KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2009/2010

FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE (COMPUTER TECHNOLOGY)

SCT 102: FUNDAMENTALS OF PHYSICS

DATE: WEDNESDAY 28TH JULY 2010 TIME: 8.00 A.M. - 10.00 A.M.

INSTRUCTIONS

1. Answer question **ONE** and any other two.
2. Quesiton one carries 30 marks while the others carry 20 marks each
3. Use the following constant where applicable
   Gravitational constant $g = 9.82\ ms^{-2}$

Question 1 (Compulsory. 30 Marks)

a. List three characteristics of electromagnetic waves (3mks)

b. Explain what is meant by duality of light (1mk)

c. A small luminous object is on the principal axis of a converging lens of focal length 40cm. The object is 50cm from the lens. Light from the object passes through the lens and is then reflected by a plane mirror. The mirror is 150cm from the lens and perpendicular to its principal axis. How far from the lens is this image? (4mks)

d. Define the angular magnification of a telescope. A telescope consists of two converging lenses. When in normal adjustment, the lenses are 450mm apart, and the angular magnification is 8. Calculate the focal lengths of the two lenses(4mks)

e. Light of wavelength 550nm is incident normally on the slit. Determine the minimum width of the slit that result in at least 4 minima appearing in the diffraction pattern within an angle of $\pm 5^0$ of the central pattern. (3mks)

f. Given that $\vec{a} = 3i - j + 2k$ and $\vec{b} = 2i + j - 2k$, find the angle between the vectors. (4mks)

g. Find the current in the circuit of Figure 1. (4mks)

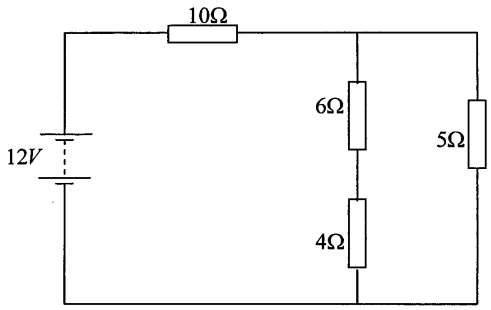

Figure 1

h. A 0.2H inductor is supplied from a 240V, 50Hz supply. Find:

i. The reactance of the inductor (2mks)

ii. The current (2mks)

i. Describe briefly how a laser works. (3mks)

Question 2 (20 marks)

a. A point object is placed on the axis of, and 3.6 cm from, a thin converging lens of focal length 3cm. A second thin converging lens of focal length 16cm is placed coaxial with the first and 26cm from it on the side remote of the object

i. Find the position of the final image (4mks)

ii. Why is this not a suitable arrangement for a compound microscope used by an observer with normal eye sight? (2mks)

iii. For such an observer wishing to use the two lenses as a compound microscope with the eye close to the second lens, decide, by means of suitable calculation where the second lens must be placed relative to the first. (4mks)

b. With the aid of appropriate ray diagrams, derive expressions for the angular magnification in terms of focal length and least distance of distinct vision of a magnifying glass when the image is

i. At near point (5mks)

ii. At infinity (3mks)

c. A thin converging lens of focal length 50mm is to be used as a magnifying glass with the observer's eye close to the lens. If the observer can see images clearly anywhere between 250mm and infinity, determine the range of possible object distances (2mks)

Question 3 (20 marks)

a. A parallel monochromatic light is incident normally on a thin slit of width 'a' and focused o to a screen. Derive the relationship between the wavelength λ and the angle of diffraction θ for the first minimum of intensity on the screen. (5mks)

b. Light consisting of two wavelengths which differ by 160nm passes through a diffraction grating with 2.5×10^5 lines per meter. In the diffracted light, the third order of one wavelength coincides with the fourth order of the other. What angle of diffraction does this coincidence occur? (5mks)

c. Define the term modulation. Hence describe the common types of modulation. (10mks)

Question 4 (20 marks)

a. What is the vector equation describing the straight line passing through the points A(-8, 1, -2) and B(10, -1, 3)? (2mks)

b. Find the coordinates of a point P on AB (in question 'a' above) such that OP is perpendicular to AB (origin O) hence find the distance OP. (8mks)

c. Show that $v^2 = u^2 + 2as$ given **u, v, a, s** as the initial velocity, final velocity, acceleration and displacement respectively. (3mks)

d. A stone is thrown vertically upwards with a velocity of $15ms^{-1}$.

   i. What is the maximum height reached? (3mks)

   ii. How long is the stone in air before hitting the ground? (2mks)

e. A boy throws a stone vertically down a well at $12ms^{-1}$. If he hears the stone hit the water 3 seconds later, how deep is the well? (2mks)

Question 5

a. Distinguish between alternating and direct EMF, hence show that a coil rotating with constant angular velocity ω in a uniform magnetic field produces a sinusoidally alternating EMF given by $E = E_0 \sin\omega t$. (5mks)

b. In the circuit of figure 2, determine the power dissipated in the circuit. (5mks)

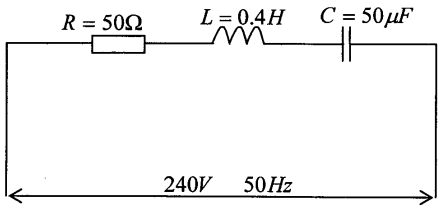

Figure 2

c. A coil of inductance 20H and resistance of 10Ω is connected in series with a battery of EMF 12V and a switch. How long after the switch is closed will the current be 0.4A? (3mks)

d. Using the circuit of figure 3, determine:

i. the total resistance (3mks)
ii. Current through the 5Ω resistor (4mks)

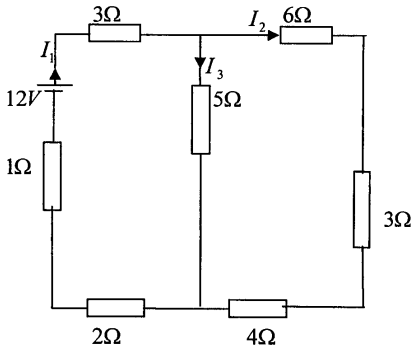

Figure 3

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