

EMBU UNIVERSITY COLLEGE
(A CONSTITUENT COLLEGE OF THE UNIVERSITY OF NAIROBI)

FIRST SEMESTER EXAMINATIONS 2014/2015
SECOND YEAR EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE

SPH 202: ELECTRICITY AND MAGNETISM II

DATE: DECEMBER 17, 2014

TIME: 10:30AM – 12:30PM

INSTRUCTIONS:

Answer Question ONE and ANY Other TWO Questions.

$\mu = 4\pi \times 10^{-7}$, $e^- = 1.6 \times 10^{-19} \text{C}$, $M_e = 9.11 \times 10^{-31} \text{kg}$

QUESTION ONE

- a) Differentiate between,
- i) Paramagnetism and ferromagnetism (2 marks)
 - ii) Permanent and temporary magnets (2 marks)
- b) i) Explain the coulomb's law (2 marks)
- ii) Explain the charge-force law (2 marks)
 - iii) Explain a dielectric medium (2 marks)
 - iv) A conductor of capacitance 20MF is charged to a potential of 1000volts.
Calculate the energy stored in the conductor. (3 marks)
- v) A bar magnet has a flux density of 0.28T and a cross – section area of 2cm^2 , find the total flux in the magnet. (2 marks)

- vi) A 240V, 50Hz A.C supply is applied to a coil of 0.06H inductance and 2.5Ω resistance connected in series with $6.8\mu\text{F}$ capacitor. Calculate
- vii) Impedance (3 marks)
- viii) Current (2 marks)
- ix) A proton has a speed of $4.5 \times 10^6\text{m/s}$ in the direction perpendicular to a uniform magnetic field and the proton moves in a circular orbit of radius 0.20m. What is the magnitude of the magnetic field. (4 marks)
- x) Explain Gauss's law. (2 marks)
- xi) Show that the electric charge (q) distribution throughout the volume of a sphere of radius R and total charge (Q) is given by $q=Qr^2/R^3$ where r is the radius of the Gaussian surface. (4 marks)

QUESTIONS TWO

- a) Explain the following terms
- i) Linear charge density (1 mark)
- ii) Volume density (1 mark)
- iii) Two magnetic south poles are located 10cm apart in air. If each pole has a strength of 6mWb find the force of expulsion between them. (3 marks)
- b) i) Differentiate between relative permeability of a material and intensity of magnetization. (2 marks)
- ii) Define the term magnetic susceptibility. (2 marks)
- iii) A specimen of iron is uniformly magnetized by a magnetizing field of 600A/M^2 . If the specimen is 0.4Wb/M^2 , find the relative permeability and susceptibility. (5 marks)
- c) A bar magnet has a flux density of 0.14T on a cross-sectional area of 2cm^2 , find the total flux in the magnet. (2 marks)

d) An electric flux of magnitude $175\text{NM}^2/\text{C}$ passes through a flat horizontal surface that has an area of 0.70 M^2 . The flux is due to a uniform electric field. What is the magnitude of the field if it points.

i) Vertically up. (2 marks)

ii) 30° above the horizontal. (2 marks)

QUESTION THREE

a) Design a RLC bandpass filter with a lower cut-off frequency of 1 kHz and a bandwidth of 3 kHz. What is the center frequency and Q of this filter? (6 marks)

b) An A.C circuit consists of resistance of 10Ω and is connected across A.C supply of 240V, 50Hz. Calculate.

i) Current (1 mark)

ii) Power consumed (2 marks)

iii) Equations for voltage and current. (3 marks)

c) Two phasors are given in the form $V_1 = 4+j3$, $V_2 = 5+j6$. Use rectangular form to evaluate

i) $V_1 \times V_2$ (2 marks)

ii) $\frac{V_1}{V_2}$ (2 marks)

iii) The usual house hold power supply in Kenyan houses “ 240- volts ac” has an rms voltage of 240V. Calculate the voltage amplitude V_0 . (2 marks)

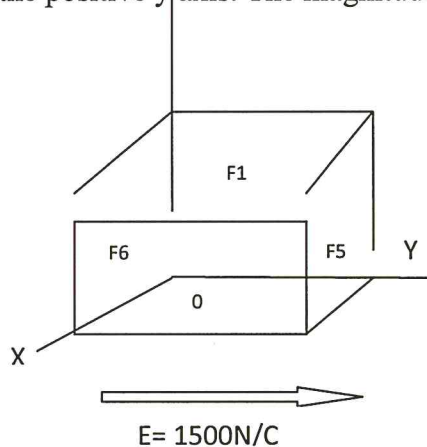
iv) A conductor of capacitance 20MF is charged to a potential of 1000volts. Calculate the energy stored in the conductor (2 marks)

QUESTION FOUR

a) A pure inductive coil allows a current of 10A to flow from a 230V, 50Hz supply. Find

- i) Inductive reactance (X_L) (2 marks)
- ii) Inductance of the coil (L) (2 marks)
- iii) Power absorbed (P) (1mark)
- iv) Write equations for voltage and current (4 marks)

b) A cube of sides 0.2m is located with one corner at the origin of an x,y,z coordinate system as shown in the diagram. A uniform electric field is parallel to the x-y plane and point in the positive y axis. The magnitude of the field is 1500N/C.



- i) Find the electric flux through each of the six faces of the cube (3 marks)
 - ii) Show that the total flux through the cubical surface is zero (2 marks)
 - iii) The electric field in the earth's atmosphere close to ground level has a uniform value of 150N/C. The direction of the field is radially inward. Earth's radius is 6380 km. Calculate the net electric charge (magnitude and sign) on the earth's surface. (3 marks)
- c) A 318 μ F capacitor is connected across 240V, 50Hz system. Determine
- i) Capacitive reactance (2 marks)

ii) R M S value of current (1mark)

QUESTION FIVE

a) i) Using a diagram explain the structure of a transformer (3 marks)

ii) A 40kv single load transformer has 400turns on the primary and 100turns on the secondary. The primary is connected to 200V, 50Hz supply. Determine ;

iii) Secondary voltage on an opened circuit (3 marks)

iv) Current flowing through the windings on the full load. (2 marks)

v) Maximum value of flux (2 marks)

b) i) State Ampere's law (2 marks)

ii) Two straight, parallel super conducting cables are kept 5.0mm apart and are intended to carry equal current of 15000A in opposite directions. (the mechanical strength of the material of the cable is given as $1.5 \times 10^3 \text{N/M}$). calculate the force per unit length. From the calculation, should we worry about the mechanical strength of these cables under operation? (4 marks)

c) The current through an 80mH inductor is $I = 0.1 \sin(400t - 25^\circ) \text{A}$. Find the voltage across it. (4 marks)

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