TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR:

DEGREE FOR THE BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING (Y1, S2)

APS 2174: PHYSICS FOR ENGINEERS

END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2014
TIME ALLOWED: 2 HOURS

Instructions to Candidates:
You should have the following for this examination
- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FIVE** questions
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

Question One (Compulsory)

a) State the principal of super position. **(2 marks)**

b) Determine the number of principal maxima produced when a grating with a spacing of 2.0×10^{-6}m is illuminated normally with light at wavelength 6.44×10^{-7}m. **(5 marks)**

c) Discuss FIVE properties of electromagnetic waves. **(5 marks)**

d) Explain THREE means of detecting:
(i) Gammar rays and
(ii) X-rays **(6 marks)**

e) A cyclist and a railway train are approaching each other. The cyclist is moving at $10ms^{-1}$ and the train at $20ms^{-1}$. The engine driver sounds a warning given at a frequency of 480Hz. Determine the frequency of the note heard by the cyclist:

(i) Before and;

(ii) After the train has passed (speed of sound in air ($340ms^{-1}$)

f) (i) Explain what is meant by the term damping. **(6 marks)**

(ii) Discuss how the amount of damping affect resonance **(4 marks)**

g) Describe the difference between stationary waves and progressive waves. **(2 marks)**

Question Two

a) Sodium has a work function of 2.3 eV. Determine:

(i) Its threshold frequency

(ii) The maximum velocity at the photoelectrons produced when the sodium is illuminated by light of wavelength $5 \times 10^{-7}m$

(iii) The stopping potential with light of this wavelength.

($h = 6.6 \times 10^{-3}JS$, $C = 3.0 \times 10^{8}\ ms^{-1}$, lev $= 1.6 \times 10^{-19}J$ mass of electrons $= 9.1 \times 10^{-31}kg$)

(10 marks)

b) Explain FIVE properties of x-rays. **(5 marks)**

c) Discuss FIVE consequences of resonance. **(5 marks)**

Question Three

$$y = a\sin(wt - kx)$$

a) The equation represents a sound wave travelling a long the x-direction. What is the physical interpretation of the quantities a, y, w, t and k. Deduce whether the wave is travelling in the positive or negative x-direction. **(6 marks)**

b) Find (a) Potential (b) Electric field intensity at point C on a line ACB in a medium of permittivity where AC = CB = 6cm given that there is a positive point charge Q1 at A and a negative point charge Q2 at B.

$$\frac{1}{4\pi\varepsilon_0} = 9.0\times10^{7}\,mF^{-1}$$

(Assume) **(6 marks)**

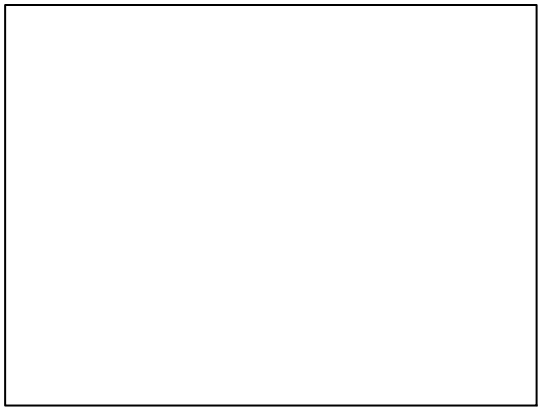
c) Light of frequency $6.0 \times 10^{14}Hz$ incidence on a metal surface ejects photo electrons having kinetic energy $2.0 \times 10^{-19}J$. Determine the energy needed to remove an electron from the metal

($h = 6.6 \times 10\text{-}^{34}JS$) **(4 marks)**

d) An object is placed 20cm from a converging lens of focal length 30cm. Determine the position of the image. State the nature of the image. **(4 marks)**

Question Four

a) Use Kirchhoff's laws to determine the currents flowing in each branch of the network shown in figure 1. **(10 marks)**



b) A convex mirror whose radius of curvature is 30cm forms an image of real object which has been placed 20cm from the mirror. Determine the position of the image and magnification produced. **(6 marks)**

c) Explain FOUR uses of radioactivity. **(4 marks)**

Question Five

a) A ray of light is incident in glass on a glass water boundary. The angle of incidence is 50^{o}. Determine the angle of refraction (Refraction index of glass = 1.5, Refraction index of water = 1.3) **(4 marks)**

b) Explain what is meant by wavelength, frequency and speed of a sinusoidal travelling wave and derive a relation between them. **(8 marks)**

c) Draw a labeled diagram of Young's apparatus for producing and observing optical interference. Indicate clearly the distances that need to be measured to enable you determine the wavelength of the light. **(8 marks)**