KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2016/2017 ACADEMIC YEAR
SECOND YEAR SECOND SEMESTER

SPECIAL/SUPPLEMENTARY EXAMINATIONS

FOR THE DEGREE OF B.ED (SCIENCE)

COURSE CODE: SPH 211

COURSE TITLE: WAVES AND VIBRATIONS

DURATION: 2 HOURS

DATE: 15TH SEPTEMBER 2017 TIME: 2:30 PM – 5:30 PM

INSTRUCTIONS TO CANDIDATES

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of **3** printed pages. Please Turn Over

KIBU observes ZERO tolerance to examination cheating

Question one

a) Write down three examples of motions having one degree of freedom. (3marks)
b) Discuss the importance of studying simple harmonic motion. (2marks)
c) Discuss the basic properties of a system that makes it to oscillate. (4marks)
d) Obtain derivations to show that the examples mentioned in (a) above constitute Simple Harmonic Motion. (6marks)
e) Show that the relaxation time for amplitude of a wave is given by $\frac{2m}{r}$ where the symbols have their usual meaning. (3marks)
f) By considering the variation of kinetic and potential energy of a simple harmonic oscillator derive the equation of simple harmonic oscillator(4marks)
g) Discuss the velocities associated with wave motion. (6marks)
h) A simple pendulum clock 2.5m ticks each time the pendulum bob reaches its maximum displacement in either direction. What is the time interval between the ticks? (2marks)

Question Two

a) Show that the periodic time of the oscillators in an LC circuit is given by $T = 2\pi\sqrt{LC}$where the symbols have their usual meaning. (10marks)
b) Derive the expression for the angular frequency ω of a torsional oscillator. (5marks)
c) The balance wheel in a watch has rotational inertia of 1.24×10^{-7}kgm^2.What should be the torsional constant of the hairspring if the period of the wheel's torsional oscillations is to be 1.00s? (5marks)

Question Three

a) Show that for two SHM motions given as $x_1 = a_1 \sin(\omega t + \emptyset_1)$ and $x_2 = a_2 \sin(\omega t + \emptyset_2)$ the resultant displacement is $x = R \sin(\omega t + \emptyset)$ (10marks)
b) Two perpendicular waves having the same frequency are given as $x = a_1 \sin(\omega t + \emptyset_1)$ and $y = a_2 \sin(\omega t + \emptyset_2)$.Show that when $a_1 = a_2$ and $\emptyset_2 - \emptyset_1 = n\pi$ where $n = 0,1,2 ...$ then the waves are plane polarized. (10marks)

Question Four

a) Given that $x = asin2\omega t$and $y = bsin\omega t$,show that the superposition of the two vibrations result into Lisajous figures. (8marks)
b) Sketch and describe the Lisajous figures formed. (2marks)
c) A wave has amplitudeof 5cm and a period of 2s, calculate the velocity of the particle at a position where acceleration is $\frac{1}{2}$ its maximum value. (10marks)

Question Five

a) A sodium chloride molecule has a natural vibration frequency of 1.14×10^{13}Hz and its effective mass equals to its reduced mass. Calculate the value of the interaction force constant given that the masses of sodium chloride atoms are 3.84×10^{-26}kg and 5.85×10^{-26}kg respectively. (10marks)

b) A wave has a displacement $x = Ae^{-pt}\sin(qt + \emptyset)$. Show that its logarithmic decrement after one oscillation is given by $p\tau = \delta$ where $\tau = 1$ period. (10marks)