



SCOTT CHRISTIAN UNIVERSITY

SCHOOL OF PROFESSIONAL STUDIES

BACHELOR OF INFORMATION COMMUNICATION TECHNOLOGY

UNIT CODE/NAME: BCT 117: ELECTRICITY AND MAGNETISM

January - April 2021/2022 End Semester Exam - Time: 2 Hours

Instructions: Answer Question ONE (Compulsory) and any other TWO questions.

QUESTION ONE

- a) An electric field is represented pictorially using electric field lines. These are lines drawn according to some rules. State the rules. (3Marks)
- b) Explain how Scott University Students can make electricity from magnets. (3Marks)
- c) A bulb is connected to the battery of some EMF equal to E . Will the bulb be brighter or dimmer if it will be reconnected to a new battery of $E_{\text{new}}=2E$. If so, calculate by how much. (5Marks)
- d) Distinguish between conducting materials and insulating materials. (4Marks)
- e) Explain Kirchhoff's two laws. (4Marks)
- f) A metallic wire has resistivity $10 \mu\Omega \cdot \text{cm}$, length L equal to 50 cm and the diameter d equal to 2 mm. Calculate the resistance. (3Marks)
- g) Distinguish between electric field (E) and electric potential (V). (4Marks)
- h) Calculate the voltage that should be applied to the $5 \mu\text{F}$ capacitor to accumulate $1 \mu\text{C}$ charge on its plates. (4Marks)

QUESTION TWO

- a) Explain the Coulomb's Law. (3Marks)
- b) Using detailed explanations and diagrams show how to calculate the capacitance in series and in parallel. (6Marks)
- c) Calculate how much Scott University spends per day by having a bulb working in the University gate circuit with a voltage of 110V and the current of 1A. (Assume that 1 kW*hour costs 10 cents). (6Marks)

QUESTION THREE

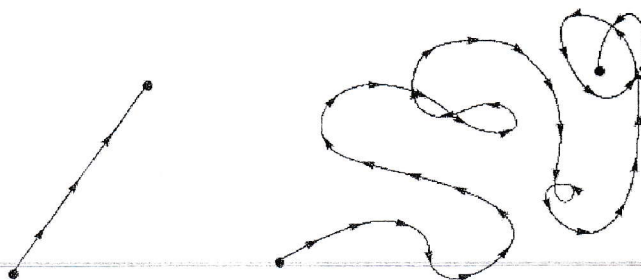
- a) State Gauss's theorem. (3Marks)
- b) In Kenyan State house, a single switch is used to controls five lighting point. Explain the type of circuit that could be in use, to connect the switch to the lights. (3Marks)
- c) Find the flux through a spherical Gaussian surface of radius $a = 1 \text{ m}$ surrounding a charge of 8.85 pC . (4Marks)
- d) What is the drift velocity of the electrons for the current of 1.6 A passing thru the wire which has a cross-sectional area of 1 mm^2 . (Assume that typical density of the electrons is 10^{30} el/m^3). (5Marks)

QUESTION FOUR

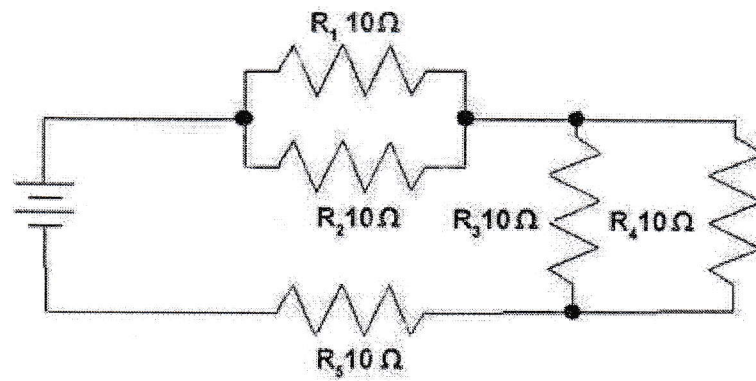
- a) State Ohm's law and explain what will happen to the current in a simple DC circuit with a constant voltage, when the resistance increases. (3Marks)
- b) Find the value of the electric field between the plates of the parallel plate capacitor if the voltage is 120 V and the distance between the plates is 1 mm . (3Marks)
- c) Calculate the difference between the potential at $r = 5 \text{ cm}$ and $r = 10 \text{ cm}$ for a single point charge of 1 C located at the origin. (3Marks)
- d) A circuit consists of the real battery ($E=10\text{V}$, $r= 2\Omega$) and the resistor $R= 3\Omega$. Calculate current and the total power released in the circuit. (6Marks)

QUESTION FIVE

- a) What is the charge that appears on the plates of the 10-pF capacitor if it is connected to a battery of 9 V . (2Marks)
- b) In the two figures below, indicate between the two paths the one that will have more work to push a charge along. Explain your answer. (3Marks)



- b) Describe the type of circuit is shown in the diagram below. (4Marks)



c) A uniform electric field with strength $E=5.40 \times 10^5 \text{ N/C}$ hits a closed hemisphere with radius $R=15.0 \text{ cm}$. The field enters the hemisphere perpendicular to the flat circular surface. The hemisphere has no charge inside of it.

- i. Find the electric flux through the flat circular surface. (3 Marks)
- ii. Find the electric flux through the curved surface. (3 Marks)