TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF TECHNOLOGY IN RENEWABLE ENERGY
BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS
(BTRE 14S/BTAP 14s)

APS 4106: WAVES & VIBRATION

END OF SEMESTER EXAMINATION
SERIES: APRIL 2015
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 TWO conditions for two sources of light to produce observable interference **(2 marks)**

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

b) The equation represents a plane wave travelling in a medium along the x-direction y being the displacement at the point x at time t.

(i) Deduce whether the wave is travelling in the positive x-direction or in negative x direction **(1 marks)**

$$a = 1.0\lambda 10^{-7}\,m,\ \ w = 6.6\lambda 10^{3}\,s^{-1}$$

(ii) If and k = $20m^{-1}$. Calculate (I) speed at ware (II) The maximum speed of a particle of a medium due to ware **(2 marks)**

c) A particle executes a simple harmonic motion with a time period T. Find the time taken by the particle to have a displacement from mean position equal to the one half of the amplitude **(4 marks)**

d) Show that the oscillations of a simple pendulum are simple harmonic, hence deduce the expansion for the time period **(8 marks)**

e) Derive the equation of stationary wave and deduce the condition for nodes and antinodes **(4 marks)**

f) (I) Define Doppler effect **(2 marks)**
(II) Derive the formula for the change in frequency
(i) When the source is approaching and recending from the observer
(ii) When the source is stationary and observe is moving towards and away from the source

Question Two

a) Distinguish between simple harmonic motion and damped harmonic motion **(2 marks)**

b) Give FIVE examples of consequences of resonance

c) A small speaker emitting a note at 250Hz is placed over the open upper end of a vertical tube which is full of water. When the water is gradually run out of the tube the air column resonates, initially when the water surface is 0.31m below the top of the tube, and next when it is 0.998m below the top. Find the speed of sound in air and the end connection **(5 marks)**

$$\left\{\pi \in +\pi/3\right\}$$

d) The equation of a particle executing SHM is y = 5sin . Determine:
(i) Amplitude
(ii) Period
(iii) Maximum velocity and;
(iv) Velocity after 1 second (y is in metres) **(8 marks)**

Question Three

a) When a grating with 300 lines per mm is illuminated normally with a parallel beam of monochromatic light a second order principal maximum is observed at 18.9^{o} the straight through direction. Find the wavelength of light. **(4 marks)**

b) (I) Explain what is meant by Huygens' principal **(2 marks)**
(II) Use the principle to show that a plane wave incident obliquely on a plane mirror is reflected:
(i) As a plane ware **(2 marks)**
(ii) SO that the angle of incidence is equal to the angle of reflection **(3 marks)**

c) Draw a labeled diagram at Young's apparatus for producing and observing optical interference indicate clearly on your diagram the distances that need to be measured to enable you to determine the wavelength of light. **(5 marks)**

d) Explain THREE applications of reflection of sound waves **(3 marks)**

Question Four

a) If two springs are connected in parallel what is the equivalent spring constant **(4 marks)**

b) A mass on attained to a spring oscillates every 4 seconds. If the mass is increased by 4kg, the period increases by 15. Find its initial mass m **(5 marks)**

c) Explain the factors affecting velocity of sound in gases **(5 marks)**

d) (i) Define progressive wave **(2 marks)**
(ii) Derive the equation of a plane progressive wave **(4 marks)**

Question Five

a) Two turning forks A and B when sounded together produce 4 beats. If A is in unison with the 0.96m length of a sonometer wire under tension, B is in unison with 0.97m length at the same wire under same tension. Calculate the frequency of the folks **(4 marks)**

b) A string of length 1m and mass 5×10^{4}kg fixed at both ends is under a tension of 20N. If it vibrates in two segments, determine the frequency at vibration of the string **(3 marks)**

c) A railway engine and a car are moving parallel but in opposite direction with velocities 144km/hr and 72km/hr respectively. The frequency of engines whistle is 500Hz and the velocity of sound is 340m/s. Calculate the frequency of sound heard in the car when:

(i) The car and engine are approaching each other
(ii) Both are moving away from each other **(8 marks)**

d) Derive an expression for the total energy of a particle executing SHM **(5 marks)**