

## CONTENT AREAS AND TEST SPECIFICATION TABLE FOR APPLIED ELECTRICITY

	Content Areas	Competencies	Descriptive statement	Course Objectives/Outcomes (DOK)				Total
				Level 1 (Recall)	Level 2 (Skills)	Level 3 (Strategic Thinking)	Level 4 (Extended Thinking)	
1	Health, Safety and Protection.	<ul style="list-style-type: none"> <li>Recognize potential health and safety hazards in handling materials and equipment in the workshop.</li> <li>Demonstrate knowledge of safety in the use of tools and materials in the workshop.</li> </ul>	<ul style="list-style-type: none"> <li>Identify various types of electrical protective devices.</li> <li>Outline safe working procedures and safety regulations.</li> <li>Explain appropriate uses of fire extinguishers.</li> <li>Describe safety procedures.</li> <li>Describe precautions to be observed when working with electricity.</li> <li>Apply safety principles when working with electricity.</li> </ul>	1	1	1		3
2	Direct Current Circuit Theory	<ul style="list-style-type: none"> <li>Demonstrate knowledge in the application of Ohm's law</li> <li>Demonstrate understanding of the application of Kirchhoff's laws</li> <li>Be aware of the types of resistors used in circuits.</li> </ul>	<ul style="list-style-type: none"> <li>Describe types of resistors and their properties</li> <li>Select any nominal value of resistor using colour codes.</li> <li>Connect resistors in series and parallel.</li> <li>Determine the power rating of a resistor.</li> <li>Explain Ohm's law.</li> <li>Apply Ohm's law in a simple circuit.</li> <li>prove Ohm's law.</li> <li>Explain Kirchhoff's laws.</li> <li>Apply Kirchhoff's laws in simple circuits.</li> <li>Analyse circuits with two loops using Kirchhoff's laws.</li> <li>Prove KCL and KVL</li> <li>Identify various conductors and insulators, describe their properties and uses.</li> <li>Describe the nature of resistivity of a conductor.</li> <li>Solve problems involving resistivity.</li> <li>Examine the temperature coefficient of resistance and show its applications.</li> <li>Distinguish between power and energy in D.C. circuits.</li> <li>Solve problems involving power and energy.</li> </ul>	1	1	2	3	7

3	Magnetic Field and Circuits	<ul style="list-style-type: none"> <li>• Demonstrate knowledge in the application of magnetisation and demagnetization.</li> <li>• Demonstrate understanding of the concept of electromagnetism.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify types of magnets and describe their applications.</li> <li>• Identify materials that have magnetic properties and explain their usage in applied electricity.</li> <li>• Solve problems involving simple magnetic circuits.</li> <li>• Describe the magnetization and demagnetization of a magnetic material.</li> <li>• Analyse the B/H curve and the hysteresis loop.</li> <li>• Assess the magnetic field around a current-carrying conductor and a solenoid when the direction of current is known.</li> <li>• Determine a force on a current-carrying conductor in a magnetic field.</li> <li>• Explain Lenz's law and Fleming's Right-Hand Rule and their applications in applied electricity.</li> <li>• Determine the induced electromagnetic force (E.M.F). in a conductor cutting a magnetic field</li> <li>• Distinguish between self and mutual induction and solve problems involving self and mutual induction.</li> <li>• describe the applications of electromagnetism.</li> <li>• calculate the energy stored in a coil</li> </ul>	0	2	1	1	4
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4	Electric Field and Circuits	<ul style="list-style-type: none"> <li>• Demonstrate understanding of the concepts of electric field and magnetic field and their relationship</li> <li>• Demonstrate understanding of applications and calculations on capacitors</li> </ul>	<ul style="list-style-type: none"> <li>• state the importance of the electric field</li> <li>• explain the electric field and its properties.</li> <li>• explain types of capacitors.</li> <li>• explain the capacitance of a capacitor</li> <li>• state the relationship between charged and applied voltage of a capacitor.</li> <li>• relate the voltage rating of a capacitor to its application</li> <li>• solve problems involving capacitors in series and in parallel.</li> <li>• develop relations for series and parallel connection of capacitors</li> <li>• calculate the energy stored in capacitors.</li> <li>• compare total capacitance in series and parallel circuits</li> </ul>	0	2	1	1	4
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5	Measurement and Instruments	<ul style="list-style-type: none"> <li>• Demonstrate knowledge of the principle of operation of measuring instruments.</li> <li>• Demonstrate skills in the use of measuring instruments.</li> <li>• Demonstrate skills in the use and care of the digital multi- meter for the measurement of quantities.</li> <li>• Demonstrate knowledge and skills in using the CRO for measuring waveform and voltage.</li> </ul>	<ul style="list-style-type: none"> <li>• explain the operation of the moving coil instrument.</li> <li>• describe the construction of a moving coil instrument.</li> <li>• describe the use of a galvanometer to measure resistance.</li> <li>• outline the advantages and disadvantages of moving coil instruments.</li> <li>• convert a moving coil galvanometer to an ammeter or voltmeter.</li> <li>• compare MI to MC instruments.</li> <li>• solve problems involving shunts and multipliers.</li> <li>• explain the operations of moving iron instruments.</li> <li>• state the advantages and disadvantages of moving iron instruments.</li> <li>• describe the construction of a moving iron instrument</li> </ul>	1	2	2	2	7
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6	Alternating Current Circuit Theory	<ul style="list-style-type: none"> <li>• Demonstrate knowledge and skills for solving problems connected with the alternating current generation.</li> <li>• Demonstrate knowledge and skills for solving problems connected with single-phase and 3-phase circuits</li> <li>• Demonstrate awareness of the effect of frequency on components in a circuit.</li> </ul>	<ul style="list-style-type: none"> <li>• identify and explain the various A.C. quantities.</li> <li>• solve problems involving RL and RC series circuits.</li> <li>• explain the conditions at which resonance occurs.</li> <li>• draw phasor diagram for RL and RC series circuit.</li> <li>• explain the characteristics of the RLC circuit and solve problems involving the RLC series circuit.</li> <li>• draw a phasor diagram for the RLC circuit.</li> <li>• explain the power factor and the effect of a low power factor.</li> <li>• determine power in a single-phase and 3-phase circuit.</li> <li>• solve problems involving active, apparent and reactive power.</li> <li>• analyse the relationship between star delta connections.</li> <li>• connect star and delta system of 3-phase and measure line and phase voltages and currents.</li> <li>• solve problems involving line voltage and phase voltage, line current and phase current.</li> </ul>	1	1	2	3	7
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7	Transformers	<ul style="list-style-type: none"> <li>• Be aware of the principles of operation of a transformer.</li> <li>• Be aware of the effects of losses in a transformer.</li> <li>• Recognize the importance of cooling a transformer.</li> <li>• Demonstrate knowledge and skills for solving problems connected with voltage regulation</li> </ul>	<ul style="list-style-type: none"> <li>• identify types of transformers and describe their construction.</li> <li>• explain the principles of operation of a transformer.</li> <li>• solve problems involving the transformation ratio.</li> <li>• identify the losses in a transformer.</li> <li>• describe the effects of losses in a transformer.</li> <li>• determine losses in a transformer and explain its effect on efficiency.</li> <li>• identify and demonstrate various methods of cooling power transformers.</li> <li>• explain the importance of cooling a transformer.</li> <li>• explain voltage regulation.</li> <li>• explain the effects of load on the voltage regulation of a transformer.</li> <li>• calculate the voltage regulation of a transformer.</li> </ul>	1	1	2	1	5
8	Semi-Conductor Devices	<ul style="list-style-type: none"> <li>• Demonstrate an understanding of the principles of semiconductor devices.</li> <li>• Recognize the difference between n-type and p-type materials.</li> </ul>	<ul style="list-style-type: none"> <li>• list the electrical properties of semiconductor materials in terms of the Periodic Table.</li> <li>• differentiate between n-type and p-type semiconductor materials and their formation.</li> <li>• explain the difference between forward and reverse biasing with reference to the P.N. diode.</li> <li>• draw a symbol of a P.N junction diode and explain the formation of the p-n junction diode.</li> <li>• applications of P.N. diode</li> </ul>	1	1	0	-	2

9	Electrical Energy Supply	<ul style="list-style-type: none"> <li>• Demonstrate knowledge of the concept of power generation.</li> <li>• Develop an awareness of the layout of substations and items installed in substations.</li> </ul>	<ul style="list-style-type: none"> <li>• explain the various methods of generating electrical power.</li> <li>• explain the different classification of renewable energy systems</li> </ul>	1	1	1	0	3
10	Direct Current Machines	<ul style="list-style-type: none"> <li>• Demonstrate knowledge of D.C. generators and motors.</li> <li>• be aware of the relationship between D.C. generators and motors.</li> </ul>	<ul style="list-style-type: none"> <li>• identify and list the parts of D.C. generators.</li> <li>• explain the principle of operation of D.C. generators and methods of connecting field windings.</li> <li>• identify the type of D.C. motors.</li> <li>• explain the principles of operation of D.C. motor and state methods of starting.</li> <li>• explain the applications for D.C. motors.</li> <li>• dismantle and describe the construction of motors.</li> <li>• analyse various methods of speed control of D.C motors.</li> </ul>	0	1	3	3	7

11	Alternating Current Machines	<ul style="list-style-type: none"> <li>• Demonstrate understanding of A.C. generators</li> <li>• Demonstrate understanding of A.C. motors</li> </ul>	<ul style="list-style-type: none"> <li>• identify the parts of an alternator.</li> <li>• identify types of Alternators.</li> <li>• explain the principles of operation of an alternator.</li> <li>• explain the relationship between speed, the number of poles and frequency.</li> <li>• identify types of three-phase and single-phase motors.</li> <li>• explain the principles of operation of an A.C. motor.</li> <li>• describe the application of AC. motors.</li> <li>• describe methods of starting 3- phase motors.</li> <li>• select and connect appropriate starters for different types of AC machines</li> </ul>	0	1	2	3	6
12	Digital Electronic	<ul style="list-style-type: none"> <li>• Demonstrate understanding of binary numbers and their various conversions with other number systems.</li> <li>• Demonstrate knowledge of the functions of the logic</li> </ul>	<ul style="list-style-type: none"> <li>• convert decimal numbers to binary numbers and vice versa.</li> <li>• explain each function and draw the truth table for each Boolean expression from a truth table and implement.</li> <li>• state the functions of the logic gates.</li> </ul>	1	0	0	0	1

13	Communication	<ul style="list-style-type: none"> <li>• Demonstrate knowledge of the concept of communication.</li> <li>• Demonstrate knowledge of the principle of modulation and waveforms.</li> </ul>	<ul style="list-style-type: none"> <li>• state the relationship between velocity, frequency, and wavelength.</li> <li>• sketch the waveforms and explain amplitude modulation.</li> <li>• sketch waveforms and explain frequency modulation.</li> </ul>	1	0	0	0	1
14	Electrical Wiring	<ul style="list-style-type: none"> <li>• Demonstrate skills in electrical wiring.</li> <li>• Appreciate the importance of IEE/Ghana Code Wiring regulations.</li> </ul>	<ul style="list-style-type: none"> <li>• identify types of cables and accessories.</li> <li>• identify the size of cables and their current ratings.</li> <li>• connect wire lighting circuit and socket outlets (ring and radial circuits) and connect plugs.</li> <li>analyse conduit, surface and trucking installations.</li> <li>explain the function of protective devices.</li> <li>select suitable sizes of protective devices for installation.</li> <li>explain the earth loop impedance of an installation.</li> <li>explain the reason for earthing.</li> <li>demonstrate the method of earthing.</li> </ul>	0	1	1	1	3
<b>Total</b>				<b>9</b>	<b>15</b>	<b>18</b>	<b>18</b>	<b>60</b>
				<b>20%</b>	<b>25%</b>	<b>35%</b>	<b>20%</b>	<b>100%%</b>

TABLE OF SPECIFICATION FOR APPLIED ELECTRICITY

	CONTENT AREAS	Course Objectives/Outcomes (DOK)				Total
		Level 1 (Recall)	Level 2 (Skills/Concepts)	Level 3 (Strategic Thinking)	Level 4 (Extended Thinking)	
1	Health, Safety and Protection.	1	1	1		3
2	Direct Current Circuit Theory	1	1	2	3	7
3	Magnetic Field and Circuits	0	2	1	1	4
4	Electric Field and Circuits	0	2	1	1	4
5	Measurement and Instruments	1	2	2	2	7
6	Alternating Current Circuit Theory	1	1	2	3	7
7	Transformers	1	1	2	1	5
8	Semi-conductor Devices	1	1	0	-	2
9	Electrical Energy Supply	1	1	1	0	3
10	Direct Current Machines	0	1	3	3	7
11	Alternating Current Machines	0	1	2	3	6
12	Digital Electronic	1	0	0	0	1
13	Communication	1	0	0	0	1
14	Electrical Wiring	0	1	1	1	3
<b>Total</b>		<b>9</b>	<b>15</b>	<b>18</b>	<b>18</b>	<b>60</b>
		<b>15%</b>	<b>25%</b>	<b>30%</b>	<b>30%</b>	<b>100%</b>