# KISII UNIVERSITY
## UNIVERSITY EXAMINATIONS
### SECOND YEAR EXAMINATION FOR THE AWARD OF
### THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE), BSC RENEWABLE
### ENERGY, BSC CHEMISRTY, BSC GEOPHYSICS
### FIRST SEMESTER 2021/2022
### (FEBRUARY – JUNE, 2022)

### PHYS 211/PHRE 219: WAVES AND VIBRATIONS

**STREAM:  Y2 S1**                                      **TIME: 2 HOURS**

**DAY: MONDAY, 12:00 PM – 2:00 PM**          **DATE: 09/05/2022**

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### INSTRUCTIONS

1. *Do not write anything on this question paper.*
2. *Answer Question ONE and any other TWO questions.*

### QUESTION ONE

(i)     Define the following terms as used in waves and vibration;
   a. Frequency
   b. Periodic time
   c. Wavelength                                                      (6marks)

(ii)    Distinguish between progressive and stationary waves          (4marks)

(iii)   The length of a weightless spring increases by 2cm when a weight of 1.0g is suspended from it. The weight is pulled down by 10 cm and released. Determine;
   a. Period of oscillation of spring and
   b. kinetic energy of oscillation of the spring                     (6marks)

(iv)    Explain any three categories of waves giving one example in each case.
                                                                      (6marks)

(v)     In a stationary wave, the wavelength is 3.6m. What is the distance between anode and the nearest antinode.                          (2marks)

(vi)     Define acoustics as used in sound                                              (2marks)

(vii)    Two sinusoidal waves $y_1(x, t)$ and $y_2(x, t)$ have the same wavelength and travel together in the same direction along a string. Their amplitudes are $y_{m1}$=4.0 mm and $y_{m2}$=3.0mm, and their phase constants are 0 and $\pi/3$ rad, respectively. What are the amplitude $y'_m$ and phase constant $\beta$ of the resultant wave?                                              (4marks)

## QUESTION TWO

i)      Explain the three factors upon which the level of noise is considered acceptable.                                              (6marks)

ii)     Define the following terms as applied to human hearing.
        (a)Threshold of hearing                                              (2marks)
        (b) Threshold of pain                                              (2marks)
        If one jet causes a sound level of 120dB on takeoff, what is the sound level of three such jets taking off simultaneously? (Take threshold of hearing $I_O$=$10^{-12}$Wm$^{-2}$)                                              (5marks)

iii)    The reverberation time is found to be 1.5 s for an empty hall and it is found to be 1s when a curtain cloth of 20 m$^2$ is suspended at the centre of the hall. If the dimensions of the hall are 10x8x6 m$^3$, calculate the coefficient of absorption of a curtain cloth.                                              (5marks)

## QUESTION THREE

(i)     Derive the general wave equation that govern the travel of all waves
                                                                            (6marks)

(ii)    State the principle of superposition of waves                      (2marks)

(iii)   Standing waves are produced by superposition of two waves, $y_1$=10sin($3\pi$t-4 $x$) and $y_2$=10sin($3\pi$t+4 $x$). Find the amplitude of the motion at $x$ =18.                                              (6marks)

(iv)    Differentiate between constructive and destructive, intermediate interference                                              (6marks)

## QUESTION FOUR

i)  How is a standing wave produced?                                       (2marks)

ii) Figure below shows resonant oscillation of a string of mass $m$=2.500 g and length $L$=0.800 m and that is under tension T=325.0 N. What is the wavelength L of the transverse waves producing the standing wave pattern, and what is the harmonic number $n$? What is the frequency $f$ of the transverse waves and of the oscillations of the moving string elements? What is the maximum magnitude of the transverse velocity $u_m$ of the element oscillating at coordinate $x$=0.180 m? At what point during the element's oscillation is the transverse velocity maximum?
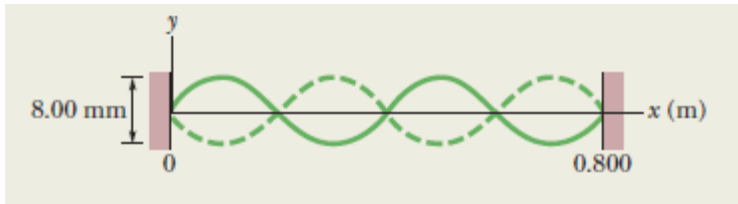
(12marks)

iii) Differentiate between longitudinal and transverse waves giving an example in each case. (6marks)

## QUESTION FIVE

(i) The maximum pressure amplitude $\Delta_{pm}$ that the human ear can tolerate in loud sounds is about 28 Pa (which is very much less than the normal air pressure of about 105 Pa).What is the displacement amplitude $s_m$ for such a sound in air of density $\rho$=1.21 kg/m3,at a frequency of 1000Hz and a speed of 343m/s? (5marks)

(ii) What is Doppler effect? (2marks)

(i) State the general equation of Doppler effect (2marks)

(ii) Bats navigate and search out prey by emitting, and then detecting reflections of, ultrasonic waves, which are sound waves with frequencies greater than can be heard by a human. Suppose a bat emits ultrasound at frequency $f_{be}$=82.52kHz while flying with velocity as it chases a moth that flies with velocity .What frequency $f_{md}$ does the moth detect? What frequency $f_{bd}$ does the bat detect in the returning echo from the moth? (6marks)

(iii) What are the applications of Doppler effect (2marks)

(iv) Why is the study of waves and vibrations important to our daily lives? (3marks)