups.

Group work/Collaborative Learning: Place students in mixed-ability groups and assign them to discuss the components and their functions of the transmission systems respectfully and openly. The teacher should go around the classroom making sure that every student is getting help and contributing to the discussion. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Experiential learning: Guide learners in GESI-responsive groups of five to visit an efficient vehicle repair and maintenance shop to identify the components of the transmission systems, then write down their functions and present a report. The teacher should ensure that learners obey and abide by the rules and regulations of the workshop, as well as provide feedback to learners on their reports and emphasise their importance in real-life situations.

Key Assessment (DoK)

1. **Level 2:** Describe a vehicle transmission system
2. **Level 1:** List at least three types of vehicle transmission systems
3. **Level 2:** Identify at least five components of a vehicle transmission system
4. **Level 3:** Explain the function of the components of a vehicle transmission system

Unit 2 Review

This unit covered lessons taught in week 14 & 17. This unit exposed learners to the concept of vehicle transmission systems. The pedagogical exemplars used in this section included problem-based learning, group work/collaborative learning and experiential learning, which helped to meet the varied needs of all learners. These strategies enable learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies such as oral/written presentations, class exercises, homework, and practical group activities were structured to cater for all varied activities of learning. These assessments were classified under the DoK level 1, 2 and 3.

Additional Reading

1. Key knowledge, skills and competencies
2. Transmission components layout
3. Function of transmission components
4. Braking system components
5. Types of braking systems
6. Takeaway key concepts
7. Automatic gearboxes
8. 4-wheel drives

Resources

Models of transmission layouts, charts/sketches, real objects and local vehicle repair workshop

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UNIT 3

Strand: **Building Construction Technology**

Sub-Strand: Pre-Construction Activities

Content Standard: Demonstrate knowledge and understanding of the roles of building construction personnel.

Learning Outcome: *Demonstrate knowledge of human resource requirements in building construction.*

INTRODUCTION AND UNIT SUMMARY

The roles of professionals in the building construction industry are diverse and vital in ensuring the success and sustainability of projects. These roles commence with the Stakeholders' Forum where the viability of the building project is assessed, and the brief determined. The design team based upon the brief produces all the necessary documents leading to the conduct of tender to select the contractor. These activities happen at the pre-contract stage. The post-contract stage begins with the signing of the building contract between the client and the contractor. The contractor subsequently takes possession and mobilises to the site. After mobilisation, the building team begins the construction work alongside the supervisory roles played by the design team and the statutory authorities. At practical completion, the building is handed over to the client to use. This includes the defects liability period, which is followed by the final handover with its attending protocols.

The unit covers only weeks 15 and 17: ***Describe the roles of professionals in building construction projects.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

The experiential learning strategy will be used through the organisation of field trips to construction sites and offices of professionals to observe and interact with them as they progress with both pre-contract and post-contract activities. This strategy will help all learners, especially those who learn best through visual and practical experience, to gain knowledge. Research using the internet, as well as other materials, is recommended to help deepen the learner's understanding of the role of professionals, especially in the international environment. This strategy will help all learners, especially those who excel in imagining and assimilating from text and other similar materials.

Collaboration, brainstorming and critical thinking combined is a one-stop strategy for the whole class comprising the approaching proficiency, the proficient and the highly proficient all of which shall be placed in mixed-ability groupings. The ability to understand, think critically and brainstorm about (1) the roles of the professionals and (2) recall the technical terms associated with the professional works and stages will be enhanced through field trip experiences and research work. For successful outcomes, GESI, SEL and National Values are to be infused to enhance the performing environment for collaboration, brainstorming and critical thinking sessions.

ASSESSMENT SUMMARY

The assessments to be used to monitor the progress of learning during instruction should be formative and include quizzes and short oral and written responses to questions. Teachers must keep track of the performance of each learner given his or her unique level of approaching proficiency, the proficient and highly proficient and provide the relevant motivation or scaffolds to enhance the understanding

of the roles of professionals within the building construction industry. The assessment will also serve as a tool to evaluate the depth of knowledge (DoK) among learners approaching proficiency, the proficient and highly proficient. In this way, the pedagogical differentiation strategies adopted will be mirrored under assessment as well.

WEEK 15 AND 17

Learning Indicators: *Describe the roles of professionals in building construction projects.*

Theme or Focal Area(s): The Roles of the Professionals in Building Construction Projects

The roles of professionals in the building construction industry commence at the Stakeholders' Forum where the viability of the building project is assessed and the brief determined. The Design Team, based upon the brief produces all the necessary documents leading to the conduct of tender and selection of the contractor at the pre-contract stage. The post-contract stage which begins with the signing of the building contract between client and contractor subsequently leads to the contractor taking possession and mobilising to the site. After mobilisation, the building team begins construction work alongside the supervisory roles played by the design team and the statutory authorities.

After practical completion comes the defects liability period when the building is handed over to the client to use for six months. After the defects liability stage, the contractor makes good the defects that are identified and subsequently goes through the final handover protocols.

Key roles of professionals

1. **The Architect:** As a professional, designs, and prepares working drawings and specifications for the building based on the client's brief at the pre-contract stage. He or she after tender and signing of the building contract between client and contractor chairs site meetings, inspects the works with the help of the clerk of works, approves payment certificates and supervises practical completion and final handover procedures all at the post-contract stage.
2. **The Quantity Surveyor (Q.S.)**: Prepares the Bill of Quantities, which describes the work to be done, the quantities involved and the price at which the work is to be performed. He or she conducts the tender by inviting all eligible contractors to price an unpriced Bill of Quantities he or she has prepared to select the most appropriate main contractor for the project at the end of the pre-contract stage. At the post-contract stage, the Q.S. vets the interim payment certificates, as well as all other relevant documents for payments to be made. Final accounts and final payment certificates are prepared by the Q.S. for the final handover of the work to the client.
3. **The Structural Engineer**: At the pre-contract stage, he or she designs and prepares the necessary working drawings for the structural work, including the foundations, columns, beams, floor slabs, staircases and roof trusses in such a way that the building would not fail or collapse. These designs and drawings are usually in line with the Architect's designs and drawings. He or she inspects and tests the structural work at the post-contract stage to ensure that the work conforms to the required details and regulations.
4. **The Electrical and Mechanical Engineers:** Respectively design and prepare drawings for services work, such as electrical and water supply installations, based on the architectural design at the pre-contract stage. They inspect and test the services work at the post-contract stage to ensure that the work is done according to the details given in the drawings.
5. **The Contractor:** He or she is usually invited to tender for the work after the drawings and other documents have been prepared towards the end of the pre-contract stage.

The contractor is usually appointed based on winning the tender process. This is most often scored on the competitiveness of their tender figures/prices, method statements and programme of work when compared to the project requirements. A contract is then signed with the client to perform the work.

Upon signing contractual agreements with the client, the contractor is given contract documents, including the building drawings, bill of quantities and conditions of the contract to follow. They take possession of the site, mobilise and begin the work.

While the main contractor performs the main work, sub-contractors may complete additional work such as the installation of electrical and mechanical services.

To ensure a successful project that is in line with budget, quality and timescales, the contractor may be subject to inspection by the architect and team of consultants as well as statutory authorities at pre-arranged times.

Learning Tasks

1. Using the appropriate operative technical terms, recall and explain the basic activities professionals perform in their order as observed on site.
2. List the activities undertaken by professionals and classify them under the broad conceptual stages of pre-contract and post-contract.
3. What activities performed by professionals lead to checks and balances in the procurement system and a product that is in line with quality expectations, budgetary requirements and timelines for a project?

Pedagogical Exemplars

Experiential learning: Organise field trips to construction sites or offices where all learners can interact with the professionals and gain an understanding of the work the onsite professionals do.

Digital learning: Using the internet, learners research different professional practices applicable to the Ghanaian building construction industry.

Collaborative learning/critical thinking: Place learners in mixed-ability groupings where the different needs of learners approaching proficiency, proficient and highly proficient will be met. Encourage all learners to engage in critical thinking and brainstorming to support understanding around professional practice, checks and balances within the procurement system and how this practice can lead to savings of time and cost while maintaining good quality.

Key Assessment (DoK)

1. **Level 1:** List the main professionals involved in the design of a building.
2. **Level 2:** Explain the specific aspects of design that the main professionals involved in the design of a building produce.
3. **Level 2:** Categorise the construction tasks, activities and protocols performed by professionals into the pre-contract and post-contract stages of the procurement process.
4. **Level 3:** Explain how inspection by the architect and the team of designers at the post- contract stage can enhance the improvement of the work.

Unit 3 Review

This unit covers the lesson taught in weeks 15 and 17. This unit provided learners with a deeper understanding of the roles of professionals in building construction projects. The pedagogical exemplars used included experiential learning, which entails the organisation of field trips to the site to enable learners to interact with and understand professionals. Digital learning was used to research different professional practices applicable to the Ghanaian building construction industry. Placing learners in mixed-ability groupings to collaborate and critically think was used to enhance understanding of professional practice, which leads to checks and balances, as well as saving time and cost while maintaining good quality.

Various assessment strategies such as oral/written presentations, class exercises, homework, and practical group activities were structured to cater for varying levels of learning. These assessments were classified under the DoK level 1, 2 and 3.

Resources

Access to construction industry sites, Internet access

Reference

1. Hackett, M.; Robinson, I. and Statham, G. (2007). The Aqua Group Guide Procurement, Tendering and Contract Administration. Blackwell Publishing
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UNIT 4

Strand: **Electrical and Electronic Technology**

Sub-Strand: Electronic Devices and Circuits

Content Standard: Demonstrate understanding of diodes as electronic devices and apply them in designing electronic circuits.

Learning Outcome: *Employ knowledge of the construction and operation of diodes to design and construct electronic circuits.*

INTRODUCTION AND UNIT SUMMARY

Understanding the disparities between electrical and electronic circuits is crucial in engineering and technology. Despite their shared aim of managing current flow, they possess distinct characteristics and functions. Electrical circuits, foundational in electrical engineering, manage power transmission and distribution using basic components such as resistors and capacitors. Their design adheres to classical physics principles, focusing on energy transfer and parameter management. In contrast, electronic circuits, a subset of electrical engineering, employ active components such as transistors and diodes to process and control electrical signals. This enables complex operations such as signal processing

and data transmission. While electrical circuits form the basis of power systems, electronic circuits enhance functionality in consumer electronics, telecommunications and computing. Recognising these differences is vital for selecting appropriate components and design methods. This unit aims to clarify the nuances between these circuit types, facilitating a deeper understanding for the learners.

The unit covers only weeks 15 & 18: ***The concept of electrical and electronic circuits.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

In teaching the differences between electrical and electronic circuits, employing diverse pedagogical methods is paramount. Visual aids like diagrams and charts clarify the components and operations of both circuits and facilitate comprehension. Hands-on activities, such as constructing circuits, strengthen theoretical understanding through direct interaction. Simulation software provides a virtual platform for experimenting with circuit configurations, offering invaluable insights into design and behaviour. Interactive demonstrations offer real-world examples, enhancing understanding through practical observation. Case studies demonstrate how electrical and electronic engineering is applied in various industries, encouraging exploration of its diverse applications. Problem-based learning tasks students with real-world challenges, promoting critical thinking and deeper understanding. Collaborative learning environments encourage shared insights and mutual learning, enriching comprehension. By integrating these approaches, educators can effectively nurture learners' grasp of the differences between electrical and electronic circuits, fostering active learning and critical thinking.

ASSESSMENT SUMMARY

Assessment for this unit encompasses a diverse range of methods to evaluate learners' understanding and proficiency. It addresses theoretical knowledge, practical skills, and critical thinking abilities essential for navigating modern electronic systems. Assessments include quizzes, tests, and written assignments to gauge learners' grasp of fundamental principles such as Ohm's Law and circuit analysis techniques. These assessments challenge learners with questions ranging from basic recall to complex problem-solving, assessing their ability to effectively apply theoretical concepts to practical scenarios. Practical assessments, conducted through laboratory exercises and experiments, evaluate learners' hands-on skills and their ability to work with circuit components.

WEEK 15 AND 18

Learning Indicator(s): *Explain the concept of electrical and electronic circuits.*

Theme or Focal Area: The Concept of Electrical and Electronic Circuits

Electrical Circuits

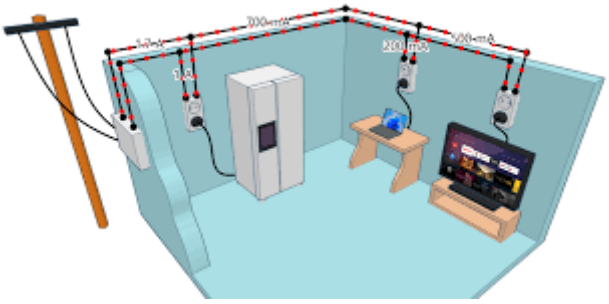

Fig. 4.10: *Electrical circuit*

An electrical circuit forms either a continuous loop or a closed loop. A continuous loop or pathway allows the flow of electric current. Comprising diverse elements such as power sources, conductors, switches, resistors, capacitors, inductors and loads, these circuits are interconnected by wires or conductive materials. A closed-loop electric circuit allows electricity to flow. They serve to regulate electricity flow, facilitating the operation of diverse electrical devices and systems. Examples include electric lamps, motors, generators, etc.

Electronic Circuits

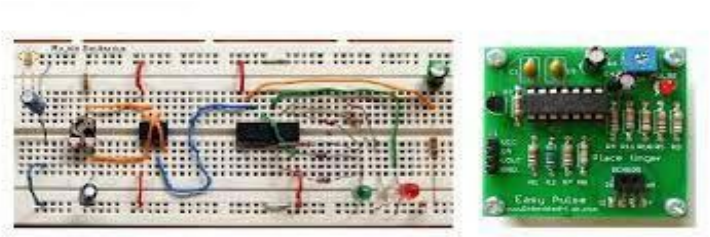

Figure 4.11: Electronic circuit.

An Electronic Circuit is a collection of interconnected electronic components that work together to perform a specific function or task. These circuits are commonly used in a wide range of electronic devices, such as computers, smartphones, televisions and many other electronic systems. The basic building blocks of an electronic circuit are electronic components, which can include resistors, capacitors, inductors, diodes, transistors, integrated circuits (ICs) and various other devices.

Differences between Electrical and Electronic circuits: Electrical circuits and electronic circuits are both systems that allow the flow of electricity to perform various functions. However, apart from variations in their definitions, there are significant differences between the two.

Below are some of the key distinctions:

Aspect	Electrical circuits	Electronic circuits
Definition	Circuits that convert electrical energy into other forms like heat, light, etc.	Circuits that control the flow of electrons to perform specific tasks.
Components used	Components like switches, fuses, resistors, capacitors and inductors may be used. They primarily rely on passive components, which do not require an external power source to operate.	They use a wide range of active and passive components, they heavily rely on active components like transistors and integrated circuits (IC). Active components require an external power supply to function and are essential for amplifying and controlling signals.
Complexity	They are generally simpler and more straightforward with the primary goal of transmitting power and performing basic control functions.	They can be highly complex due to the integration of various active and passive components. The complexity allows electronic circuits to perform sophisticated signal processing and logic operations.
Application	They are commonly found in power distribution systems, homes, commercial buildings and industrial facilities for delivering electricity to different devices and systems.	They are used in a wide range of applications, including consumer electronics, telecommunications, control systems, computers, medical devices and many other electronic devices and systems.
Voltage levels	They typically operate at higher voltage levels, ranging from tens of volts to thousands of volts in power distribution systems.	They operate at much lower voltage levels, ranging from a few volts to a few hundred volts in most cases. However, there are exceptions like high-voltage power electronics.
Power consumption	Higher power consumption.	Lower power consumption.
Safety	Generally, less safe due to higher voltages.	Safer due to lower voltages and power requirements.

Learning Tasks

1. Explain how both types of circuits use resistors, capacitors and inductors in their design.
2. Describe what an electronic circuit is and how it differs from an electrical circuit.
3. How do the voltage and current levels differ between electrical and electronic circuits?
4. Explain how the components used in electrical circuits differ from those used in electronic circuits.

Pedagogical Exemplars:

Talk for learning: Watch a video of an electronic circuit and an electrical circuit. Brainstorm the meaning of an electronic circuit and how it differs from an electrical circuit. To push thinking, the teacher should use prompting questions to learners as they discuss with one another. Pull all students back in for whole-class feedback and to collect definitions.

Group work/collaborative learning: Place learners into mixed-ability groups and task them to co-operatively discuss the description of voltage and current levels and how these differ between electrical and electronic circuits. The teacher should go round the classroom to ensure all learners are supported and participating in the discussion. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Experiential learning: Learners undertake an educational visit to a local electrical and electronic workshop or go to the school's workshop where learners observe components used in electrical circuits and electronic circuits. Task learners to explain the differences between them, etc.

Key Assessment (DoK)

1. **Level 2:** Explain three key differences between electrical circuits and electronic circuits in terms of components used and their applications.
2. **Level 2:** In terms of their application, differentiate between electrical and electronic circuits.
3. **Level 3:**
    i. Compare the complexity and power consumption of electrical and electronic circuits in terms of design and functionality.
    ii. Describe three applications of electrical and electronics circuits and industries where electrical and electronics are used.
    iii. Explain at least two safety consideration variations between electrical and electronic circuits due to their differences in voltage and current.

Unit 4 Review

Through exploration of their unique characteristics, applications and voltage levels, the unit provided learners with an understanding of the differences between electrical and electronic circuits. Practical examples illustrated electronic circuits' applications in telecommunications, computing and consumer electronics. Hands-on activities reinforced learning, aiding learners in effectively grasping complex concepts. Assessment tasks evaluated learners' comprehension through practical assessments and problem-solving tasks. These assessments gauged theoretical understanding, circuit design proficiency and troubleshooting skills. Criteria included accuracy, clarity and practical application of knowledge. Overall, the unit offered learners a comprehensive understanding of circuit principles and practical skills, empowering them to apply this knowledge effectively in real-world scenarios.

References

1 Electronic Tutorials. Assessed April (2024). electronic tutorials - Search (bing.com)

UNIT 5

Strand: **Metal Technology**

Sub-Strand: Welding Technology

Content Standard: Demonstrate knowledge and understanding of tools and equipment for welding.

Learning Outcome: *Apply the principle of gas and arc welding to produce artefacts and solve problems in sheet metal and metal plate fabrication.*

INTRODUCTION AND UNIT SUMMARY

This unit covers electric arc welding, which is one of the most versatile welding processes, allowing learners to join a wide range of metals and alloys. Understanding this technique opens opportunities to work with various materials, including steel, aluminium, copper and their alloys. Studying electric arc welding in metalwork equips learners with valuable skills that are in demand across multiple industries, enhances career prospects and enables learners to work with a diverse range of materials and applications. Teaching electric arc welding requires a combination of pedagogical strategies to ensure effective learning and skills development. By combining these pedagogical strategies, teachers can create a comprehensive and engaging learning environment for effectively teaching electric arc welding. Tailoring instruction to meet the diverse needs of learners and integrating theory with hands-on practice are key elements in welding education. In this unit, various assessment levels are used to evaluate the proficiency and competency of learners. These assessment levels help ensure that learners meet industry standards, produce high-quality welds and maintain safety practices.

The unit covers only weeks 16 & 18: ***Describe various tools and equipment for electric arc welding.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Learners carry out an educational visit to a local welding workshop or school workshop where the set up and the use of tools and equipment are explained. Guide learners to make appropriate reference to the equipment used in electric arc welding using relevant resources. Conduct small group sessions to ensure personalised attention and hands-on guidance. This approach allows teachers to address individual learning needs, answer questions and provide immediate feedback.

ASSESSMENT SUMMARY

To demonstrate conceptual understanding of the ideas covered in this unit, learners must show how the concepts are applied in real-world situations. As a result, levels 1, 2 and 3 of the DoK should be substantially covered in the assessments. Once more, to gather data regarding learners' progress and provide timely feedback, teachers should utilise a range of formative assessment tools, including pairs of tasks, reports, oral and written presentations and home assignments. Teachers should administer tests such as class exercises (including individual worksheets) after each lesson, homework, scores on practical group activities on the tools and equipment for electric arc welding and document students' results in continuous assessment records. Tasks should encompass the significance, diverse branches and career prospects, and dispel misconceptions surrounding applied technology. This ensures students grasp the broader context and relevance of technology across different domains.

WEEK 16 AND 18

Learning Indicator(s): *Describe various tools and equipment for electric arc welding.*

Theme or Focal Area: Tools and Equipment for Electric Arc Welding

Electric arc welding

Arc welding is a type of welding process that uses an electric arc generated by a welding machine to create heat to melt and join metals. A power supply either direct current (DC) or alternating current (AC) creates an electric arc between a consumable or non-consumable electrode and the base material using currents.

Consumable electrodes: They are electrodes that melt down during welding and subsequently deposit on the weld bead.

Non-consumable electrodes: These electrodes have higher melting points and do not directly melt into the metal throughout the welding process. Converse to consumable electrodes, a non-consumable act solely as heat-generating arcs during metal fusion. It remains intact throughout the welding.

Tools and equipment for arc welding

1. **Welding machines:** These are machines that produce the current needed for arc welding.

Fig. 4.12: *Welding machine.*

There are three types of welding machines:

i. **Generator welding machines**: They are operated by gasoline or diesel engines. Welding generators are quite cheap to buy but expensive to maintain. They have the advantage that they can be used at sites where electricity is not available.
ii. **Transformer welding machine**: Transformer welding machines operate on an electrical supply. The transformer reduces the high voltage of 220V to a low voltage and provides the appropriate current for welding. Transformer welding machines are strongly built, light and run quietly. They cannot be used at sites where there is no electricity.
iii. **Transformer-rectifier welding machine**: Transformer-rectifier welding machines convert alternating current (AC) supply power into direct current (DC) welding supply. They contain a transformer, which converts the high-voltage supply into a low-voltage but high current and a rectifier, which changes the alternating current (AC) to direct current (DC).

2. **Electrode holder:** A handle-like piece of equipment used to grip the electrode when welding.

Fig. 4.13: *Electrode holder.*

3. **Ground clamp:** A metal connection joined to the end of the electrical cable that connects the work or the worktable.

Fig. 4.14: *Ground clamp.*

4. **Wire brush:** A brush with stainless steel bristles used for cleaning the weld bead after chipping. Before welding, wire brushes are used to clean the base metal surface, removing rust, mill scale, dirt, oil, grease and other contaminants. Proper surface preparation with a wire brush ensures good weld penetration, adhesion and quality by promoting proper fusion between the base metal and the filler metal.

Fig. 4.15: *Wire brush.*

5. **Welding hand shield:** A hand-held welding mask used to protect the face from ultraviolet rays during welding. Welding hand shields play a crucial role in protecting welders from arc radiation, UV light, heat, sparks and molten metal splatter during welding tasks. They enhance safety, visibility, comfort and compliance with safety regulations, making them indispensable tools in welding operations.

Fig. 4.16: *Hand-held shield.*

6. **Welding helmet:** A type of personal protective equipment with a protective lens used to protect the throat, face, forehead and eyes from ultraviolet rays during welding. Welding helmets are an

indispensable piece of safety equipment for welders, offering comprehensive protection against eye injuries, facial burns, respiratory hazards, electrical risks and occupational exposures in welding operations. They enhance safety, visibility, comfort and productivity while ensuring compliance with occupational safety and health standards in the welding industry.

Fig 4.17: *Welding helmet.*

7. **Welding gloves:** Welding gloves are designed to protect the welder's hands and fingers from burns, sparks and molten metal splatter. They are made of leather such as cowhide/cowskin or flame-retardant materials with insulation against heat and abrasion.

Fig. 4.18: *Welding gloves*

8. **Leather apron:** A garment made from leather usually tied around the waist, worn to protect the underclothing and the body from sparks from the welding process.

Fig. 4.19: *Apron.*

9. **Welding screen or booth:** A welding booth or screen is made up of multiple joined panels that create a semi-enclosed space that gives protection to other people in the work area protection from ultraviolet rays during the welding process. Welding booths play a crucial role in creating a safe, controlled and efficient environment for welding operations, protecting workers, preserving air quality, reducing fire risks and maintaining high standards of weld quality and productivity.

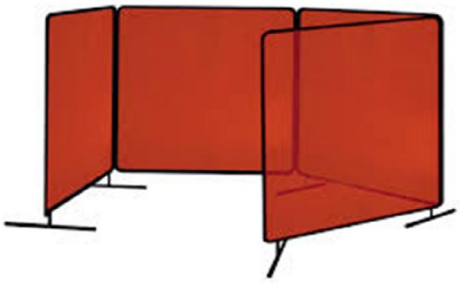

Fig. 4.20: *Welding screen.*

10. **Chipping hammer:** A tool used to remove slag, flux and welding spatter from the welded joint after welding. It has a chisel end for chipping and a pointed end for cleaning welds.

Fig. 4.21: *Chipping hammer. (Source: Chipping hammer - Search Images (bing.com))*

Learning Tasks

1. Explain the electric arc welding process.
2. Explain with line diagrams at least five tools and equipment used in the arc welding process.
3. What is an arc welding machine?
4. Describe the following types of electric arc welding machines.
   i. Transformer welding machine
   ii. Generator welding machine

Pedagogical Exemplars

The teacher should consider the following:

Pre-Assessment: Begin by conducting a pre-assessment to gauge learners' prior knowledge, experience and skills related to electric arc welding tools and equipment. Use quizzes, surveys, hands-on demonstrations or informal discussions to identify learners' strengths, areas for improvement and individual learning needs.

Experiential Learning: Learners undertake an educational visit to a local welding workshop or go to the school's workshop where the set up and the use of tools and equipment are explained. Learners are further guided to make appropriate reference to the equipment used in electric arc welding using relevant resources. Offer differentiated resources such as welding manuals, online tutorials, interactive simulations, virtual welding labs and supplementary readings that cater to diverse learning needs and abilities. Provide access to resources at varying levels of complexity, technical detail and visual presentation to accommodate students with different learning preferences and aptitudes.

Small Group Instruction: When conducting small group discussions, group learners flexibly based on their proficiency levels, prior experience and learning preferences. Consider creating mixed-ability groups for collaborative learning activities, or group learners homogeneously for targeted instruction and practice sessions tailored to their skill levels in electric arc welding. Conduct small group sessions to provide individualised attention and guidance. Facilitate peer learning, collaboration and problem-solving among learners. Encourage discussions, feedback and sharing of experiences within groups.

Scaffolded Learning: Provide ample opportunities for learners to identify electric arc welding tools and equipment. Start with simple exercises and progress to more complex tasks as skills develop. Use real-world projects to apply theoretical knowledge and enhance practical skills. Scaffold the learning process by breaking down complex welding concepts and techniques into manageable steps. Provide structured guidance, step-by-step instructions and welding procedures to support learners as they develop their skills with electric arc welding tools and equipment.

Key Assessment (DoK)

1. **Level 3:** Evaluate the differences between the generator welding machine and the transformer welding machine.
2. **Level 3:** Describe with the aid of a diagram at least five of the following tools used in electric arc welding and demonstrate their uses.
   i. Electrode holder
   ii. Ground clamp
   iii. Welding hand shield
   iv. Welding helmet
   v. Welding apron
   vi. Welding gloves
   vii. Welding booth
3. **Level 4:** Demonstrate the use of the generator welding machine and the transformer welding machine.

Unit 5 Review

This unit reviews the various tools and equipment for electric arc welding. They are essential for beginners in metalwork technology. The lesson equips the learners with the tools and equipment for electric arc welding and their uses. Examples are given for learners to recognise and identify the tools and equipment used. Overall, tools and equipment studied in electric arc welding contribute to the development of skilled, safety-conscious and innovative learners who play a vital role in various industries and contribute to sustainable and quality-driven welding practices.

Reflection

1. What was my best moment in today's lesson and how can I create more of such situations?
2. Were learners able to identify the various tools and equipment for electric arc welding?
3. Were learners able to explain the uses of the various tools and equipment for electric arc welding?
4. Were the learners able to use the tools and equipment for electric arc welding?
5. Which resources best supported the teaching and learning of the tools and equipment for electric arc welding?
6. Did learners find the resources useful for electric arc welding?
7. Were the different subgroups in the class catered for?

Resources

Pictures of the tools and equipment for electric arc welding, videos/YouTube showing how the tools and equipment for electric arc welding are being used, real objects (arc welding machines, electrode holder, ground clamp, welding helmet, welding booth, welding gloves, chipping hammer, electrodes welding goggles, wire brush), sketches, charts and drawings of the tools and equipment for electric arc welding.

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SECTION 5

The section covers the following units (strands); woodwork technology, automotive technology, building construction technology, electrical and electronic technology as well as metal technology.

The learners will acquire the following knowledge and understanding in each of the units:

Woodwork technology: The advantages and disadvantages of manufactured boards from wood and non-wood residues.

Automotive technology: Learners will be able to detect problems in vehicle transmission and breaking systems and gain an understanding of vehicle technology subsystems.

Building construction technology: The mobilisation for building construction.

Metal technology: The use of tools and equipment for welding.

Electrical and electronic technology: An understanding of diodes as electronic devices and how to apply them in designing electronic circuits.

All the above are treated from unit 1 to unit 6.

UNIT 1

Strand: **Woodwork Technology**

Sub-Strand: Material and Artefacts Production Woodwork Industry in Ghana

Content Standard: Demonstrate knowledge and understanding of the utilisation of Manufactured Boards from Wood Residues.

Learning Outcome: *Demonstrate knowledge and understanding of manufactured boards from wood and non-wood residues to describe their types and uses*

INTRODUCTION AND UNIT SUMMARY

This unit will help learners to discover the advantages and disadvantages of manufactured boards over solid wood.

This unit covers week 19: ***Advantages and disadvantages of manufactured boards over solid wood.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

For this unit to be accomplished, learners must explain the advantages and disadvantages of manufactured boards over solid wood. The teacher should employ pedagogies such as critical thinking and talk for learning, group work/collaborative learning and experiential learning. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individually. All learners, irrespective of their learning abilities should be encouraged to participate fully in investigations as well as the presentation of findings. The teacher should implement differentiation strategies to accommodate diverse learning needs.

ASSESSMENT SUMMARY

The concepts in this unit require learners to demonstrate conceptual understanding, including their real-life applications. Hence, the assessments should largely cover levels 1, 2 and 3 of the DoK. Teachers should employ a variety of formative assessment strategies such as oral/written presentations, pair tasks, reports, homework tasks, etc. to collect information about learners' progress and give prompt feedback. Teachers should administer assessments such as class exercises (including individual worksheets) after each lesson, homework, scores on practical group activities on the advantages and disadvantages of manufactured boards over solid wood and document students' results in continuous assessment records.

Week 19

Learning Indicator(s): *Discuss the advantages and disadvantages of manufactured boards over solid wood.*

Theme or Focal Area: Advantages and Disadvantages of Manufactured Boards Over Solid Wood

The advantages and disadvantages of manufactured boards include:

Table 5.1: *Advantages and disadvantages of manufactured board*

No	ADVANTAGES	DISADVANTAGES
1.	Available in large sizes and uniform thickness covers large areas easily.	Adhesives used in manufacturing can be hazardous when inhaled.
2.	Aesthetic flaws like knots can be eliminated, stable-no shrinkage and do not warp.	Adhesives used in manufacturing can also blunt tools quickly.
3.	Boards required very few finishes.	Many traditional woodworking joints cannot be used and the edges are hard to finish.
4.	Some are flexible and easy to bend over formers for laminating.	Boards are prone to absorbing moisture
5.	Residue from timber production can be used in producing manufactured boards.	Cutting and sanding some types of boards generates hazardous dust particles.
6.	Do not experience seasonal defects such as bowing, twisting or cupping.	Delamination may occur after a long period of use.

Learning Tasks:

1. State at least two advantages of manufactured boards over solid wood.
2. Explain at least three advantages of manufactured boards over solid wood.
3. Describe two advantages and two disadvantages of manufactured boards over solid wood.

Pedagogical Exemplars

Critical Thinking and Talk for Learning Approaches: Brainstorm and discuss the advantages of manufactured boards over solid wood. Use prompting questions to push thinking on and encourage learners as they discuss with one another. Pull all students back in for a whole-class discussion to gather feedback and collect meaningful explanations from learners.

Group work/Collaborative Learning /Digital Literacy learning: Place learners into small mixed-ability groups and task them to co-operatively discuss the disadvantages of manufactured boards over solid wood. The teacher should circulate the classroom ensuring all learners are supported and participating in the discussion. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Key Assessment

1. **Level 1**: State at least two advantages of manufactured boards over solid wood.
2. **Level 2**: Explain at least four disadvantages of manufactured boards over solid wood.
3. **Level 2:** Describe at least two advantages and two disadvantages of manufactured boards over solid wood.

Unit 1 Review

Unit 1 of week 19 covered the advantages and disadvantages of manufactured boards over solid wood. The pedagogical exemplars used in this section included talk for learning and group work/collaborative learning, which helped to meet the varied needs of all learners. These strategies enabled learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies such as oral/written presentations, class exercises, homework, and practical group activities were structured to cater for all varied activities of learning. These assessments were classified under the DoK level 1 and 2.

Reflection

Are learners able to explain the advantages and disadvantages of manufactured boards over solid wood?

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UNIT 2

Strand: **Automotive Technology**

Sub-Strand: Introduction to Vehicle Technology

Learning Outcomes: *Detect problems in the vehicle transmission and braking system.*

Content Standard: Demonstrate knowledge and understanding of vehicle technology subsystems.

Learning Indicators: *Evaluate the components of braking systems and state their functions.*

INTRODUCTION AND UNIT SUMMARY

This unit aims to introduce learners to the vehicle braking system. The braking system in a vehicle serves as a fundamental pillar of both safety and control. Its complex mechanisms and components are designed to effectively slow down or halt a vehicle, translating kinetic energy into heat through friction. Brakes are essential for navigating traffic, negotiating corners and responding to sudden obstacles on the road. On completion of this unit, learners will be able to explain the basic principles of the vehicle braking system, the operation of the vehicle braking system and describe the functions of the various components of the vehicle braking system.

This unit covers week 19: ***Evaluate the components of the braking system and state their functions.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

For this section to be achieved, learners must fully participate in the explanation of the basic principles of the vehicle braking system, explain the operation of the vehicle braking system and describe the functions of the various components of the vehicle braking system. The teacher should employ pedagogies such as group work/collaborative learning, experiential learning and project-based learning. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individually. All learners, irrespective of their learning abilities should be encouraged to participate fully. Teachers should make considerations and accommodations for the differing needs of learners. Offer below-average/approaching proficiency learners the opportunity to make oral presentations and use samples of real objects in their explanation of the basic principles of vehicle braking systems, their explanation of the operation of the vehicle braking system and their descriptions of the functions of the various components of the vehicle braking system. Extend activities for the above-average/highly proficient learners.

ASSESSMENT SUMMARY

Learners must demonstrate how they apply the concepts in practical settings to demonstrate a conceptual understanding of the principles presented in this unit. Levels 1, 2 and 3 of the DoK should therefore be thoroughly addressed in the evaluations. Again, teachers should use a variety of formative assessment techniques including reports, oral and written presentations, homework assignments and pairs of activities to collect information about students' progress and give timely feedback. More specifically, teachers should administer the following assessments to learners and record their scores in continuous assessment logs:

1. class exercises (including individual worksheets) after each lesson
2. homework tasks
3. scores on practical group activities.

WEEK 19

Learning Indicator(s): *Describe the components of the braking system and state their functions.*

Theme or Focal Area(s): Introduction to Automotive Braking Systems

A **brake** is a device designed to restrain motion by absorbing energy from a moving system usually through friction. It is used to slow or stop a moving vehicle or wheels.

Principle of operation: Brakes work on the principle of friction. When a moving element is brought into contact with a stationary element, the motion of the moving element is affected. This is due to frictional force, which acts in the opposite direction of the motion and converts the kinetic energy into heat energy.

The conventional brake system is composed of a service brake system and a parking brake system.

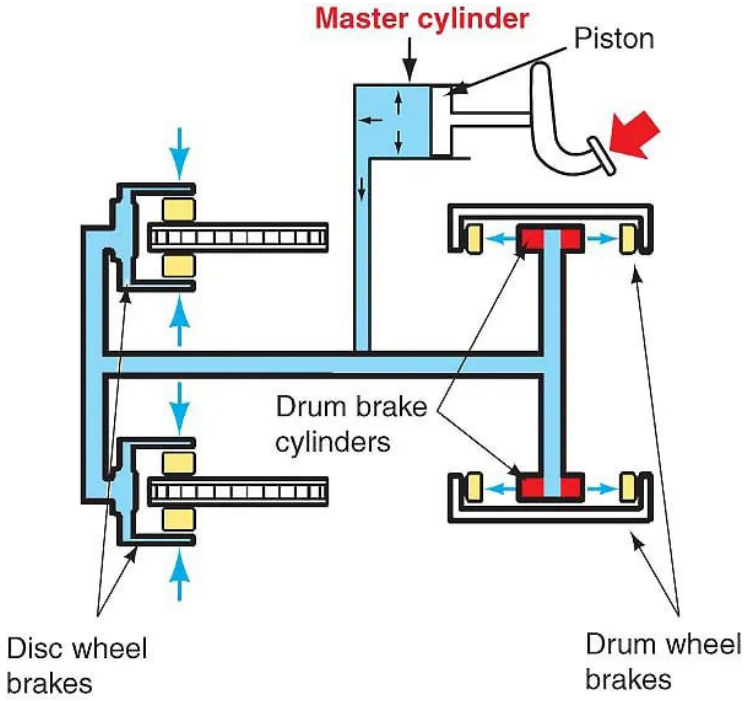

Fig. 5.1: *Brake.*

Brake pedal: The component of a brake system used to activate the brake by pressing it down by foot. It's located in the middle of the accelerator and clutch pedal in a manual transmission.

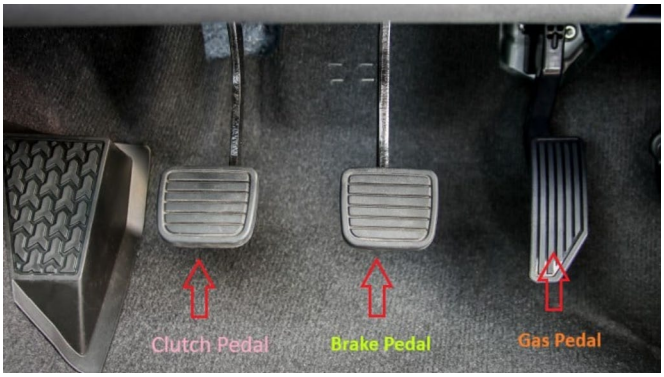

Fig. 5.2: *Brake pedal.*

Master cylinder

The brake master cylinder pushes hydraulic fluid down into the brake lines from the brake fluid reservoir.

Fig. 5.3: *Master cylinder*

Fluid reservoir: The fluid reservoir is the housing where the brake fluid or brake oil is stored.

Fig. 5.4: *Fluid reservoir*

Fluid lines: The fluid lines are the pipes through which the brake fluid flows in the vehicle.

Figure 5.5: *Fluid lines*

Brake pads: The brake pad is a steel backing plate employed on disc brakes. It's often made of ceramic, metal or other hard-wearing composite materials.

Figure 5.6: *Brake pads*

Brake drum: The brake drum is a rotating drum-shaped component used in the drum brake system.

The brake drum is the alternative to a brake rotor when you have a drum brake system. As the drum component spins, the brake shoe goes inside and pushes against it when you step on the brake pedal.

Figure 5.7: *Brake drum.*

Brake shoes: Brake shoes are two pieces of sheet steel joined together so they can carry the brake lining.

Fig 5.8: *Brake shoes.*

Brake disc or rotor: The brake disc is made from cast iron and connected to a wheel or axle, sometimes made of reinforced carbon-carbon, ceramic, or some other composite. Ceramic brake discs for road use are usually carbon-ceramic (carbon fibre reinforced silicon carbide (C/SiC).

Fig 5.9: *Cast Iron brake discs (Rotors).*

Brake lining: A brake lining is a heat-resistant, soft but also tough material with high friction characteristics. It's enclosed inside the brake shoe.

Fig. 5.10: *Brake linings*

ABS Module:

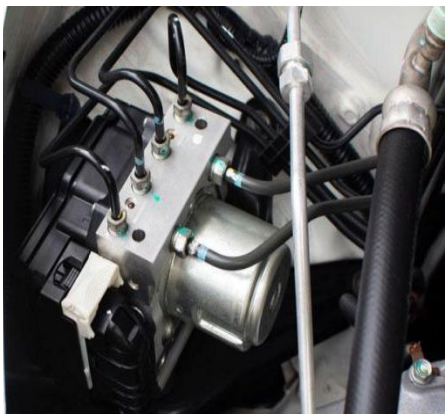

Fig. 5.11: *ABS module.*

Found on vehicles equipped with an anti-lock brake, an ABS module is a computer for the braking system. This computer modulates the brakes when one or more tyres are at the limit of traction.

Learning Tasks

1. Briefly explain the basic principles of the vehicle braking system.
2. Explain the operation of the vehicle braking system.
3. Describe the functions of the various components of the vehicle braking system.

Pedagogical Exemplars

The teacher should consider the following activities:

Problem-Based Learning: Place learners in groups to discuss the basic principles of the vehicle braking system. To encourage participation, the teacher should ask prompting questions while the learners are discussing among themselves. Gather all learners back together for whole-class feedback.

Group work/Collaborative Learning: Place students in mixed-ability groups and assign them to come up with an explanation of the operation of the vehicle braking system. The teacher should go around the classroom making sure every student is getting help and contributing to the discussion. It is possible to assign HP students to assist the teacher in group discussions.

Experiential learning: Guide learners in GESI-responsive groups of five on a visit to a local vehicle repair workshop to observe real objects and the operation of the vehicle braking system. The learner should use sketches to describe the functions of the various components of the vehicle braking system. The teacher must ensure that learners obey and abide by the rules and regulations of the workshop, as well as provide feedback to learners on the description of the functions of the various components of the vehicle braking system.

Key Assessment (DoK)

1. **Level 2:** Briefly explain the principles of the vehicle braking system.
2. **Level 3:** With the aid of a conventional brake system diagram, explain the operation of the vehicle braking system.
3. **Level 3:** Describe the function of five components of the vehicle braking system.

Unit 2 Review

In Unit 2, week 19, learners covered the principles, operation and functions of the various components of the vehicle braking system. The pedagogical exemplars used in this section included problem-based learning, group work/collaborative learning and experiential learning which helped to meet the varied needs of all learners. These strategies enable learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies, such as oral/written presentations, class exercises, homework and practical group activities, were structured to cater for the varying abilities of learners. The assessments were classified under the DoK levels 2 and 3.

Resources

Models of braking systems, charts/sketches, real objects, local vehicle repair workshop

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UNIT 3

Strand: **Building Construction Technology**

Sub-Strand: Pre-Construction Activities

Content Standard: Demonstrate Knowledge and Understanding of Mobilisation for Building Construction.

Learning Outcome: *Establish reasons for mobilisation and determine the schedule of works involved in site preparation.*

INTRODUCTION AND SECTION SUMMARY

Mobilisation is the initial preparatory activity that a contractor undertakes immediately after signing a contract and gaining possession of the construction site. It involves assembling the necessary resources and erecting essential facilities that will create a conducive environment for the successful start and completion of the building works. Mobilisation involves critical tasks such as testing of the soil at the site, site clearance, levelling and other earth works, eradicating or managing the risk of termites, hoarding off the site as well as providing the site with temporary structures, services and access roads.

This unit covers only week 20: ***Discuss the reasons for mobilisation.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Field Trips to new construction sites where mobilisation is in progress will be organised to provide an experiential learning experience to all learners.

Research, using the internet as well as other similar materials will be used to deepen learners' understanding of mobilisation as they compare what happens locally to what is practised internationally. The whole class, comprising of the approaching proficiency, the proficient and the highly proficient will be engaged in collaboration, brainstorming and critical thinking in mixed-ability groupings to share ideas about mobilisation and further find out how it contributes to good quality, good price and progress of the constructional works. To enhance the learning environment at the sessions teachers should ensure that GESI, SEL and National Values are infused. Teachers must keep track of the performance of each learner and provide, where necessary, the relevant motivation or scaffolds to enhance the understanding of the concept.

ASSESSMENT SUMMARY

The assessments to be used to monitor the progress of learning during instruction should be formative and this includes quizzes and short oral and written responses to questions. Teachers must keep track of the performance of each learner given his or her unique level as approaching proficiency, proficient or highly proficient and provide the relevant motivation or scaffolds to enhance their understanding of mobilisation. The assessment will also serve as a tool to evaluate the depth of knowledge among learners approaching proficiency, proficient and highly proficient. In this way, the differentiation strategies adopted under pedagogy shall equally be assessed to observe how successful they have been.

WEEK 20

Learning Indicators: *Discuss the reasons for mobilisation.*

Theme or Focal Area: Reasons for Mobilisation

The critical tasks that confront the contractor as he or she mobilises to the site include testing the soil at the site, site clearance, levelling and other earthworks, eradicating or managing the risk of termites, hoarding off the site, as well as providing the site with the necessary plant and equipment, as well as temporary structures, services and access roads.

1. **Testing the soil at the site:** This process involves taking soil samples and conducting tests to determine their suitability for the recommended foundation types.
2. **Site clearance:** Site clearing is the removal of all obstructions from the land area designated for construction. This includes hazardous materials such as asbestos, topsoil, vegetative cover, trees, roots, and existing structures that no longer serve their purpose.

Fig. 5.12: *Site clearing*

3. **Earthworks:** Earthworks include activities such as using bulldozers and backhoes to excavate elevated portions of the site and fill depressions. The objective is to level the site according to the recommended levels for the construction.
4. **Managing termite risks:** To prevent future termite attacks, the contractor must remove termite hills and treat the soil with appropriate insecticides.
5. **Hoarding off the site:** Hoarding off the construction site, as part of a broader mobilisation process, is a preparatory activity carried out by contractors. It involves the construction of temporary fencing at the perimeter of the site with the major objective of secluding the site and creating an environment conducive to the successful execution of the project.

   Hoarding off the site prevents easy access to the site by unauthorised persons and subsequently enhances security, as well as protecting trespassers from hazards inherent at construction sites.

Fig. 5.13: *Hoarding off the site prevents easy access.*

Learning Tasks

1. List the basic facilities that the contractor installs at a construction site during the mobilisation period.
2. Explain the relevance of activities such as site clearance and termite eradication completed in the mobilisation phase to the building construction process.
3. Explain how activities and facilities provided under mobilisation can save cost and time, and enhance the quality of the entire building project.

Pedagogical Exemplars

The teacher should consider the following activities:

Experiential Learning: Organising field trips to construction sites where mobilisation is in progress for learners to observe and interact with contractors who are involved in mobilisation.

Digital learning: Encourage research on the internet to help learners build a deeper understanding of mobilisation as well as appreciate alternate methods used abroad.

Group work/collaborative learning: Deliberately place learners in mixed-ability groupings where the different needs of learners Approaching Proficiency, the Proficient and Highly Proficient will be met and where they will all be encouraged to engage in critical thinking and brainstorming about mobilisation.

Teachers should move about picking up on both verbal and non-verbal feedback from learners during the brainstorming sessions about the challenges they face. Learners should refer to practical experiences they had on the field trips as solutions or illustrations to some of the challenges they may be facing.

Key Assessment (Dok)

1. **Level 1**: List the major facilities that the Contractor installs at the site during the mobilisation period.
2. **Level 2**: Explain how facilities put in place by the contractor during the mobilisation stage help during the construction stage.
3. **Level 3:** Describe how mobilisation can influence the cost and duration of any project.

Unit 3 Review

In Unit 3, week 20, learners developed a deeper understanding of mobilisation at the start of any building construction project. The pedagogical exemplars used in this section included talk for learning, group work/collaborative learning, digital learning and experiential learning which helped to meet the varied needs of all learners. These strategies enabled learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies such as oral/written presentations, class exercises, homework and practical group activities were structured to cater for the varying abilities of learners. The assessments were classified under the DoK level 1, 2 and 3.

Resources

Visits to the construction industry, research using the internet to find out about processes involved in mobilisation.

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UNIT 4

Strand: **Metal Technology**

Sub-Strand: Welding Technology

Content Standard: Demonstrate knowledge and understanding of tools and equipment for welding.

Learning Outcome: *Apply the principle of gas and arc welding to produce artefacts and solve problems in sheet metal and metal plate fabrication.*

INTRODUCTION TO UNIT SUMMARY

The unit covers the applications of gas welding and electric arc welding and why it is important for beginners in metalwork technology to have a diverse skill set, cost-effective solutions, portability, precision, heat management capabilities and a strong foundation in welding principles, all of which contribute to successful welding projects. These applications demonstrate the widespread use of gas and electric arc welding across industries for manufacturing, construction, repair and maintenance tasks involving metal joining and fabrication. Teaching the applications of gas welding and electric arc welding requires a combination of pedagogical approaches to ensure effective learning and skill development among learners. By combining these pedagogical approaches, teachers can create a comprehensive and engaging learning experience for students studying the applications of gas welding and electric arc welding, facilitating their development in welding practices and education. By using various assessment levels, teachers can obtain a comprehensive understanding of learners' performance, progress and areas needing improvement in learning the applications of gas and electric arc welding. This multi-faceted approach to assessment helps ensure that learners develop a well-rounded skill set and knowledge base essential for success in welding practices.

The unit covers only week 20: ***Indicate the various applications of gas and electric arc welding.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Teaching the applications of gas and electric arc welding involves employing effective pedagogical strategies to ensure students understand the concepts, techniques, and real-world uses of these welding methods. The teacher can use experiential learning, project-based learning and flexible grouping/ collaborative strategies such as small group work, peer tutoring, or collaborative projects, to allow

students to work with peers of similar abilities or interests in identifying the various applications of gas and electric arc welding. Group members should also be rotated periodically to provide opportunities for students to interact with different classmates and learn from diverse perspectives. By integrating these pedagogical exemplars into teaching gas and electric arc welding applications, teachers can create a comprehensive and engaging learning experience that combines theoretical and practical knowledge which will prepare and expose the students to careers in welding and related industries.

ASSESSMENT SUMMARY

To demonstrate an understanding of the applications of gas and electric arc welding, learners must show how they apply the importance of this knowledge in real-world situations. As a result, levels 1, 2, and 3 of the DoK should be substantially covered in the assessments. Once more, to gather data regarding learners' progress and provide timely feedback, teachers should utilise a range of formative assessment tools, including pairs of tasks, reports, oral and written presentations and home assignments. To be more precise, teachers should administer assessments such as class exercises (including individual worksheets) after each lesson, homework, scores on practical group activities on the various applications of gas and electric arc welding and document learners' results in continuous assessment records.

WEEK 20

Learning Indicator(s): *Indicate the various applications of gas and electric arc welding.*

Theme or Focal Area(s): Applications of Gas And Electric Arc Welding

Applications of Gas welding

Gas welding, also known as oxy-fuel welding, is a welding process that uses a combination of fuel gases and oxygen to generate a flame for joining metals. This technique has several applications across various industries due to its versatility and effectiveness. Some of the key applications of gas welding include:

1. **Metal fabrication**: Gas welding is widely used in metal fabrication shops to join different types of metals, including steel, aluminium and copper. It is suitable for both thin and thick metal sections, making it a versatile choice for fabricating metal structures and components.

Fig. 5.14: *Gas welding.*

2. **Repair and maintenance**: Gas welding is often used for repair and maintenance work in industries such as automotive, aerospace and manufacturing. It allows technicians to repair metal parts, components and equipment on-site or in workshops.

Fig. 5.15: *Repair and maintenance with gas welding.*

3. **Construction**: Gas welding is utilised in construction projects for tasks such as welding structural steel beams, joining metal pipes and fabricating metal frameworks for buildings and infrastructure.

Fig. 5.16: *Reinforcement fabrication with gas welding.*

4. **Plumbing and HVAC**: Plumbers and HVAC technicians use gas welding to join copper pipes, fittings and other metal components in plumbing and heating, ventilation and air conditioning systems. (HVAC – Heating, Ventilation and Air Conditioning).

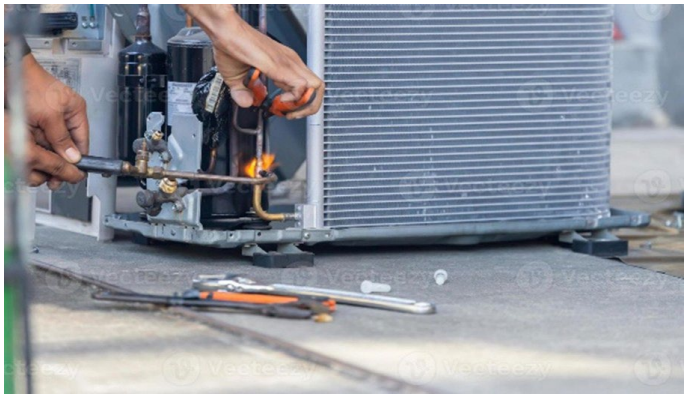

Fig. 5.17: *Plumbing and HVAC.*

5. **Artistic and sculptural work**: Gas welding is popular among artists and sculptors for creating metal artwork, sculptures and decorative pieces. It provides precise control over the welding process, allowing artists to achieve intricate designs and shapes.

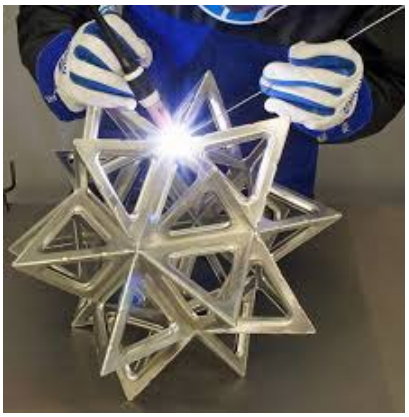

Fig. 5.18: *Artistic and sculptural work.*

6. **Automotive and transportation**: Gas welding is used in the automotive industry for repairing vehicle frames, exhaust systems and other metal components. It is also employed in the fabrication of custom vehicles and transportation equipment.

Fig. 5.19: *Automotive and Transportation.*

7. **Shipbuilding and marine industries**: Gas welding plays a role in shipbuilding and marine repairs for welding hulls, decks and structural elements of ships and boats.

Fig. 5.20: *Gas welding in shipbuilding and marine industries.*

8. **Jewellery making**: In the jewellery industry, gas welding is used for soldering and joining precious metals like gold, silver and platinum to create intricate jewellery pieces.

Fig. 5.21: *Jewellery making with gas welding.*

9. **Welding training and education**: Gas welding is commonly taught in welding schools and vocational training programmes as it helps students learn fundamental welding techniques, safety practices and metal joining principles.

Fig. 5.22: *Teaching gas welding school.*

10. **Home and DIY projects:** Gas welding kits are available for home use, allowing DIY enthusiasts and hobbyists to undertake metalworking projects such as metal furniture, sculptures and repairs. (DIY – Do It Yourself).

Fig. 5.23: *Home and DIY projects.*

Applications of electric arc welding

Electric arc welding is a welding process that uses electricity to create an electric arc between an electrode and the base material, generating the heat required to melt and join metals. This welding method has numerous applications across various industries due to its versatility, efficiency and ability to weld a wide range of materials. Some of the key applications of electric arc welding include:

1. **Construction and structural fabrication**: Electric arc welding is extensively used in the construction industry for welding structural steel components such as beams, columns and trusses. It is also employed in fabricating bridges, buildings and other infrastructure projects.

Fig. 5.24: *Electric arc welding in the construction industry.*

2. **Automotive manufacturing and repair**: Electric arc welding is a crucial process in the automotive industry for manufacturing vehicles and welding components such as chassis, frames, exhaust systems and body panels. It is also used for repairing automotive parts and equipment.

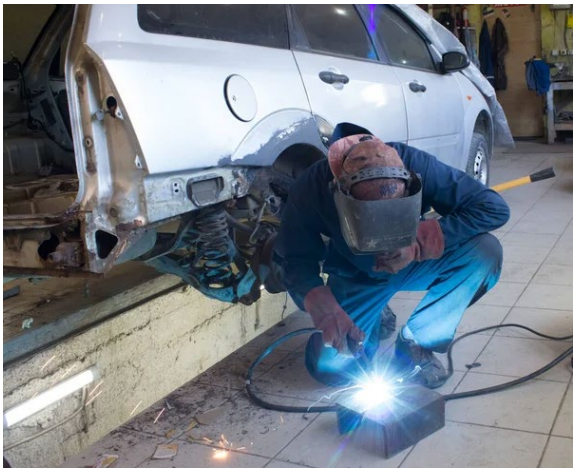

Fig. 5.25: *Electric arc welding in automotive manufacturing and repair. (*

3. **Pipelines and Oil/Gas industry**: Electric arc welding is utilised in the construction and maintenance of pipelines for transporting oil, gas and other fluids. It is used to weld pipeline sections, fittings and related infrastructure in the oil and gas industry.

Fig. 5.26: *Electric arc welding in Pipelines and Oil/Gas Industry.*

4. **Aerospace and aviation**: Electric arc welding is employed in the aerospace sector for fabricating aircraft components, fuselages, wings, and engine parts. It meets the stringent quality and safety standards required for aviation applications.

Fig. 5.27: *Electric arc welding in aerospace and aviation.*

5. **Shipbuilding and marine construction**: Arc welding plays a vital role in shipbuilding for welding hulls, decks, bulkheads, and other structural elements of ships and marine vessels. It is also used for repairing and maintaining ships and offshore platforms.

Fig. 5.28: *Shipbuilding and marine construction.*

6. **Metal manufacturing and fabrication:** Arc welding is used in metal fabrication shops to join a wide range of metals, including steel, aluminium, stainless steel and titanium. It is suitable for fabricating metal structures, machinery, equipment and components.

Fig. 5.29: *Metal manufacturing and fabrication.*

7. **Railroad and transportation:** Electric arc welding is utilised in the railroad industry for welding railway tracks, switches and related infrastructure. It is also used in the manufacturing and maintenance of railcars, locomotives and transportation equipment.

Fig. 5.30: *Railroad and Transportation.*

8. **Industrial maintenance and repair**: Arc welding is used for maintenance and repair work in industrial facilities, including factories, refineries, power plants and processing plants. It helps in repairing equipment, machinery, pipelines and structural components.

Fig. 5.31: *Industrial maintenance and repair.*

9. **Fabrication of consumer goods:** Arc welding is used in the fabrication of consumer goods such as appliances, metal furniture, metal cabinets, metal beds and electronic enclosures. It allows manufacturers to create durable and functional products.

Fig. 5.32: *Fabrication of consumer goods.*

10. **Welding training and education**: Electric arc welding is taught in welding schools, vocational training programs and apprenticeship courses to train welders in various welding techniques, safety practices and welding procedures.

Fig. 5.33: *Welding training and education.*

Learning Tasks

1. Identify at least four applications each of gas welding and electric arc welding.
2. Explain with one or more specific example(s) how gas welding can be used in various industries.
3. Describe with one or more specific example(s) how electric arc welding can be used in various industries.

Pedagogical Exemplars

The teacher should consider the following:

Group work/collaborative learning: Organise the learners into mixed-ability and gender-inclusive groups, and task them to research the specific applications where gas and electric arc welding are used. E.g. Burglar proofing for windows, gates, car body repairs, local containers, metal tables, chairs etc.

Experiential learning: Offer learning experiences on the various applications of gas and electric arc welding through practical workshops, lab sessions, or field trips. Provide learners with opportunities to practice welding using actual welding equipment, such as gas welding torches or electric arc welding machines under close supervision. Start with simple welding tasks and progress to more complex joints and materials on specific applications as learners gain proficiency.

Project-Based Learning: Assign projects that require learners to apply gas and electric arc welding techniques to solve practical problems or create products. Projects could include fabricating a metal structure, repairing a damaged component or designing a welded assembly for a specific application.

Key Assessment (DoK)

1. **Level 1:** Identify at least four applications each of gas and electric arc welding.
2. **Level 3:** Explain at least three applications of electric arc welding in construction projects and describe the advantages of using electric arc welding for these applications.

3. **Level 3:** Explain at least two specific applications each of gas and electric arc welding in shipbuilding and metal fabrication.
4. **Level 4:** Describe at least four specific applications of gas welding in the automotive industry and explain why gas welding should be chosen over electric arc welding.

Unit 4 Review

The unit covered the applications of gas and electric arc welding, which are essential for beginners in metalwork technology. The unit equipped the learners with the knowledge of the applications of gas-electric arc welding. The assessment required learners to explain and appreciate the applications of gas and electric arc welding. In effect, studying the applications of gas welding and electric arc welding reinforces the concepts and understanding of the welding process. This also equipped learners with valuable knowledge, skills and competencies that are essential for success and practice in the welding industry, engineering professions and other technical fields that rely on welding practitioners.

Reflection

1. What was my best moment in today's lesson and how can I create more of such situations?
2. Were learners able to identify the various applications of gas and electric arc welding?
3. Were learners able to apply the knowledge gained in gas and electric arc welding to solve real-life problems?
4. Which resources best supported the teaching and learning of the applications of gas and electric arc welding?
5. Did learners find the resources useful for better understanding to apply?
6. Were the different subgroups in the class catered for?

Resources

Pictures of finished products from gas and electric arc welding processes, videos/YouTube showing some finished products from gas and electric arc welding processes in use, real objects (welded metal gate, welded cylinder cage, burglar proof, welded metal table and chair, welded metal bed, welded metal cloth hanger, etc.)

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UNIT 5

Strand: **Electrical and Electronic Technology**

Sub-Strand: Electronic Devices and Circuits

Content Standard: Demonstrate understanding of diodes as electronic devices and apply them in designing electronic circuits.

Learning Outcome: *Employ knowledge of the construction and operation of diodes to design and construct electronic circuits.*

INTRODUCTION AND SECTION SUMMARY

In the domain of electrical and electronic technology, diodes are essential components shaping modern circuitry. Understanding their principles and operations is crucial for engineers and enthusiasts, enabling the design of efficient electronic systems. Diodes, two-terminal semiconductor devices, exhibit nonlinear current-voltage characteristics, primarily governed by a P-N junction's construction. Rectifier diodes convert AC to DC by allowing current flow in one direction. Zener diodes regulate voltage by operating in reverse breakdown. LEDs efficiently convert electrical energy to light, finding extensive use in indicators and displays. Additionally, Schottky, varactor, and photodiodes serve specific purposes like high-speed switching and light sensing. This introduction explores diode mechanisms and applications, paving the way for creative electronic system designs.

The unit covers only week 21: ***Describe the principles of operation of the various diodes.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Using a variety of instructional strategies is essential when instructing students on the principles and functions of the various types of diodes. Diodes, with their PN junctions, control current flow based on voltage. Rectifier diodes convert AC to DC by allowing one-directional current flow. Through direct involvement, hands-on activities like building circuits increase theoretical comprehension. With the use of simulation software, one may virtually experiment with different circuit configurations and gain important insights into behaviour and design. Interactive displays provide examples from the actual world, improving comprehension through hands-on experience. Case studies illustrate applications in several industries, encouraging investigation into the many domains of electrical and electronic engineering. Learners are given real-world problems to solve through problem-based learning, which encourages critical thinking and deeper comprehension. Collaborative learning settings enhance comprehension by promoting reciprocal learning and sharing insights. Teachers can effectively foster learners' understanding of the various types of diodes incorporating these approaches.

ASSESSMENT SUMMARY

Assessing learners' grasp of diode principles and operations is pivotal in electrical and electronic technology. This assessment focuses on testing comprehension across crucial diode concepts, including the PN junction, rectification, voltage regulation, and specific applications. Tasks will assess learners' capacity to define diode structure and function, emphasising the role of the PN junction in current control. Furthermore, learners will differentiate between diode types, particularly rectifier diodes, and analyse Zener diodes' role in voltage regulation and overvoltage protection. Assessment methods

may include written exams, practical demonstrations, and problem-solving exercises. Exams gauge theoretical knowledge, while practical sessions involve constructing and testing diode circuits like rectifiers. Problem-solving tasks present complex design challenges, evaluating learners' ability to select appropriate diodes based on specifications.

WEEK 21

Learning Indicator(s): *Describe the principles of operation of the various diodes.*

Theme or Focal Area: The Principle of Operation of Some Selected Diodes

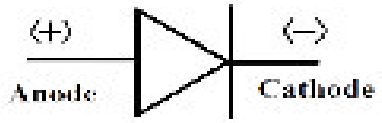
An electronic diode is a two-terminal device that allows current to flow in only one direction. It is a fundamental building block of electronic circuits and is commonly used for rectification, signal modulation and switching purposes. Diodes are typically made from semiconductor materials such as silicon or germanium.

Types of diodes and their applications

There are several types of diodes, each with its own characteristics and applications:

PN Junction Diode

A Picture of a Diode



Symbol of a Diode

Fig. 5.34: *Diode.*

A PN junction diode is a fundamental semiconductor device that allows current to flow in only one direction. It is formed by joining together two types of semiconductor materials: P-type (positively doped) and N-type (negatively doped). Here's how it works:

1. **PN Junction formation:** When a P-type semiconductor material, which has an excess of positively charged 'holes', is joined with an N-type semiconductor material, which has an excess of negatively charged electrons, a junction is formed between them.
2. **Diffusion:** At the junction, due to the concentration gradient, the majority of charge carriers (holes from the P-region and electrons from the N-region) tend to diffuse across the junction. As they cross, they recombine with minority carriers (electrons in the P-region and holes in the N-region) near the junction. This process creates a depletion region, which is devoid of mobile charge carriers and has a net electric field pointing from the N-region to the P-region.
3. **Equilibrium:** Eventually, an equilibrium is reached where the diffusion of carriers across the junction is balanced by the electric field preventing further movement. At this point, a potential barrier, known as the built-in potential, is established across the junction, creating an electric field that opposes the further flow of charge carriers.
4. **Forward bias:** When a forward bias voltage (positive to the P-side and negative to the N-side) is applied across the diode, it reduces the potential barrier at the junction. This reduces the width of the depletion region, allowing the majority of carriers to easily overcome the barrier and current to flow through the diode.
5. **Reverse bias**: Conversely, when a reverse bias voltage (negative to the P-side and positive to the N-side) is applied, it increases the potential barrier at the junction, widening the depletion region. This makes it very difficult for the majority of carriers to cross the junction, effectively blocking the flow of current.

In summary, a PN junction diode works by utilising the properties of a semiconductor junction to control the flow of current in a circuit, allowing current to flow freely in one direction (forward biased) while blocking it in the opposite direction (reverse biased).

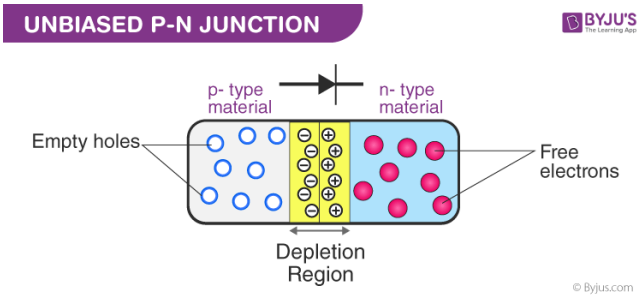
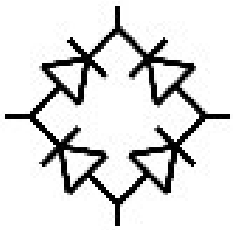
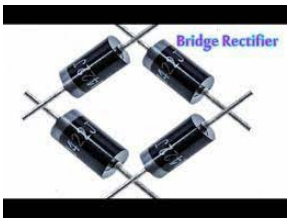


Fig. 5.35: *Unbiased PN Junction Diode*

Rectifier Diode





A picture of a Rectifier *A Symbol of a Rectifier*

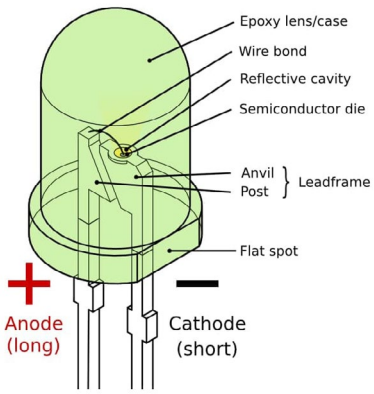
Fig. 5.36: *Rectifier. (Source: Rectifier - Search Images (bing.com))*

A rectifier diode is a semiconductor device used to convert alternating current (AC) into direct current (DC). It is the most common type of diode used for rectification, converting alternating current (AC) to direct current (DC). It allows current to flow in one direction only, blocking it in the opposite direction. Here's a simplified explanation of how it works:

A rectifier diode is typically made of a semiconductor material such as silicon or germanium. It consists of a PN junction, where one side of the junction is doped with a material that introduces an excess of electrons (N-type), and the other side is doped with a material that introduces a deficiency of electrons or "holes" (P-type).

Light-Emitting Diode (L.E.D)

Picture of L.E.D **Symbol of L.E.D**



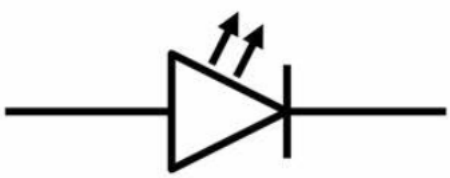


Fig. 5.37: *Light Emitting Diode.*

LEDs are diodes that emit light when current passes through them. They are widely used for indicators, displays, lighting and various applications requiring low-power consumption and long life.

1. **Semiconductor material:** LEDs are made from semiconductor materials, typically compounds like gallium arsenide (GaAs) or gallium phosphide (GaP).
2. **PN Junction:** The heart of an LED is a semiconductor diode, which has two regions: the P-type region (where the majority charge carriers are positively charged 'holes') and the N-type region (where the majority charge carriers are negatively charged electrons). When these two regions are brought together, they form a junction called the PN junction.
3. **Electron movement:** When a voltage is applied across the PN junction (typically by connecting the LED to a power source in a circuit), electrons from the N-type region flow into the P-type region, and holes from the P-type region flow into the N-type region. This movement of charge carriers across the junction is what creates an electric current.
4. **Recombination:** As electrons and holes cross the junction, they recombine at the junction. During recombination, energy is released in the form of photons (light particles). The energy of the photons corresponds to the energy gap between the conduction band and the valence band of the semiconductor material. This energy determines the colour of the light emitted by the LED.
5. **Light emission:** The released photons escape from the semiconductor material, resulting in the emission of light. This process is highly efficient, making LEDs one of the most energy-efficient sources of light.
6. **Colour control:** The colour of the light emitted by an LED can be controlled by varying the semiconductor materials used, as well as by adding impurities called dopants to adjust the energy bandgap. Different combinations of materials and dopants result in LEDs emitting different colours of light, ranging from infrared to ultraviolet and all colours of visible light.

Overall, LEDs provide a highly efficient and versatile means of generating light, with applications ranging from indicator lights and displays to general lighting and automotive lighting.

Zener Diode

Picture of Zener diode *Symbol*

Fig. 5.38: *Zener Diode.*

A Zener diode is a special type of diode designed to reliably allow current to flow 'backwards' (inverted polarity) when a certain set reverse voltage, known as the Zener voltage, is reached. Zener diodes are used for voltage regulation, voltage reference and overvoltage protection.

It works on the principle of the Zener effect, which is a type of electrical breakdown phenomenon that occurs in a reverse-biased semiconductor junction. When a Zener diode is reverse-biased (meaning the voltage across it is in the opposite direction of its intended operation), it maintains a nearly constant voltage drop across its terminals regardless of the current flowing through it. This characteristic makes Zener diodes useful for voltage regulation and overvoltage protection in electronic circuits.

Here's how it works:

1. **Reverse bias:** When a voltage is applied across a Zener diode in the reverse direction (anode positive, cathode negative), the majority carriers (electrons in the P-type material and holes in the N-type material) are pushed away from the junction, creating a depletion region.
2. **Zener breakdown:** As the reverse voltage increases, the electric field across the depletion region also increases. At a certain critical voltage known as the Zener voltage (Vz), the electric field is strong enough to pull electrons from the valence band of the P-type material into the conduction band, creating electron-hole pairs. This process, known as Zener breakdown or avalanche breakdown, allows current to flow through the diode in the reverse direction.
3. **Stable voltage:** Once the Zener breakdown occurs, the voltage across the Zener diode remains relatively constant, typically around the specified Zener voltage. This is because the breakdown process maintains a constant voltage drop across the diode, even as the current through it varies.
4. **Voltage regulation:** By properly selecting a Zener diode with a specific Zener voltage, it can be used to regulate the voltage across a circuit. When the voltage exceeds the Zener voltage, the diode conducts, shunting excess current away from the load and maintaining a stable output voltage.

Overvoltage protection: Zener diodes are also commonly used for overvoltage protection. When a voltage spike occurs in a circuit, the Zener diode can conduct to absorb the excess voltage and protect sensitive components from damage.

In summary, Zener diodes exploit the Zener effect to provide a stable voltage reference or overvoltage protection in electronic circuits, making them essential components in various applications.

Schottky Diode

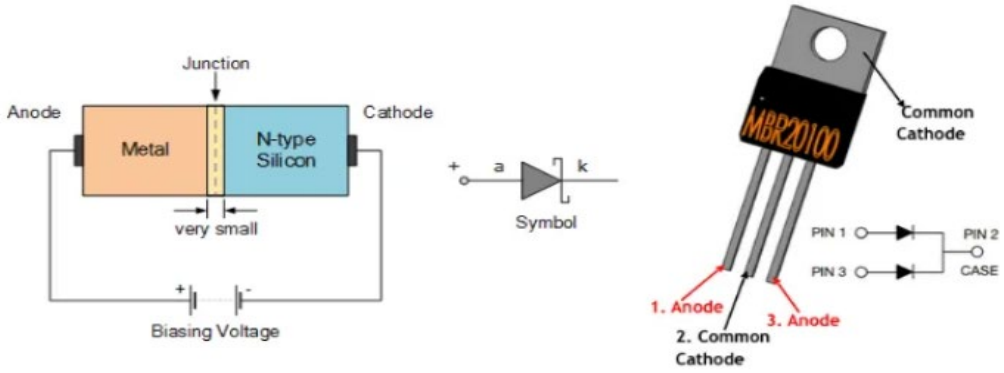


Fig. 5.39: *Schottky Diode.*

A Schottky diode is a type of semiconductor diode that operates on the Schottky barrier principle. Unlike conventional PN junction diodes, which rely on the interaction between P-type semiconductor materials, Schottky diodes use a metal-semiconductor junction.

1. **Metal-semiconductor junction:** The Schottky diode consists of a metal (usually a metal like gold, platinum, or tungsten) in contact with a semiconductor material (often silicon or gallium arsenide). This metal-semiconductor junction forms a barrier at the interface, known as the Schottky barrier.
2. **Barrier formation:** When the metal comes into contact with the semiconductor material, there is a difference in the Fermi levels between the metal and the semiconductor. This difference creates an energy barrier at the junction, known as the Schottky barrier height. Electrons from the semiconductor with energy greater than the barrier height can move into the metal, while holes from the metal can move into the semiconductor.

3. **Forward bias**: When a positive voltage is applied to the metal side and a negative voltage to the semiconductor side (forward bias), it reduces the height of the energy barrier. This allows electrons to move more easily from the semiconductor into the metal, resulting in current flow across the junction.
4. **Reverse bias:** When a negative voltage is applied to the metal side and a positive voltage to the semiconductor side (reverse bias), it increases the height of the energy barrier. This prevents significant current flow across the junction because the barrier height impedes the movement of charge carriers.
5. **Low forward voltage drops:** One of the key advantages of Schottky diodes is their low forward voltage drop compared to conventional PN junction diodes. This is because the Schottky barrier is typically lower than the potential barrier in the PN junction diode. As a result, Schottky diodes are commonly used in applications requiring fast switching and low power losses, such as rectification, voltage clamping, and RF detection.

In summary, Schottky diodes work based on the principle of a metal-semiconductor junction, where the Schottky barrier controls the flow of current depending on the applied voltage polarity.

Schottky diodes have a lower forward voltage drop compared to other diodes. The advantage of this diode is that it has a very fast switching action, which makes it suitable for use in circuits, which need high-speed switching, and it is used in solar panels to stop overnight battery discharge. They are commonly used in high-frequency applications, rectification, and as protection diodes in circuits with high-speed switching elements.

Varactor Diode

Varactor diode picture *Symbol of varactor diode*

Fig. 5.40: *Varactor Diode.*

Also known as a Varicap diode, it is specifically designed to act as a voltage-controlled capacitor. The Varactor diode is used in electronics tuners in radios, televisions and other commercial receivers.

1. **PN junction:** Like other diodes, a varactor is made up of semiconductor material with a PN junction. However, in a Varactor diode, the semiconductor region is typically lightly doped to create a wide depletion region.
2. **Depletion region:** When no voltage is applied across the varactor diode, a depletion region forms around the PN junction due to the doping levels between the P-type and N-type semiconductor regions. This depletion region creates a fixed capacitance called the junction capacitance.
3. **Voltage-depletion capacitance:** Applying a voltage across the varactor diode changes the width of the depletion region, thereby altering the capacitance of the diode. When a reverse bias voltage is applied (negative voltage to the P-type side and positive voltage to the N-type side), the depletion region widens, reducing the capacitance. Conversely, when a forward-bias voltage is applied, the depletion region narrows, increasing the capacitance.
4. **Application in tuneable circuits:** Varactor diodes are commonly used in tuneable circuits where the capacitance needs to be adjusted based on a control voltage. For example, in voltage-

controlled oscillators (VCOs), the varactor diode is used to vary the frequency of oscillation by changing the capacitance in the tuned circuit.

5. **Frequency modulation and filters:** Varactor diodes are also used in frequency modulation. (FM) circuits, where the capacitance variation is used to modulate the frequency of a carrier signal. Additionally, they find application in voltage-controlled filters where the cutoff frequency can be adjusted based on the control voltage.

In summary, varactor diodes operate by changing their capacitance in response to an applied voltage, allowing them to be used in various applications where voltage-controlled capacitance is required.

Photodiode

photodiode picture *Symbol of photodiode*

Fig. 5.41: *Photodiode. (Source: Photodiode - Search Images (bing.com))*

A photodiode is a semiconductor device that converts light into electrical current. It's constructed similarly to a regular semiconductor diode but a specifically optimised to respond to light. The basic overview of the construction of a photodiode:

1. **Semiconductor material:** Photodiodes are typically made of semiconductor materials such as silicon, germanium and arsenide. Silicon is the most common material due to its abundance and efficiency in converting light to electricity.
2. **PN Junction:** Like regular diodes, a photodiode has a PN junction formed by doping one side of the semiconductor material with acceptor impurities (P-type) and the other side with donor impurities (N-type). This junction is crucial for the photovoltaic effect, where light generates electron-hole pairs within the semiconductor.
3. **Window layer:** To allow light to enter and interact with the semiconductor material, a transparent window layer is often added to the photodiode. This layer can be made of materials like glass or a thin layer of transparent semiconductor material.
4. **Metal contact:** Metal contacts are attached to the P-type and N-type regions of the photodiode to provide electrical connections for external circuits. These contacts allow the generated photocurrent to be extracted from the device.
5. **Packing:** Photodiodes are typically housed in a package to protect them from environmental factors such as dust, moisture and mechanical damage. The package also often includes leads for easy integration into circuits.
6. **Reverse bias operation**: Photodiodes are usually operated under reverse bias, meaning a voltage is applied across the PN junction such that the P-type region is. Connected to the negative terminal of the power supply and the N-type region is connected to the positive terminal. This reverse bias helps to increase the width of the depletion region, enhancing the efficiency of light absorption and the generation of electron-hole pairs.

Overall, the construction of a photodiode involves optimising the semiconductor material, adding a window layer for light entry, providing electrical contacts, and packaging the device for protection and integration into circuits.

Silicon - Controlled rectifier (SCR)

A silicon-controlled rectifier or semiconductor-controlled rectifier is a four-layer solid-state current-controlling device. The name 'silicon-controlled rectifier' is General Electric's trade name for a type of thyristor.

SCRs are mainly used in electronic devices that require control of high voltage and power. This makes them applicable in medium and high AC power operations such as motor control functions.

An SCR conducts when a gate pulse is applied to it, just like a diode. It has four layers of semiconductors that form two structures namely, NPNP or PNPN. In addition, it has three junctions labelled as J1, J2 and J3 and three terminals anode, cathode and a gate. In an SCR, the intrinsic semiconductor is silicon to which the required dopants are infused. However, doping a PNPN junction is dependent on the SCR application.

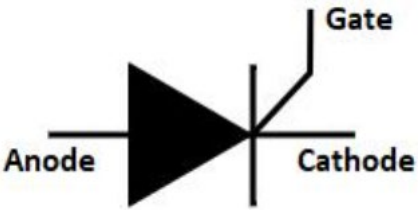


Fig. 5.42: *Symbol for SCR.*

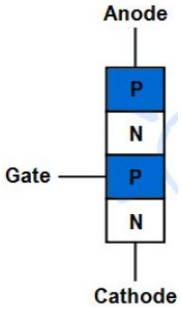


Fig. 5.43: *PNP junction on SCR.*

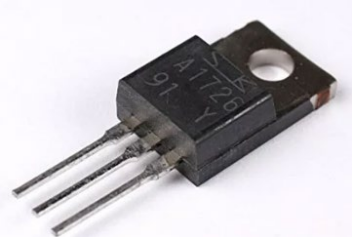


Fig. 5.44: *Picture. Silicon Controlled Rectifier*

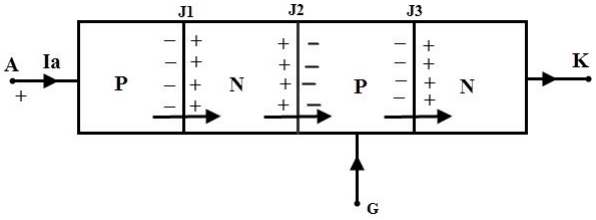


Fig. 5.45: *Structure of SCR: (Structure Silicon Controlled Rectifier*

Infrared light-emitting diode (IR LED)

An IR LED is a special-purpose light-emitting diode that emits infrared rays ranging from 700 nm to 1 mm wavelength. Infrared LEDs serve as a source of invisible infrared light unlike regular LEDs that emit visible light, IR LEDs produce radiation beyond the human eye's perception.

Photo of IR LED diode

Symbol of IR LED diode

Fig. 5.46: *Photo of IR LED diode and Symbol of IR LED diode*

Mode of operation on IR LED diode

IR LED diodes are typically made from semiconductor materials such as gallium arsenide or gallium aluminium arsenide. These materials have specific bandgap energies that determine the wavelength

of light they emit. An IR LED diode consists of a P-N junction. This junction allows current to flow in one direction when a forward bias voltage is applied.

When an electric current flows through an IR LED, it emits infrared light, since our eyes cannot detect this radiation, the focus should be on the cameras such as phone cameras to visualise it.

Applications of IR LED Diode

IR LED diodes are used primarily for their ability to emit infrared light efficiently. IR LEDs are utilised in various applications such as:

1. Remote controls for televisions (TVs) and digital versatile disc (DVD) players
2. Proximity sensors
3. Data communication

Modes of operation in SCR

1. **OFF state (forward blocking mode):** Here the anode is assigned a positive voltage. The gate is assigned a zero-voltage disconnected and the cathode is assigned a negative voltage. As a result, Junctions J1 and J3 are in forward bias while J2 is in reverse bias. J2 reaches its breakdown avalanche value and starts to conduct. Below this value, the resistance of J1 is significantly high and is thus said to be in the off state.
2. **ON state (conducting mode):** An SCR is brought to this state either by increasing the potential difference between the anode and cathode above the avalanche voltage or by applying a positive signal at the gate. Immediately the SCR starts to conduct, the gate voltage is no longer needed to maintain the ON state and is, therefore, switched off by:
    1. Decreasing the current flow through it to the lowest value is called holding current.
    2. Using a transistor placed across the junction.
    3. **Reverse blocking**: This compensates for the drop in forward voltage. This is because a low-doped region in P1 is needed. It is important to note that the voltage ratings of forward and reverse blocking are equal.

Learning Tasks

1. Describe the basic working principle of a PN junction diode.
2. How does a Zener diode differ from a regular PN junction diode?
3. How does a light-emitting diode (LED) work and what causes it to emit light?
4. Discuss the operation of a photodiode and its use in light detection applications.

Pedagogical Exemplars

Collaborative Learning/Talk for Learning Approaches: As a class learners brainstorm and explain the formation of the PN junction, list the types of diodes and describe the construction of each e.g. LED, Zener diode, power diode. To push thinking, the teacher should use prompting questions to learners as they discuss with one another. The teacher should pull all students back in for whole-class feedback and collect meaningful explanations from learners.

Group Work/Collaborative Learning /Digital Learning: Place learners into small mixed-ability groups and task them to describe the construction and operation of each diode and its operations. The teacher should circulate the classroom ensuring all learners are supported and participating in the discussion. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Note:

1. Learners with additional needs should be given more time to complete a given task.
2. During presentations, ensure that anyone regardless of the background i.e. Sex, physical abilities or intellectual abilities is encouraged to present on behalf of the groups**.**
3. Any learner can be selected as a leader of a group.

Key Assessment (DoK)

1. **Level 2:** What is a diode, and what is its primary function in electronic circuits?
2. **Level 3:** Describe the significance of the depletion region in a diode and how it affects its operation.
3. **Level 3:** Explain the role of LEDs in displays and signage systems. What makes them more suitable for this purpose compared to other diodes?
4. **Level 4:** How are photodiode arrays employed in medical imaging devices, such as X-ray and CT scanners?
5. **Level 4:** Discuss the benefits of using these arrays over other light-sensing technologies.

Unit Review

The unit explored the functionalities of diodes, starting with the basics of PN junctions and progressing to various diode types such as rectifier diodes, Zener diodes and LEDs. Practical demonstrations reinforced theoretical knowledge, highlighting diodes' significance in real-world scenarios. Assessments evaluated learners' comprehension of diode applications, including theoretical explanations. Problem-solving tasks challenged learners to select appropriate diodes based on specifications. Criteria included accuracy, proficiency in circuit analysis, and practical application skills. Overall, assessments provided opportunities for learners to demonstrate mastery of diode principles and their ability to apply this knowledge effectively in electronic circuits. Through a combination of pedagogical exploration and assessments, learners acquired the skills necessary to navigate and select the appropriate diode for various applications in various circuit contexts.

Resources

Photodiode, signal generator, Oscilloscope, Capacitors, computer installed with mutism application

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6. www.bing.com
7. ***www.byjuslearning.com***
8. www.electronicshub.org

9. ***www.google.com***

10. www.tutorialspoint.com

UNIT 6

Strand: **Automotive Technology**

Sub-Strand: Introduction to vehicle technology

Learning Outcomes: Detect problems in the vehicle transmission and braking system

Content Standard: Demonstrate knowledge and understanding of vehicle technology subsystems.

Learning Indicators: *Differentiate between mechanical, hydraulic, and pneumatic braking systems.*

INTRODUCTION AND UNIT SUMMARY

This unit introduces learners to the difference in construction and operation between mechanical, hydraulic and pneumatic brakes. Mechanical brakes absorb energy and act by generating frictional forces. The stopping power of a mechanical brake largely depends on the surface area of frictional surfaces as well as on the actuation force that is applied. Hydraulic and pneumatic brakes use liquid (hydraulics) and gas (pneumatics). After successful completion of this unit, learners will be able to describe the constructional and operational differences between mechanical, hydraulic and pneumatic braking systems. The teacher should guide learners to participate fully in the entire unit and ensure that all learners can describe the constructional and operational differences between mechanical, hydraulic and pneumatic braking systems.

The unit covers only week 21: ***Differentiate between mechanical, hydraulic and pneumatic braking systems.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

For this unit to be achieved, learners must fully participate in describing the constructional and operational differences between mechanical, hydraulic and pneumatic braking systems. The teacher should employ pedagogies such as group work/collaborative learning, experiential learning and project-based learning. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individually. All learners, irrespective of their learning abilities should be encouraged to participate fully in describing the constructional and operational difference between mechanical, hydraulic and pneumatic braking systems. Teachers should make considerations and accommodations for the differing needs of learners. Offer below-average/approaching proficiency learners the opportunity to make oral presentations and use samples of real objects in their explanation of the constructional and operational differences between mechanical, hydraulic and pneumatic braking systems. Extend activities for the above-average/highly proficient learners.

ASSESSMENT SUMMARY

Learners must demonstrate how they apply the concepts in practical settings to demonstrate a conceptual understanding of the principles presented in this unit. Levels 3 of the DoK should

therefore be thoroughly addressed in the evaluations. Teachers should use a variety of formative assessment techniques, including reports, oral and written presentations, home assignments, and pairs of activities to collect information about students' progress and give timely feedback. More specifically, teachers should administer the following assessments to learners and record their scores in continuous assessment logs:

4. Class exercises (including individual worksheets) after each lesson.
5. Homework tasks.
6. Scores on practical group activities on the constructional and operational difference between mechanical, hydraulic and pneumatic braking systems.

WEEK 21

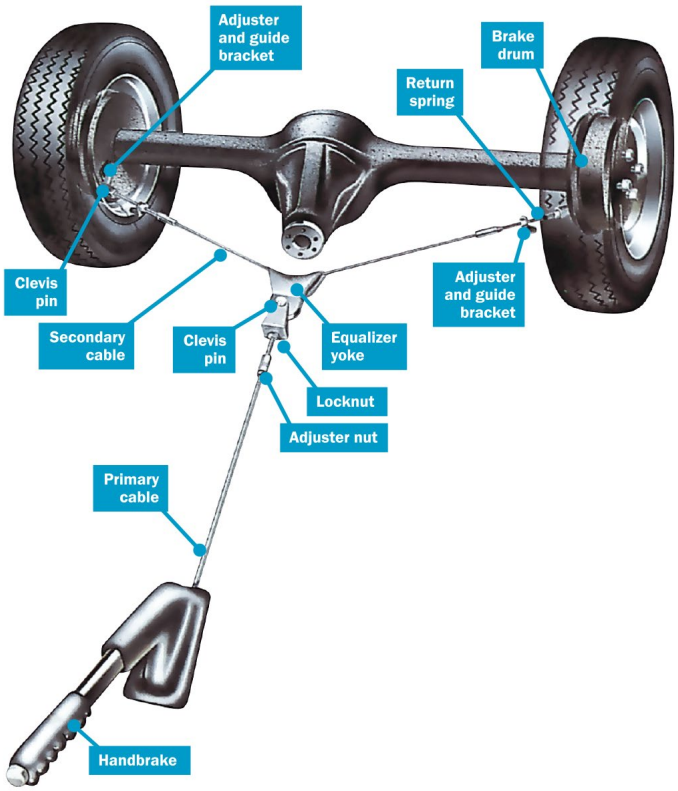
Learning Indicator(s): *Differentiate between mechanical, hydraulic and pneumatic braking systems.*

Theme or Focal Area (S) 3: Methods of Operating Vehicle Braking Systems

1. Mechanical braking system operation

A type of braking system in which the brake force applied by the driver on the brake pedal is transferred to the final brake drum or disc rotor through the various mechanical linkages like cylindrical rods, fulcrums, springs, levers, cables to reduce the speed or stop the vehicle. Mechanical brakes were used in various old automobile vehicles, but they are now obsolete as the main brakes due to them being less effective than other options available. Mechanical brakes are still employed in modern vehicles as parking brakes.

In the actual operation, when the brake pedal is pressed down, its motion is transmitted to the cam through various mechanical linkages. The motion of the cam tends to expand out the brake shoes. This inward motion of the brake shoes will slow down the motion of the rotating brake drum. As the wheel is fixed to the brake drum, it will automatically be prevented from moving further. Force (F) is applied through a brake actuating mechanism, which forces the brake shoe against the revolving drum, thereby applying the brakes. When the brake pedal is released, the pedal will move up due to the tension of the return spring. A retracting spring draws the shoes away from the drum when the cam is moved to its initial position meaning the brake shoes are no longer in contact with the drum, which is now free to rotate.



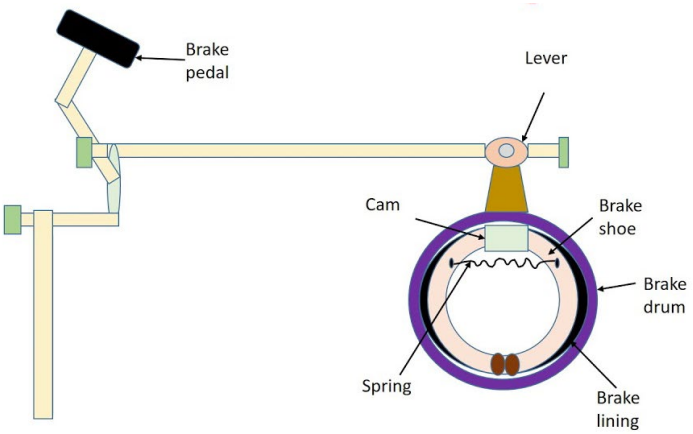


Fig. 5.47: *Mechanical brake system.*

2. Hydraulic braking system operation

A type of braking system in which the brake force applied by the driver on the brake pedal is first converted into hydraulic pressure by the master cylinder. This hydraulic pressure from the master cylinder is then transferred to the final brake drum or disc rotor through brake lines.

i. Instead of mechanical linkages, brake fluid is used in hydraulic brakes for the transmission of brake pedal force to stop or de-accelerate the vehicle.

ii. The majority of bikes and cars on the road today are equipped with a hydraulic braking system due to its high effectiveness and high brake force-generating capability.

iii. When the brake pedal is depressed, pressure is applied to the liquid in the master cylinder. This causes the liquid to flow out of the master cylinder into the wheel cylinder. As a result, the pressure is uniformly transmitted and unaltered through the liquid to the piston and wheel cylinder, forcing both pistons outward and pressing the brake shoes against the wheel rim, causing the wheel to slow down. Pressure is transmitted through the liquid, exerting equal pressure on all the vehicle's wheels connected to the pipeline. When the brake pedal is released, the liquids return from the wheel cylinder to the master cylinder, and the spring returns the brake shoes to their initial position.

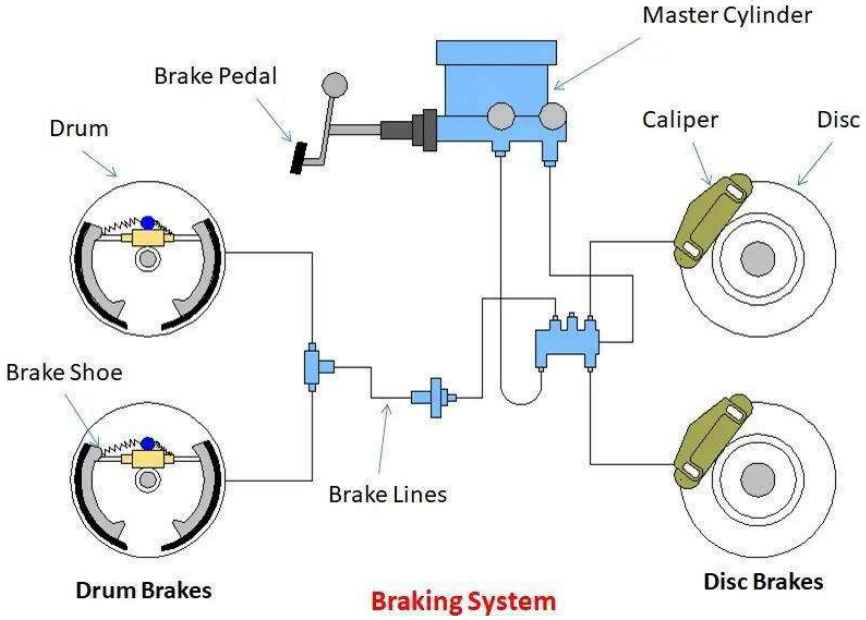


Fig. 5.48: *Hydraulic brake system.*

3. Pneumatic braking system operation

A type of braking system in which atmospheric air through compressors and valves is used to transmit brake pedal force from the brake pedal to the final drum or disc rotor.

i. Air brakes are used in heavy vehicles such as buses and trucks as hydraulic brakes fail to transmit high enough brake force through a greater distance. Pneumatic brakes generate a higher brake force than hydraulic brakes which is needed for heavy vehicles.

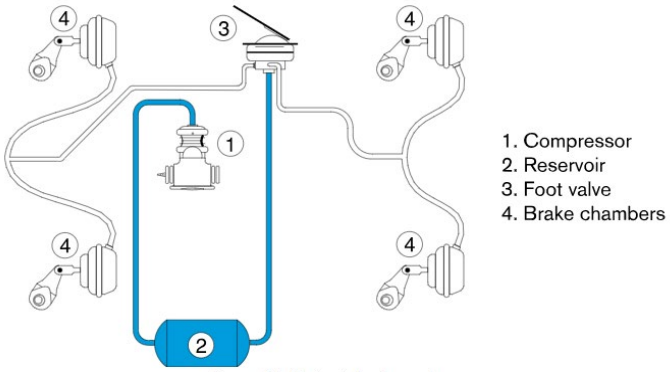
ii. The chances of brake failure are less in pneumatic brakes as they are usually equipped with a reserve air tank, which comes into action when there is a brake failure caused by a leakage in the brake lines.

iii. Some high-end cars also use air brakes due to their effectiveness and fail-proof ability.

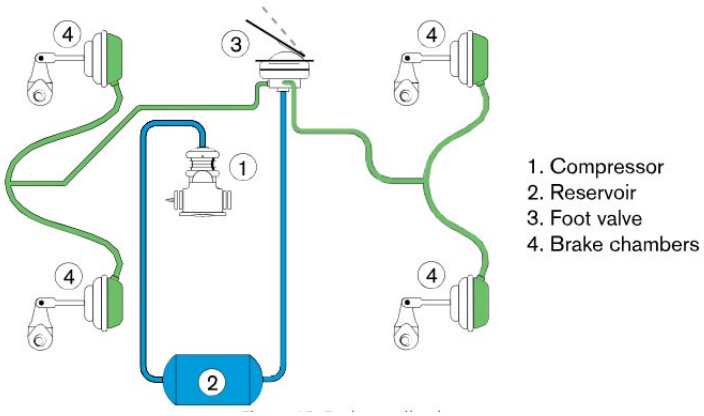
In actual operation, when the brakes are applied, air is delivered through the foot valve to the service brake chambers. Air pushes against each service-brake diaphragm causing the push rod to move the slack adjuster. The slack adjuster rotates the brake cam, which forces the shoes against the brake drum.

When you release the foot valve, the air in the brake chambers is exhausted through the foot valve, which releases the brakes.

When reservoir air pressure drops, the governor puts the compressor back into the pumping stage at the appropriate minimum pressure value to keep adequate air pressure available for future brake applications.



Brake not applied



Brake applied

Fig. 5.49: *Pneumatic brake system.*

Learning Tasks:

1. Describe the constructional difference between mechanical, hydraulic and pneumatic braking systems.
2. Describe the operational difference between mechanical, hydraulic and pneumatic braking systems.

Pedagogical Exemplars

The teacher should consider the following activities:

Group work/collaborative learning: Learners brainstorm to share ideas on the constructional difference between mechanical, hydraulic and pneumatic braking systems.

Talk for learning approaches: In mixed-ability groups, assist learners in making appropriate references to models for actuating the brakes effectively. Show videos on the three ways (mechanical, hydraulic and pneumatic) of operating the vehicle brakes. The teacher should use prompting questions to assist learners when discussing in their groups how brakes work.

Key Assessment (DoK)

1. **Level 3** With the aid of a diagram, describe the constructional differences between mechanical, hydraulic and pneumatic braking systems.
2. **Level 3** With the aid of a diagram, describe the operational differences between mechanical, hydraulic and pneumatic braking systems.

Unit 6 Review

In Unit 6, week 21, learners developed an understanding of the constructional and operational differences between mechanical, hydraulic and pneumatic braking systems. The pedagogical exemplars used in this section included group work/collaborative learning and talk-for-learning approaches, which helped to meet the varied needs of all learners. These strategies enable learners to develop communication, collaboration, critical thinking and problem-solving skills in learning the differences in construction and operation between mechanical, hydraulic and pneumatic brakes. The various assessment strategies such as oral/written presentations, class exercises, homework, and practical group activities catered for varied levels of learning.

Resources

1. Charts, pictures, videos and real objects (nose mask, goggles, safety boots, overcoat, gloves helmet)
2. Hillier, V. A. W. (2004). Fundamentals of motor vehicle technology (5th ed.).
3. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=1377
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SECTION 6

The section covers the following units (strands); woodwork technology, building construction technology, electrical and electronic technology as well and metal technology.

The learners will acquire the following knowledge and understanding in each of the units:

Woodwork technology: The utilisation of manufactured boards from wood residues.

Building construction technology: The roles of building construction personnel and the mobilisation and determination of the schedule of works and provision of plants and equipment.

Metal technology: The use of tools and equipment for welding.

Electrical and electronic technology: Understanding diodes as electronic devices and applying them in designing electronic circuits.

UNIT 1

Strand: **Building Construction Technology**

Sub-Strand: Pre-Construction Activities

Content Standard: Demonstrate Knowledge and understanding of Mobilisation for Building Construction.

Learning Outcome: *Analyse mobilisation and determine the schedule of works and provision of plants and equipment (e.g. bulldozer, excavator, dumper, concrete mixer, poker vibrator, grader, hoist etc) involved in site preparation (e.g. clearing, hoarding, provision of services, establishing temporal structures and roads) for mobilisation to completion.*

INTRODUCTION AND UNIT SUMMARY

Plant and equipment refers to tangible assets such as machinery, vehicles and other essential equipment used in the building process.

Plant refers to machinery, apparatus and fixtures employed in constructional works and includes heavier items such as earth-moving machines and large vehicles. These items are considered fixed assets. The plant is subject to stringent maintenance and inspection rules often carried out by external specialists.

Equipment refers to smaller machinery, powered tools, PPE (personal protective equipment), portable electrical items, hand tools – anything which is used to carry out the work at hand.

As with plants, all items of equipment must also be subject to regular maintenance and inspection. Usually, this can be carried out in-house.

These assets are mobilised to become an integral part of the contractor's operations and are crucial for the start and completion of the building construction project. At the mobilisation stage, Contractors assemble plant and equipment relevant to their project works intending to enhance the quality of work, speeding up progress as well as minimising costs.

The contractor may purchase plant or equipment items such as a concrete mixer if this will be used all the time and is not likely to sit idly on the site. It is prudent, however, to hire or lease equipment that will not be in use frequently. In this way, the contractor will avoid locking up capital in unnecessary items.

This unit covers only week 22: ***Identify and state functions of plants and equipment for construction works.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Experiential Learning may be provided through the organisation of field trips to new construction sites where mobilising and specifically purchasing or leasing of plant and equipment is being done. This is to provide learners with the opportunity to observe some typical plants and equipment used at the site and ask relevant questions about their type and functions. Research using the internet and other similar media will also be used to deepen learners' understanding of plants and equipment as used at sites locally and internationally. The whole class, comprising the approaching proficiency, the proficient and the highly proficient, will be engaged in collaboration, brainstorming and critical thinking in mixed-ability groupings to share ideas about types and functions of basic plant and equipment that would be used on a typical 3-bedroom self-contained building. They will also share ideas on how the plant and equipment are obtained and transported to the site and how their use can contribute to a good quality of work, save time, as well as minimise costs to a project. Teachers should ensure that GESI, SEL and National Values are infused. Teachers should also keep track of the performance of each learner given their different levels of understanding and provide, where necessary, the relevant motivation or scaffolds to enhance understanding of the concept.

ASSESSMENT SUMMARY

The assessments to be used to monitor the progress of learning during instruction should be formative and this should include quizzes and short oral and written responses to questions. Teachers must keep track of the performance of each learner given his or her unique level of understanding and provide the relevant motivation or scaffolds to enhance their appreciation of how to mobilise plants and equipment for a building project.

The assessment will also serve as a tool to evaluate the depth of knowledge among learners approaching proficiency, the proficient and highly proficient. In this way, the differentiation strategies adopted under pedagogy shall equally be assessed to find out if they have been successful or not.

WEEK 22

Learning Indicators: *Identify and state functions of plants and equipment for construction works.*

Theme or Focal Area: Identification and Functions of Plant and Equipment

Tangible assets, such as machinery and vehicles, are referred to as plants while classifying, smaller machinery or anything, which is used to carry out the work at hand as equipment.

These assets are mobilised to become an integral part of the contractor's operations and are crucial for the start and completion of the building construction project.

Plant And Equipment

Table 6.1: *Plant and equipment, brick & block laying tools and PPE*

Plant and Equipment	Functions/ Uses	Pictures/Illustrations
Bulldozer	The bulldozer is used to remove the topsoil/top layer of construction sites, to a certain depth. The bulldozer can also be used to remove trees and during the clearing of the site. They are used within the work zones and kept at the mechanical workshop.	
Excavator	Excavators are used for digging trenches and foundations, demolishing, removing trees, dredging rivers and handing out materials. It can also be used for lifting heavy objects on site. They are used within the work zones and kept at the mechanical workshop.	
Backhoe	The backhoe is used for digging earth and carrying loose soil from one place to another. They are used within the work zones and kept at the mechanical workshop.	
Grader	Graders are used to finish or grade the upper surface of a large area usually as a follow-up operation to scraping or bulldozing. They are used within the work zones and kept at the mechanical workshop.	

Plant and Equipment	Functions/ Uses	Pictures/Illustrations
Scraper	The scraper is used for site stripping and levelling operations during the clearing of the site. Scrapers are often used in large construction sites due to their size and turning capabilities. They are used within the work zones and kept at the mechanical workshop.	
Loader	The loader is used to load different kinds of materials onto dump boxes, dump trucks and other vehicles or platforms. They are used within the work zones and kept at the mechanical workshop.	
Trencher	The trencher is used when making long and narrow ditches or trenches for the installation of drainages, electrical cables or pipes. They are used within the work zones and kept at the mechanical workshop.	
Dumper	A dumper is a type of vehicle designed to transport material. It is mostly used in the construction industry to carry rubble, waste, soil, rubble, and any other loose material. The container that makes up the dumper is positioned at the front, while the driver is usually at the back of the machine. They are used within work zones and kept at the mechanical workshop.	
Guage box	A measuring box /gauge box is used to measure the quantity of sand and aggregate used for making concrete. It is of fixed dimensions so, aggregate need not be weighed for every use. The general dimensions of a measuring box are 300mm X 300mm X 400mm (length x width x depth). The volume of the measuring box is generally 1 Cubic Feet, which makes it easy to measure concrete or mortar ratios. They are used within the work zones and kept at the workshop.	

Plant and Equipment	Functions/ Uses	Pictures/Illustrations
Wheelbarrow	A wheelbarrow is used to transport bulk weights of materials like cement, sand, concrete mix etc. It contains one or two wheels at its front and two handles at its back, which are used to push the wheelbarrow. They are used within the work zones and kept at the workshop.	
Spade	A spade is used to dig the soil for foundation trenches, mixing of concrete, etc. It contains a metal plate at the end of a long wooden handle. They are used within the work zones and kept at the workshop	
Head Pan	A head pan is made of iron which is used to lift the excavated soil or cement or concrete to the working site etc. It is commonly used on construction sites. It is used within the work zones and kept at the workshop	
Concrete Mixer	Concrete mixers are used to mix sand, cement, aggregate, and water to form concrete. The mixer can also be used to mix sand, cement and water to form mortar. This type of equipment is used by construction companies to speed up their concrete production and complete large tasks on time. It is used within the work zones.	
Automatic concrete cement block moulding machine	These machines play a crucial role in the manufacturing of concrete blocks particularly in the production of concrete blocks in large quantities to facilitate the work. They are used at the block and concrete manufacturing workshops.	

Plant and Equipment	Functions/ Uses	Pictures/Illustrations
Manual concrete cement block moulding machine	This machine is commonly used to produce concrete blocks in small quantities for smaller projects. They are used at the block manufacturing workshop.	

Brick & Block Laying Tools	Functions/ Uses	Pictures/Illustrations
Spirit level	A spirit level is made of wood or metal (aluminium) with a bubble tube in the middle. The bubble tube is partially filled with alcohol. to allow the air bubble to be formed. Spirit levels are used in brick masonry to check the level of vertical and horizontal surfaces. The spirit level is placed on the surface and the bubble is checked. The surface is levelled when the bubble settles in the middle of the tube.	
Trowel	A trowel is used to lift and apply the cement mortar in small quantities. It is made of steel and a wooden handle is provided for holding. The ends of a trowel may be pointed, or bull-nosed	
Line and pins	Line and pins consist of a thread whose ends are connected with two solid metal rods with pinpoints. They are used to level the alignment of the brick course while laying bricks.	

Brick & Block Laying Tools	Functions/ Uses	Pictures/Illustrations
Wooden float	A wooden float is made of wood, which is used with the trowel when laying bricks/blocks. It contains a handle on its top and a smooth wooden surface on its bottom.	
Brick hammer	A brick hammer is used to cut bricks and to push bricks if they come out of the curse line.	
Bolster	A bolster is like a chisel, but it is used to cut bricks. Its cutting edge is wider than the width of the brick. It is used with the club hammer for accurate cutting of bricks.	
Builder's Square	Builder Square is used to achieve a perfect right angle at the corner of the wall. It is L-shaped. The first course is laid accurately using the builder's square. The remaining layers of bricks are then set out based on the first course.	
Tape measure	A tape measure is used to check the thickness, length or width of brick/ block walls, foundation concrete beds, excavated trenches etc.	

Personal Protective Equipments (PPE)	Functions/ Uses	Pictures/Illustrations
Safety shoes	Safety shoes are worn to protect the feet from falling objects and contact with chemicals and materials like cement.	
Safety Helmet	The safety helmet is necessary in construction work to protect from falling materials or structures A safety helmet should be used to protect the head from injury or accident that may prove fatal.	
Gloves	Gloves are required to prevent the hands from direct contact with cement, paints etc. and to avoid injury while using machines, tools etc.	
Coverall/overall	Coveralls/overalls are worn to protect the body when working on the construction site. They are used for mould removal, disaster cleanup and other situations with harmful chemicals.	
Safety Glasses	Safety glasses are worn to protect the eyes from dust, dangerous chemicals, actions of materials etc.	

Learning Tasks

1. Distinguish between plant and equipment and give three examples of each.
2. List the plants you are likely to mobilise into the inner perimeter fence if you are to build a 3-storey block of Flats.
3. List any two plants or equipment you will hire instead of purchase at the stage of mobilising and give reasons for the decision.

Pedagogical Exemplars

The Teacher should consider the following activities:

Experiential learning: Organise field trips to construction sites or offices where all learners can interact with the contractors that are involved in mobilising to site plant and equipment to identify them and understand their functions.

Digital learning: Using the internet, research different uses of plants and equipment both within Ghana and abroad.

Collaborative learning/critical thinking: Place learners in mixed-ability groupings where the different needs of learners approaching proficiency, the proficient and highly proficient will be met. Encourage all learners to engage in critical thinking and brainstorming to support understanding of mobilising and use of plant and equipment at the construction site.

Teachers should move about providing both verbal and non-verbal feedback to learners during the brainstorming sessions to help with the challenges they may face. Learners should refer to practical experiences they have had at the field trips as solutions or illustrations to some of the challenges they may be facing.

Key Assessment (DoK)

1. **Level 2**. List three plants and equipment that the contractor mobilises to the site and explain their functions.
2. **Level 2**. List two plants and equipment that must be mobilised when constructing a three-storey building and state the function of the plant.
3. **Level 3**. Describe three ways and means in which plant and equipment deployed at the site can contribute to good quality work and early completion of the project.

Unit 1 Review

In Unit 1, week 22, learners developed an understanding of plant and equipment as a category of items to be made available at the site during mobilisation. The pedagogical exemplars used in this section included experiential learning, digital learning and collaborative learning/critical thinking, which helped to meet the varied needs of learners. These strategies enabled learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies such as oral/written presentations, class exercises, homework and practical group activities were structured to cater for varying levels of learning. These assessments were classified under the DoK levels 2 and 3.

Resources

Visits to the construction industry, surfing the internet to find out about plant and equipment as a category of items to be made available at the site during mobilisation.

Reference

1. Hackett, M.; Robinson, I. and Statham, G. (2007). The Aqua Group Guide Procurement, Tendering and Contract Administration. Blackwell Publishing
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UNIT 2

Strand: **Woodwork Technology**

Sub-Strand: Material and Artefacts Production Woodwork Industry in Ghana

Content Standard: Demonstrate knowledge and understanding of the utilisation of Manufactured Boards from Wood Residues.

Learning Outcome: *Demonstrate knowledge and understanding of manufactured boards from Wood and non-wood residues to describe their types and uses*

INTRODUCTION AND UNIT SUMMARY

This unit will help learners learn the uses of manufactured boards made from Wood and non-wood residues.

This unit covers week 22: ***Outline the uses of manufactured boards made from wood and non-wood residues.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

For this unit to be achieved, learners outline the uses of manufactured boards made from wood and non-wood residues. The teacher should employ pedagogies such as critical thinking and talk for learning, group work/collaborative learning and experiential learning. These strategies should be used in mixed-ability and mixed-gender groupings, in pairs and individually. All learners, irrespective of their learning ability, should be encouraged to participate fully in investigations, as well as presentations of findings. The teacher should implement differentiation strategies to accommodate diverse learning needs.

ASSESSMENT SUMMARY

The concepts in this unit require learners to demonstrate conceptual understanding, including their real-life applications. Hence, the assessments should largely cover levels 1, 2 and 3 of the DoK. Teachers should employ a variety of formative assessment strategies such as oral/written presentations, pair tasks, reports, homework tasks, etc. to collect information about learners' progress and give prompt feedback. Teachers should administer assessments such as class exercises (including individual worksheets) after each lesson, homework tasks, scores on practical group activities on the uses of manufactured boards made from wood and non-wood residues and document students' results in continuous assessment records.

Week 22

Learning Indicator(s): Outline the uses of manufactured boards made from wood and non-wood residues.

Theme or Focal Area: Uses of Manufactured Boards Made From Wood and Non-Wood Residues

When ordering a manufactured board, the following areas should be considered:

1. **Interior work:** For interior use only, where it will not come into contact with moisture.
2. **Moisture resistant**: It should only be used extremely where limited exposure to the elements is expected.
3. **Weather and billproof:** This has a high resistance to the elements and can be used in most exterior applications.

Uses of manufactured boards made from wood and non-wood residues include:

1. **Furniture, shelving, moulding,** joinery (flash doors), ship/car/aeroplane interior decoration and **cabinets** (kitchen cabinet, Waldrop)**.**
2. **Ceiling** decoration**.**

Fig 6.1: *Oriented strand board*

3. **Wall panelling and partitioning**

Fig 6.2: *Oriented strand board*

4. Floorwork or flooring

Fig 6.3: *Oriented strand board in use*

5. Clipboards

Fig 6.4: *Oriented strand board*

Learning Tasks:

1. Identify at least two uses of manufactured boards made from wood residues.
2. Explain at least two uses of manufactured boards made from non-wood residues.
3. Describe three each, the uses of manufactured boards made from wood and non-wood residues.

Pedagogical Exemplars

Critical Thinking and Talk for Learning Approaches: Guide learners through a video demonstration of manufactured boards (Engineered wood), and brainstorm the uses of manufactured boards (Engineered wood). To push thinking, the teacher should use prompting questions to learners as they discuss with one another. Pull all students back in for whole-class feedback and to collect definitions.

Group work/Collaborative Learning /Digital Literacy learning: Place learners into mixed-ability groups and task them to discuss the uses of manufactured boards (Engineered wood). The teacher should circulate the classroom ensuring all learners are supported and participating in the discussion. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Experiential learning: Take learners on a trip to a woodwork industry to observe the artefact production etc. and task learners in mixed ability groups to identify and explain the uses of manufactured boards (Engineered wood) with open-mindedness. Highly Proficient learners can be assigned to assist groups in discussions in addition to the teacher.

Key Assessment (DoK)

1. **Level 1:** State at least three uses of manufactured boards made from wood residues.
2. **Level 1:** State at least two uses of manufactured boards made from non-wood residues.
3. **Level 2:** Describe how the chipboard is most commonly used.

Unit 2 Review

Unit 2, week 22 exposed learners to the uses of manufactured boards made from wood and non-wood residues. The pedagogical exemplars used in this section included pedagogies such as talk for learning, group work/collaborative learning and experiential learning which helped to meet the varied needs of all learners. These strategies enable learners to develop communication, collaboration, critical thinking and problem-solving skills. Various assessment strategies such as oral/written presentations, class exercises, homework, and practical group activities were structured to cater for all varied activities of learning. These assessments were classified under the DoK level 1 and 2.

Reflection

Can learners explain the uses of manufactured boards made from wood and non-wood residues?

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2. Walton, J., (1970). Woodwork Theory in and Practice (metric edition).
3. www.booktopia.com.au
4. www.cameroontimberexport.com
5. www.google.com
6. www.usvintagewood.com
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8. www.woodworkly.com

UNIT 3

Strand: **Electrical and Electronic Technology**

Sub-Strand: Electronic Devices and Circuits

Content Standard: Demonstrate understanding of diodes as electronic devices and apply them in designing electronic circuits.

Learning Outcome: *Employ knowledge of the construction and operation of diodes to design and construct electronic circuits.*

INTRODUCTION AND UNIT SUMMARY

Electrical and electronic technology relies heavily on the application of diodes in designing circuits. Diodes, semiconductor devices with two terminals, play a pivotal role in shaping modern circuitry by controlling the flow of current. Understanding the principles of diodes and their applications is fundamental for learners. This topic explores how diodes are applied in designing circuits, ranging from basic rectification to advanced signal processing and control.

The unit covers only week 23: ***Apply the principles of diodes in designing circuits.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Teaching the application of diodes in designing circuits involves a comprehensive pedagogical approach aimed at providing learners with practical knowledge and skills. The pedagogical summary emphasises hands-on learning experiences and real-world applications to reinforce theoretical concepts. Learners are introduced to the application of diodes, including the PN junction and its role in controlling current flow. Practical demonstrations and simulations are employed to illustrate how diodes are utilised in various circuit configurations, such as rectifiers, voltage regulators and signal modulation circuits. The curriculum focuses on problem-solving exercises and project-based learning to engage learners in designing and analysing diode-based circuits. Additionally, case studies and industry examples are integrated to highlight the importance of diodes in modern electronic systems.

ASSESSMENT SUMMARY

Assessment tasks in this topic aim to evaluate learners' comprehension of diode applications in circuit design. theoretical knowledge, requiring learners to explain applications of diodes in circuit design. Practical assessments of testing diodes as well as rectifying circuits. Problem-solving tasks present learners with complex circuit design challenges, assessing their ability to select appropriate diodes and justify design choices based on given specifications. Assessment criteria include accuracy of explanations, proficiency in circuit analysis and design, and clarity in presenting solutions.

WEEK 23

Learning Indicator: *Apply the principles of diodes in designing circuits.*

Theme or Focal Area: Applying The Principles of Diodes in Designing Circuits.

Testing of diodes

Testing a diode is important to ensure its proper functionality and to determine if it is good or bad. There are several methods to test a diode, depending on the equipment you have available. Here are a few common ways to test a diode:

1. **Using a Multimeter**

   This is the most straightforward method for testing diodes. Set your multimeter to the diode test mode (usually denoted by a diode symbol or a small triangle). Follow these steps:

   i. Connect the black probe (negative) of the multimeter to the cathode (negative end) of the diode.
   ii. Connect the red probe (positive) of the multimeter to the anode (positive end) of the diode.
   iii. Read the display on the multimeter.

   If the diode is good, the multimeter should display a voltage drop typically between 0.6V to 0.7V for a silicon diode and around 0.2V for a germanium diode.

   If the diode is bad or open, the multimeter will display “OL” (open loop) or a high voltage reading in both directions.

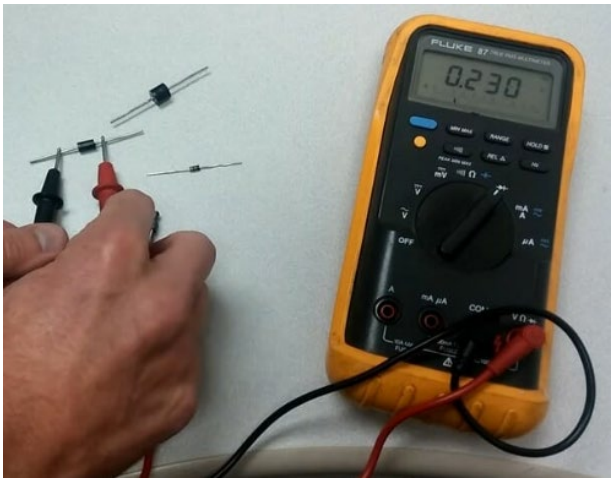

Fig. 6.5: *A technician using a multimeter to test a diode.*

2. **Using a Digital Oscilloscope**

   An oscilloscope can be used to check the forward voltage drop across the diode. It can help visualise the diode’s characteristics. Connect the oscilloscope probes in the same manner as described for the multimeter and observe the waveform. A good diode should show a voltage drop within the expected range, and the waveform should be clean.

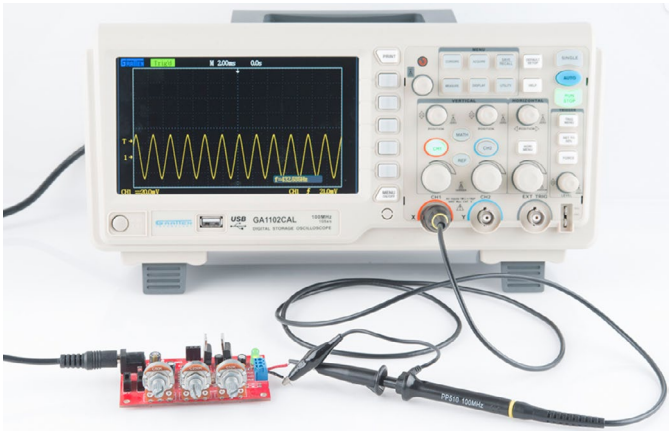

Fig. 6.6: *An oscilloscope being used to test a diode.*

3. Using a Test Circuit

You can build a simple test circuit using a resistor, voltage source, and the diode. By applying a small forward voltage, you can measure the current flowing through the diode using a Multimeter or an ammeter. Note that the ammeter must be connected in series with the diode. A good diode should conduct current in the forward direction.

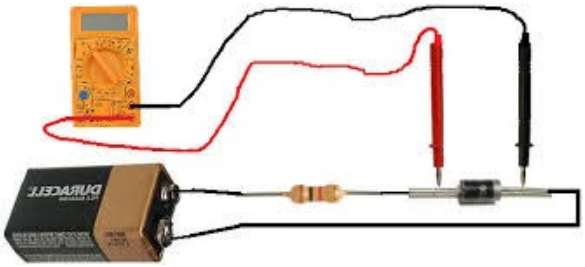

Fig. 6.7: *A picture of a diode connected in the forward bias mode. The voltmeter measures the voltage across it.*

4. Reverse Bias Test

This method checks the diode's ability to block current in the reverse direction. Use a power supply and a series resistor to limit current. Connect the diode in reverse bias (swap the positions of the probes from the first method). A good diode should block the current effectively in the reverse direction, and the Multimeter should show "OL" or a high resistance reading.

Fig. 6.8: *A picture of a diode connected in the reversed bias mode. The voltmeter measures the voltage across it.*

Simulation of half-wave or full-wave rectification

Simulation, in the context of engineering and science, refers to the process of creating a virtual model or representation of a real-world system or phenomenon to study its behaviour, performance or characteristics. Simulation of rectifying circuits refers to the process of modelling and analysing the behaviour of rectifiers using specialised software tools such as LTSpice, Circuit Wizard, and Multisim, among others. Rectifying circuits, commonly known as rectifiers, are electrical circuits that convert alternating current (AC) to direct current (DC). They are essential components in power supplies and various electronic devices where a stable DC voltage is required.

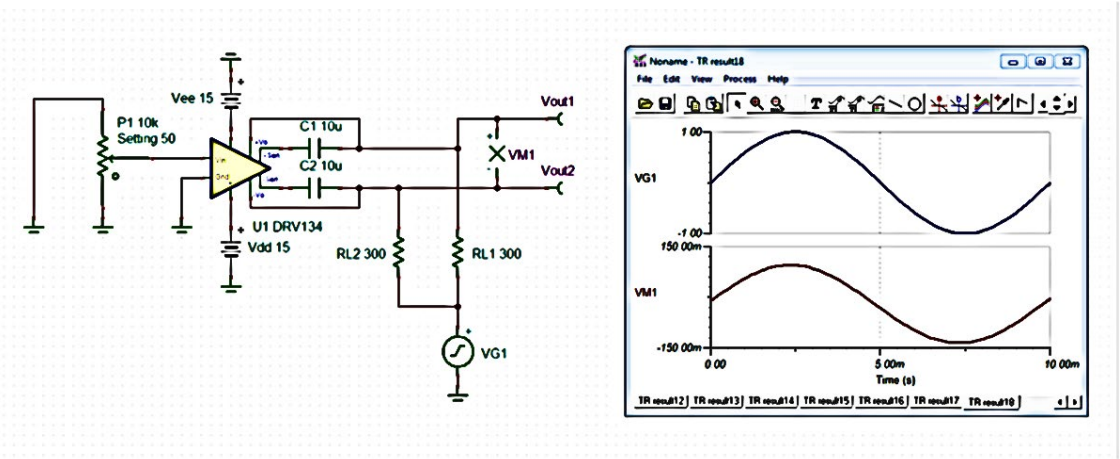

Fig. 6.9: *A set-up showing a simulation of a full wave rectification.*

The rectification Process:

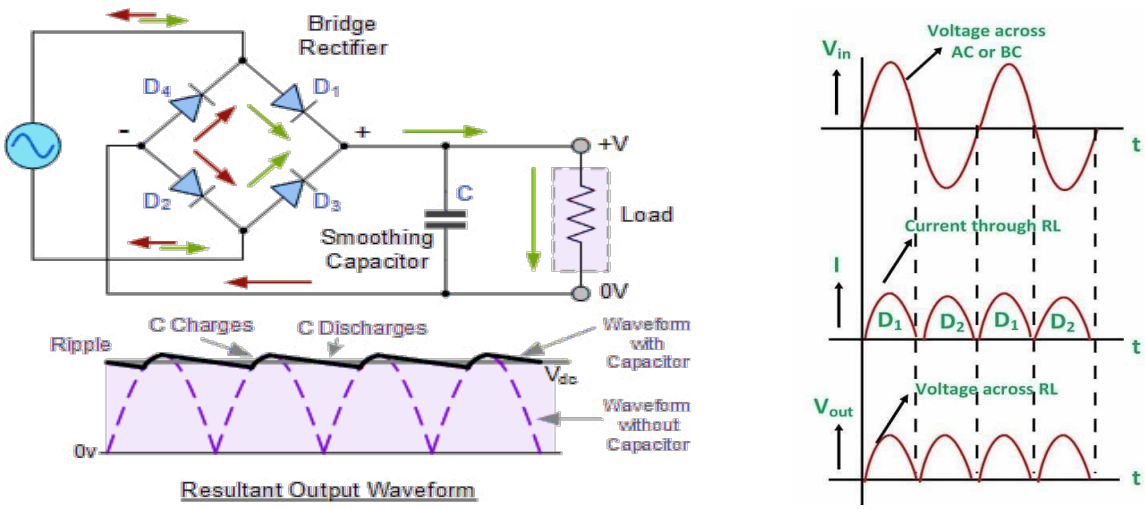

Fig. 6.10: *Rectification process.*

Full-wave rectification rectifies the negative component of the input voltage to a positive voltage and then converts it into DC (pulse current) utilising a diode bridge configuration. In contrast, half-wave rectification removes just the negative voltage component using a single diode before converting to DC. Afterwards, the waveform is smoothed by charging/discharging a capacitor.

Learning Tasks

1. How do you test a diode using a Multimeter? Describe the procedure.
2. What indications would you expect to see on the Multimeter when performing a diode continuity test on a functional diode?
3. Explain the principle behind forward voltage testing of diodes.
4. Describe a practical method to measure the forward voltage of a diode using a Digital Multimeter.

Pedagogical Exemplars

Experiential learning: Engage learners in mixed-ability groupings to test for good diodes and faulty ones. Design and simulate using Multism software, rectification circuit (half wave and full wave) using diodes task learners to go through the process of rectification.

(Note: Zener diode should be used to stabilise the output DC and LED to be used as an indicator).

Project-based learning: Engage learners in mixed-ability groups to build a security circuit using photodiodes and infrared diodes as a project work.

Note: When using mixed-ability and mixed-gender groupings encourage those with less interest in practical activities as well as the use of computers in designing by making these learners the leaders of the various groups.

Key Assessment (DoK)

1. **Level 1:** What does a good diode's forward voltage reading indicate?
2. **Level 1:** What does a bad diode's reading typically show?
3. **Level 2:** What is the significance of the depletion region in a diode and how does it affect its operation?
4. **Level 2:** What are the potential reasons for obtaining inaccurate readings when testing a diode, and how can errors be minimised in the testing process?
5. **Level 3:** How does a full-wave rectifier differ from a half-wave rectifier? What are the advantages of using a full-wave rectifier?
6. **Level 3:** How would you set up an oscilloscope to test for a diode and what would you expect to observe?
7. **Level 4:** Discuss the voltage drop method for testing a diode.

Unit 3 Review

This unit covered applying the principles of diodes in designing circuits and provided learners with a comprehensive understanding of diode applications in electrical and electronic technology. Beginning with an introduction to diode principles, learners explored how diodes are utilised in various circuit configurations. Practical demonstrations and hands-on activities reinforced theoretical concepts, allowing learners to design a rectifying circuit and analyse diode-based circuits effectively. Assessments evaluated learners' mastery of diode principles and their ability to apply this knowledge in circuit design. Overall, the unit equipped learners with the skills necessary to utilise diodes effectively in designing innovative and robust electronic circuits.

Resources:

Photodiode, signal generator, Oscilloscope, Capacitors, computer installed with multism application.

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UNIT 4

Strand: **Metal Technology**

Sub-Strand: Welding Technology

Content Standard: Demonstrate knowledge and understanding of tools and equipment for welding.

Learning Outcome: *Apply the principle of gas and arc welding to produce artefacts and solve problems in sheet metal and metal plate fabrication.*

INTRODUCTION TO UNIT SUMMARY

This unit presents a set of advantages and disadvantages of gas welding and electric arc welding, which are the two common methods used in the welding industry. Gas welding offers portability, versatility and cost advantages, but may be slower and less suitable for thick materials. Electric arc welding provides higher productivity, deeper penetration and automation capabilities, but requires a stable power supply, can be more costly, and may produce welding fumes and spatter. The choice between these two welding methods depends on the specific requirements of the welding application, material thickness, budget constraints, and available resources. It is essential to use effective pedagogical approaches that engage learners and help them understand the key concepts. By incorporating these pedagogical approaches, the teacher can create an engaging and informative learning experience that helps learners grasp the nuances of gas welding and electric arc welding, enabling them to make informed decisions and apply their knowledge effectively in welding applications. By incorporating assessment levels that progress from basic knowledge acquisition to higher-order thinking skills such as analysis, synthesis and evaluation, teachers can effectively evaluate learners' mastery of

the advantages and disadvantages of gas welding and electric arc welding while promoting critical thinking, problem-solving, and practical application abilities in welding education.

This unit covers week 23: ***Compare the advantages and disadvantages of gas and electric arc welding.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Teaching the advantages and disadvantages of gas and electric arc welding involves employing effective pedagogical strategies that help students understand the strengths and limitations of each welding method. The teacher can use project-based learning, experiential learning, and flexible grouping/ collaborative strategies such as small group work, peer tutoring, or collaborative projects, to allow students to work with peers of similar abilities or interests in identifying the various advantages and disadvantages of gas and electric arc welding. Teachers can also alternate group members periodically to provide opportunities for students to interact with different classmates and learn from a variety of viewpoints. By incorporating these pedagogical strategies into teaching about the advantages and disadvantages of gas and electric arc welding, teachers can foster a deeper understanding of welding processes, promote informed decision-making, and prepare students to effectively apply welding methods in diverse applications.

ASSESSMENT SUMMARY

To demonstrate an understanding of the advantages and disadvantages of gas and electric arc welding, learners must show how they apply the importance of this knowledge in real-world situations. As a result, levels 1, 2, 3 and 4 of the DoK should be substantially covered in the assessments. Once more, to gather data regarding learners' progress and provide timely feedback, teachers should utilise a range of formative assessment tools, including pairs of tasks, reports, oral and written presentations, and home assignments. To be more precise, teachers should administer assessments such as class exercises (including individual worksheets) after each lesson, homework, scores on practical group activities on the various advantages and disadvantages of gas and electric arc welding and document learners' results in continuous assessment records.

WEEK 23

Learning Indicator(s): *Compare the advantages and disadvantages of gas and electric arc welding.*

Theme or Focal Area(s): Advantages And Disadvantages of Gas and Electric arc Welding

Gas welding and electric arc welding are two common methods used in the welding industry, each with its own set of advantages and disadvantages. These include:

Advantages of gas welding

1. **Portability:** Gas welding equipment is generally more portable compared to electric arc welding machines, making it suitable for fieldwork and outdoor projects.
2. **Versatility:** Gas welding can be used on a wide range of metals and alloys, including ferrous and non-ferrous metals.
3. **Control:** Gas welding provides good control over the heat input, allowing for precise welding on thin materials without causing excessive distortion.
4. **Cost:** Gas welding equipment is often less expensive than electric arc welding machines, making it a more economical option for some applications.

Disadvantages of gas welding

1. **Lower productivity:** Gas welding typically has a slower welding speed compared to electric arc welding processes, which can lead to reduced productivity on large-scale projects.
2. **Limited thickness:** Gas welding may not be suitable for welding thick materials or heavy structural components due to its lower heat input capabilities.
3. **Skill requirement:** Gas welding requires a higher level of skill and experience to achieve quality welds, especially on challenging materials or joint configurations.
4. **Safety concerns:** Gas welding involves handling flammable gases and open flames, posing a higher risk of fire hazards compared to some electric arc welding processes.

Advantages of electric arc welding

1. **High productivity and speed*:*** Electric arc welding processes, such as shielded metal arc welding (SMAW) and gas metal arc welding (GMAW), offer higher welding speeds and increased productivity, making them suitable for large-scale fabrication projects.
2. **Versatility and portability:** Electric arc welding can be used on a wide range of materials and thicknesses, from thin sheet metals to heavy structural components. The apparatus required for arc welding is very simple and portable.
3. **Automation*:*** Some electric arc welding processes, like robotic welding, can be fully automated, improving efficiency and consistency in welding operations.
4. **Penetration and temperature*:*** Electric arc welding processes provide deeper weld penetration compared to gas welding, making them suitable for welding thick materials. The electric arc welding gives superior temperature at the point of welding.
5. **Electricity supply*:*** Electric arc welding can work on both AC and DC supply.
6. **Cost of installation*:*** It is inexpensive to install.

Disadvantages of electric arc welding

1. **Power requirement*:*** Electric arc welding machines require a stable power supply, which may limit their use in remote or off-grid locations.
2. **Equipment cost*:*** Electric arc welding equipment, especially advanced machines like TIG welders or robotic welding systems, can be more expensive than gas welding equipment.
3. **Welding fume and spatter*:*** Electric arc welding processes can produce welding fumes and spatter, requiring proper ventilation and safety measures to protect welders and surrounding areas.
4. **Complex setup*:*** Some electric arc welding processes, such as TIG welding, require more complex setup and control parameters, increasing the learning curve for operators.

Learning Tasks

1. Identify four advantages each for gas welding and electric arc welding.
2. Describe at least three disadvantages each for gas and electric arc welding.
3. Explain why you will choose electric arc welding instead of gas welding to carry out a given project.
4. Explain why gas welding is the best option for specific industrial applications.

Pedagogical Exemplars

Group work/collaborative learning: Organise the learners into mixed-ability and gender-inclusive groups, and task them to research the specific applications where gas and electric arc welding are used. E.g. Burglar proof for windows, gates, car body repairs, local containers, metal tables and chairs etc. Organise group discussions or debates where learners can discuss and debate the merits and drawbacks of gas welding and electric arc welding. Assign roles to students representing different perspectives (e.g. welder, project manager, safety officer) to encourage a comprehensive discussion.

Problem-Based Learning: Present learners with welding scenarios or challenges that require them to analyse the requirements and choose the most suitable welding method (gas welding or electric arc welding). This approach encourages critical thinking and decision-making skills.

Field Trips: Organise field trips to welding workshops, fabrication facilities, or industrial sites where learners can observe welding processes in action. Encourage learners to ask questions and interact with welders and technicians to deepen their understanding.

Key Assessment (DoK)

1. **Level 2:** Describe at least two advantages, each of gas welding and electric arc welding.
2. **Level 2:** Describe at least two disadvantages of gas welding and electric arc welding.
3. **Level 3:** Explain why a welder will choose electric arc welding instead of gas welding to carry out a project.
4. **Level 3:** Explain why gas welding is the best option for joining non-reactive metals such as aluminium and chromium.
5. **Level 4:** Analyse two advantages of gas welding over electric arc welding and explain how these advantages contribute to its suitability for specific welding applications.
6. **Level 4*:*** Evaluate two advantages and two disadvantages of gas welding compared to electric arc welding and justify your evaluation with examples from industry applications.

Unit 4 Review

This unit covered the advantages and disadvantages of gas and electric arc welding. This knowledge is essential for beginners in metalwork technology. Assessments required learners to explain and appreciate the advantages and disadvantages of gas and electric arc welding. In effect, studying the advantages and disadvantages of gas welding and electric arc welding equipped learners with valuable knowledge, skills and competencies that are essential for success and practice in the welding industry, engineering professions and other technical fields that rely on welding practitioners.

Reflection

1. What was my best moment in today's lesson and how can I create more of such situations?
2. Were learners able to compare the advantages and disadvantages of gas and electric arc welding?
3. Were the learners able to apply the advantages and disadvantages of gas and electric arc welding in producing items for use?
4. Which resources best supported the teaching and learning of the advantages and disadvantages of gas and electric arc welding?
5. Did learners find the resources useful for better understanding to apply?
6. Were the different subgroups in the class catered for?

Resources

Pictures of finished products from gas and electric arc welding processes, videos/YouTube showing some finished products from gas and electric arc welding processes in use, real objects (welded metal gate, welded cylinder cage, burglar proof, welded metal table and chair, welded metal bed, welded metal cloth hanger, etc)

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UNIT 5

Strand: **Building Construction Technology**

Sub-Strand: Pre-Construction Activities

Content Standard: Demonstrate Knowledge and understanding of Mobilisation for Building Construction.

Learning Outcome: *Analyse mobilisation and determine the schedule of works and provision of plants and equipment (e.g bulldozer, excavator, dumper, concrete mixer, poker vibrator, grader, hoist etc) involved in site preparation (e.g. clearing, hoarding, provision of services, establishing temporal structures and roads) for mobilisation to complete.*

INTRODUCTION AND SECTION SUMMARY

A typical construction site consists of various functional zones or spaces where different activities are performed such as installation of plants and equipment, access roads as well as other services. These are all provided at the mobilisation stage to enhance the quality of the works, speed up progress as well as minimise costs involved in producing the works. The functional spaces provided usually include the work zone, welfare facilities, warehouses, workshops, administration blocks, inner perimeter fencing to secure the work zone, open space around the work zone, security posts, fuel depot and access roads to the site. The site planning principles that influence the location of the above-mentioned infrastructure end up specifically enhancing order, health & safety, security, efficiency and various forms of incentives at the construction sites.

This unit covers only week 24: ***Explain the specific locations of temporal structures, services, welfare facilities and equipment at the new construction site to ensure order, safety, progress of work and security.***

SUMMARY OF PEDAGOGICAL EXEMPLARS

Field trips should be organised to new construction sites where mobilising and specifically the location of temporary structures, services and access roads are being done. This is to provide learners with the opportunity to experience site operations relating to the unit.

Research using the internet as well as other similar materials will also be used to deepen learners' understanding of construction site planning as they compare what happens locally to what is practised internationally. The whole class, comprising of the approaching proficiency, the proficient and the highly proficient, will be engaged in collaboration, brainstorming and critical thinking in mixed-ability groupings to share ideas about site planning and further find out how it contributes to good quality of the works, speeding up progress as well as minimising costs involved in producing the works. Teachers should ensure that GESI, SEL and National Values are infused. Teachers should also keep track of the performance of each learner given their different levels of understanding and provide, where necessary, the relevant motivation or scaffolds to enhance understanding of the concept.

ASSESSMENT SUMMARY

The assessments to be used to monitor the progress of learning during instruction should be formative and this should include quizzes and short oral and written responses to questions. Teachers must keep track of the performance of each learner given his or her unique level as Approaching Proficiency,

Proficient and Highly Proficient and provide the relevant motivation or scaffolds to enhance understanding of mobilisation.

The assessment will also serve as a tool to evaluate the depth of knowledge among learners Approaching Proficiency, the Proficient and Highly Proficient. In this way, the differentiation strategies adopted under pedagogy will equally be assessed to observe how successful they have been.

WEEK 24

Learning Indicators: *Explain the specific locations of temporal structures, services, welfare facilities and equipment at the new construction site to ensure order, safety, progress of work and security.*

Theme or Focal Area: Specific Locations of Temporal Structures, Services, Welfare Facilities as Well as Plant and Equipment at The New Construction Site

A typical construction site consists of various functional zones, installation of plant and equipment, access roads as well as other services. These are all provided to enhance good quality, speed up progress as well as minimise costs.

The principles influencing the site planning for the location of the above-mentioned infrastructure specifically enhance order, health & safety, security and efficiency and support various forms of incentives at the construction sites. Functional zones include:

Table 6.2: *Functional zones and their locations at site*

Functional zone and their location at the site	Spaces within the zone	Activities performed in the space
Administration is normally located near the main entrance.	Reception, offices, drawing rooms, conference/meeting room, visitors' lounge, toilets.	Day-to-day administrative work, processing workers' pay, site meetings etc.
The visitor car park is usually located in front of the Administration.	Parking for staff and visitors, open durbar ground for workers.	Meeting with workers, to check on attendance and to allocate tasks for the day.
The work zone is usually located on the Block Plan. It is encompassed and protected within an inner perimeter fencing at the site.	Free and open buffer space surrounding the project work, spots for concrete mixers, hoists and security posts.	Mixing of concrete, block laying, movement of plant and equipment, forming of steel reinforcement bars, keeping of security, supervision and inspection of works.
The Workshops are usually relegated to the periphery of the site.	Workshop spaces, stores, offices and toilets.	Prefabrication works such as casting sand-cement blocks, concrete coverts, honeycomb blocks and fabrication of timber frames.
The warehousing zone is normally located close to the security gate at the main entrance.	Reception, offices, open sheds, covered sheds, stores and toilets etc.	Receiving and issuing of building materials.
The welfare zone is usually relegated to the periphery of the site but not too far from the works.	Changing rooms, toilets, washrooms, canteen, infirmary, sick bay, TV room, foyer for workers.	Changing, having lunch, attending to nature's call, seeing company doctor, entertainment etc.

Functional zone and their location at the site	Spaces within the zone	Activities performed in the space
Security is located at the main entrance and all corners of the site, usually on security towers.	Office, toilet.	Watching the works and personnel, receiving visitors, inspecting materials being delivered, checking all vehicles entering and exiting and documenting in the occurrence book all the above-mentioned activities.
Access the road from the nearest public road.		Transportation of materials and personnel to and from the site.

Site planning principles are employed in the location of temporal structures at the construction site.

1. Welfare facilities, where provided, tend to serve as incentives and save a lot of man-hours at the site as physiological needs are served promptly within the close and healthy vicinities of the workplace.

Fig. 6.11: *Canteen facility at a work camp.*

Fig. 6.12: *Changing room at a work camp.*

2. When the warehouse is close to a security gate, the security personnel are better placed to keep watch over the material delivery and issuance.
3. Erecting and securing a see-through inner perimeter fence around the work zone is to further restrict access to the project, prevent theft and espionage, as well as to ensure that only those in protective clothing may get close.
4. To keep open space around the work zone to enable the Fire Service easy access in times of emergency and access for hoists and other plant and equipment to be moved all around the building to perform one form of work or the other.

Fig. 6.13: *Security watching the works, personnel, visitors, materials and entire site.*

Fig. 6.14: *Open space around the work zone to enable fire Service, hoists, and other plants access.*

Learning Tasks

1. Explain the usefulness of the security checkpoint at the entrance of the inner perimeter fencing.
2. Explain the relevance of workshops as regards early completion of projects.
3. Explain why buffer spaces should be left around the work zone.

Pedagogical Exemplars

The teacher should consider the following activities:

Experiential learning: Organise field trips to construction sites where site planning, layout and location of temporal structures as well as road constructions are taking place. Learners are expected to observe and interact with contractors who are involved in the layout of the temporal structures to learn from the activities.

Digital learning: Research, using the internet construction site planning, including methods used in Ghana, as well as alternate methods used abroad.

Collaborative learning/critical thinking: Place learners in mixed-ability groupings where the different needs of learners approaching proficiency, the proficient and highly proficient will be met. Encourage all learners to engage in critical thinking and brainstorming to support the understanding of planning the construction site. Teachers should move around providing both verbal and non-verbal feedback to learners during the brainstorming sessions to help with challenges they may face. Learners should refer to practical experiences they have had at the field trips as solutions or illustrations to some of the challenges they may be facing.

Key Assessment (DoK)

1. **Level 2**: List the major facilities that the contractor provides space for during site planning and relate them to activities that the contractor performs during the construction period.
2. **Level 2:** List functional spaces that are provided for within the Welfare Zone and relate their usefulness to the constructional projects.
3. **Level 3:** Describe the facilities and functional spaces that must be provided to enhance security at the site.

Unit 5 Review

Unit 5, week 24 exposed learners to site planning at the inception of building construction projects. The pedagogical exemplars used in this section included talk for learning, group work/ collaborative learning and experiential learning, which helped to meet the varied needs of all learners. These strategies enabled learners to develop communication, collaboration, critical thinking, and problem-solving skills. The assessments that were used to monitor the progress of learning during instruction were formative and this included quizzes and short oral and written responses to questions for varying levels of learning. These assessments were classified under the DoK levels 2 and 3.

Resources

Visits to the construction industry, surfing the internet to find out about processes involved in mobilisation.

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