MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

FIRST YEAR **SECOND** SEMESTER EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING

APH109: PHYSICS II

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer Question one and any other two questions.

2. Mobile phones are not allowed in the examination room.

3. You are not allowed to write on this examination question paper.

Some useful constants:

Charge of an electron = 1.602 x 10^{-19}c
Speed of light C =2.998 x 10^8m/s
Permittivity of free space = 8.854 x 10^{-12} Fm
Mass of a proton = 1.0073 amu
Mass of a neutron = 1.0087 amu
Mass of an electron = 9.109 x 10^{-31}kg
Planks' constant = 6.626 x 10^{-34} Js
I a.m.u = 931 mev
Resistivity of copper = 1.720 x 10^{-8}Ωm
Magnetic permeability of free space =4Π x 10^{-7}H/M

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a) Define the following terms   (3marks)
    i.   Current density
    ii.   Electric field
    iii.   Electric resistance
b) An electron covers a distance of 60mm when accelerated from rest by an electric field of 2.0 x 10^4 N/c, calculate the travel time.   (4marks)
c) State three ways of increasing the magnetic flux through a coil   (3marks)
d) An NPN transistor has a direct current gain (β) of 200. Calculate the base current required to switch on a resistive load of 4mA.   (3marks)
e) A camera has a focal length of 50mm. You are taking a picture of a person who is 2m tall and stands 3m away from the lens.
    i.   How far from the lens should the film be located?   (2marks)
    ii.   How tall is the person's image on the film?   (2marks)
f) A square coil of side 5 cm lie perpendicular to a magnetic field of flux density 4.0T. The coil consists of 200 turns of wire. What is the magnetic flux cutting the coil?   (3marks)
g) State the two postulate of the special theory of relativity   (2marks)
h) What is the maximum Kinetic energy in eV of electrons ejected from a certain metal by 472nm EM radiation given that the work function of the metal is 2.33eV.   (3marks)
i) Describe the origin of the universe using the big bang theory   (3marks)
j) State two components of the solar system apart from the sun.   (2marks)

SECTION TWO: ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a) Distinguish between resistance and impedance   (2marks)
b) A 500µH inductor, $\frac{80}{\pi^2}$ pF capacitor are connected to form a series RLC circuit with a 628 Ω resistor. Calculate.
    i.   The resonant frequency of the circuit   (3marks)
    ii.   Capacitive reactance at a frequency of 40Hz   (2marks)
    iii.   Inductive reactance   (2marks)
    iv.   Impendence of the circuit   (2marks)

c) Describe how x-rays are produced in an x-ray tube (3marks)
d) An x-ray tube is operating with an anode potential of 10KV and a current of 20.0 mA. calculate
    i.   Number of electrons hitting the anode per second (3marks)
    ii.   The wavelength of the x-rays produced given that the tube is 30% efficient
                                                          (3marks)

QUESTION THREE (20 MARKS)

a) A particle having a change of $q=5 \times 10^{-6}$ C moves from point Q along a straight line, covering a distance of 6m. the electric field is uniform along this line in the direction from P to Q with a magnitude E=600N/C. calculate
    i.   Force on the charge (3marks)
    ii.   Work done on it by the field (2marks)
b) The radius of a copper wire is 1.63mm, a p.d of 60v is applied across a 20m length of this wire. Determine
    i.   Resistance (3marks)
    ii.   Current (2marks)
c) i. State De Broglie hypothesis (1mark)
    ii. Determine the De Broglie wavelength of a wave associated with an electron that moves with a speed of 3.72×10^{6} m/s (5marks)
    iii.   determine the rest energy of an electron (2marks)
d) Two slits are spaced 0.2mm apart and a screen is at a distance of 1m, the third bright fringe is found to displaced 7.5mm from the central bright fringe. Determine the
    i.   Wavelength of the light used (3marks)
    ii.   Distance from the central fringe to the second bright fringe (2marks)

QUESTION FOUR (20 MARKS)

a) State four planets that have solid bodies (4marks)
b) Define the following terms
    i.   Galaxies
    ii.   Satellite
    iii.   Cosmolgy (3marks
c) The time at point A(50°N, 10°W) is 3.05 pm. Determine the time at point B(30°N, 80°E). (3marks)
d) A circular coil of radius 8.0cm and 20turns is rotated about its vertical diameter with angular speed of 50 rad/s in a uniform horizontal magnetic field of magnitude 3.0×10^{-2}T. If the coil forms a closed loop of resistance 10Ω. Determine
    i.   Maximum induced e.m.f. (4marks)
    ii.   Maximum value of current in the coil (2marks)
    iii.   Average power loss due to heating. (2marks)
e) Convert 1680 from decimal to binary number system. (2marks)