

**CHUKA**



**UNIVERSITY**

**UNIVERSITY EXAMINATIONS**

**EXAMINATION FOR THE AWARD OF DEGREE OF  
BACHELOR OF SCIENCE IN FOOD SCIENCE AND TECHNOLOGY**

**ICEN 206: ELECTRICAL ENGINEERING PRINCIPLES**

**STREAMS: BSC (FOST)**

**TIME: 2 HOURS**

**DAY/DATE: TUESDAY 14/04/2020**

**11.30 AM – 1.30 PM**

**INSTRUCTIONS:**

- **Answer Question One and any other Two Questions**
- **Do not write on the question paper**

**SECTION ONE**

- (a) Define the term, resonant frequency. [2 marks]
- (b) Using magnetic lines, describe the properties of magnetic field lines. [2 marks]
- (c) What is a transistor? How is it different from a relay? [2 marks]
- (d) Name the advantages of three phase power transmission for power utilities? [2 marks]
- (e) Explain why high voltages used in power transmission for power utilities? [2 marks]
- (f) When is a diode considered forward biased? [2 marks]
- (g) What is an electromechanical energy conversion system? [2 marks]
- (h) Show that the energy stored in capacitors can be given by  

$$E = \frac{Q^2}{2C}$$
 [4 marks]
- (i) State Kirchoff's junction and Loop rule. [4 marks]

- (j) Three resistors are connected in parallel as shown.

A potential difference of 18V is maintained between point A and B

- (i) Find the current in each resistor. [3 marks]
- (ii) Calculate the power delivered to each resistor and the total power. [3 marks]
- (iii) Find the equivalent resistance of the circuit. [2 marks]

## SECTION TWO

### QUESTION TWO

- (a) Define Faraday's Law using a formula. [2 marks]
- (b) Explain three applications of Faraday's law in engineering. [9 marks]
- (c) Explain the types of power losses in a real transformer. [6 marks]
- (d) List three losses experienced in an electromechanical energy conversion system. [3 marks]

### QUESTION THREE

- (a) Briefly explain the working principle of a power transformer. [4 marks]
- (b) In the classical model of the hydrogen atom, the electron revolves around the proton with a radius of  $r = 0.53 \times 10^{-10}m$ . The magnitude of the charge of the electron and proton is  $e = 1.6 \times 10^{-19}C$ .
- (i) What is the magnitude of the electric force between the proton and the electron? [4 marks]
- (ii) What is the magnitude of the electric field due to the proton at r? [4 marks]
- (iii) What is ratio of the magnitudes of the electrical and gravitational force between electron and proton? Does the result depend on the distance between the proton and the electron? [5 marks]

- (c) State the Coulomb's law of electromagnetism. [3 marks]

#### QUESTION FOUR

- (a) State three disadvantages of series connections in an electrical circuit. [3 marks]
- (b) An electric dipole has opposite charges of  $5 \times 10^{-15} \text{ C}$  separated by a distance of 0.4 mm. it is oriented at  $60^\circ$  with respect to a uniform electric field of magnitude  $2 \times 10^3 \text{ N/C}$ .

Determine

- (i) The electric dipole moment. [2 marks]
- (ii) The magnitude of the torque exerted on the dipole by the electric field. [5 marks]
- (c) If a resistor of 5 ohms, an inductor of 0.08H and a capacitor of  $15 \mu\text{F}$  are connected in series to a 50V, 50Hz, supply, calculate
- (i) The impedance of the circuit [3 marks]
- (ii) The current [2 marks]
- (iii) The power [2 marks]
- (iv) The power factor. Verify the power factors [3 marks]

#### QUESTION FIVE

- (a) What is a p-n junction? [2 marks]
- (b) A parallel plate capacitor has an area  $A = 2.00 \times 10^{-4} \text{ m}^2$  and a plate separation distance  $d = 1.00 \times 10^{-3} \text{ m}$ . Find its capacitance. [4 marks]
- (c) Explain the applications of p-n junction diodes. [4 marks]
- (d) Briefly explain the operation principle of a DC generator. [6 marks]
- (e) What is a transformer? [2 marks]
- (f) Why is a neutral conductor connected to earth at a supply transformer? [2 marks]
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