Ser. No. EDU 052/17

GARISSA UNIVERSITY

UNIVERSITY EXAMINATION 2017/2018 ACADEMIC YEAR ONE
FIRST SEMESTER EXAMINATION

SCHOOL OF EDUCATION, ARTS AND SOCIAL SCIENCES

FOR THE DEGREE OF BACHELOR OF EDUCATION (ARTS)

COURSE CODE: PHY 211 / PHY 212

COURSE TITLE: VIBRATION AND WAVES / OSCILLATION AND WAVES

EXAMINATION DURATION: 3 HOURS

DATE: 05/12/17 **TIME: 09.00-12.00 PM**

INSTRUCTION TO CANDIDATES

- **The examination has SIX (6) questions**
- **Question ONE (1) is COMPULSORY**
- **Choose any other THREE (3) questions from the remaining FIVE (5) questions**
- **Use sketch diagrams to illustrate your answer whenever necessary**
- **Do not carry mobile phones or any other written materials in examination room**
- **Do not write on this paper**

This paper consists of FOUR (4) printed pages ***please turn over***

QUESTION ONE (COMPULSORY)

(a) i) what is a wave **[1 mark]**

ii) Discuss the difference between electromagnetic and mechanical waves **[2 marks]**

(b) The equation of a transverse wave travelling on a rope is given by

$y = 5\sin\pi\,(0.02x - 4.00t)$, where y and x are expressed in centimeters and t is in seconds. Find the

i. Frequency **[2 marks]**

ii. velocity **[2 marks]**

(c) The speed of a wave on a string is given by $v = \sqrt{\frac{F}{\mu}}$. Show that the right-hand side of this equation has the units of speed. **[2 marks]**

(d) Two strings are tuned to fundamentals of f_1 =4800Hz and f_2 =32Hz.Their lengths are 0.05 and 2.0m, respectively. If the tension in these two strings is the same, find the ratio of the masses per unit length of the two strings. **[3 marks]**

(e) i) What is meant by simple harmonic motion **[1 mark]**

ii) Show that when a standing wave is formed, each point on the string is undergoing SHM transverse to the string **[2 marks]**

(f) A sinusoidal wave on a string travelling in the +x direction at 8m/s has a wavelength 2m.

i) Find its wave number and frequency **[2 marks]**

ii) If the amplitude is 0.2m, and the point x = 0 on the string is at its equilibrium position (y =0) at time t =0, find the equation for the wave. **[2 marks]**

(g) A tuning fork of frequency 300c/s gives 2 beats/s with another fork of unknown frequency.

On loading the unknown fork the beats increase to 5/s, while transferring the load to the fork of known frequency increases the number of beats per second to 9. Calculate the frequency of the unknown fork (unloaded) assuming the load produces the same frequency change in each fork.

[3 marks]

An open organ pipe is suddenly closed with the result that the second overtone of the closed pipe is found to be higher in frequency by 100 vibrations/s than the first overtoneof the original pipe. Find the fundamental frequency of the open pipe **[3 marks]**

QUESTION TWO

(a) A particle which executes SHM along a straight line has its motion represented by $x = 4\sin(\pi t/3 + \pi/6)$. Find

i. Time period; **[2 marks]**

ii. Frequency; **[2 marks]**

iii. Velocity, at t = 1s,x being in cm **[2 marks]**

(b) For ordinary conversation, the intensity level is given as 60dB. Find the intensity of the wave **[4 marks]**

(c) Show that if the tension in a string if F and its linear density is μ , then the speed v of a transverse pulse travelling on it is given by $v = \sqrt{\frac{F}{\mu}}$ **[5 marks]**

QUESTION THREE

(a) i) Show that the superposition of the waves $y_1 = A\sin(kx - \omega t)$ and $y_2 = 3A\sin(kx+\omega t)$ is a pure standing wave plus a travelling wave in the negative direction along the x-axis. **[4 marks]**

ii) Find the amplitude of the standing wave and the travelling wave. **[2 marks]**

(b) i) What is Doppler effect **[1 mark]**

ii) A railway engine whistles as it approaches a tunnel, and the sound is reflected back by the wall of the rock at the opening. If the train is proceeding at a speed of 72km/h and if the effect of the wind be neglected, find the ratio of the relative frequencies of the reflected and direct sounds as heard by the driver of the engine. **[4 marks]**

(c) i) What is the meaning of resonance **[1 mark]**

ii) Give three examples of resonance effect **[3 marks]**

QUESTION FOUR

(a) Sketch the first and second harmonic standing waves on a stretched string of length L. Deduce an expression for the frequencies of the family of standing waves that can be excited on the string **[6 marks]**

(b) The wave function of a standing wave on a string that is fixed at both ends is given in SI units by $y(x,t) = (0.024)\sin(62.8x)\cos(471t)$. Find the speed of the waves on the string, and the distance between nodes for the standing wave. **[5 marks]**

(c) i) what are beats **[1 mark]**

ii) When two notes are sounded a beat frequency of 3Hz is heard. If one note is 600Hz. What are the possible frequencies of the other **[3 marks]**

QUESTION FIVE

(a) Two trains move away from each other at a speed of 25m/s relative to the earth's surface. One gives a 520Hz signal. Find the frequency heard by the observer on the other train (sound velocity=330m/s). **[6 marks]**

(b) A sound source from a motionless train emits a sinusoidal wave with a source frequency of fs = 514Hz. Given that the speed of sound in air is 340m/s and that you are a stationary observer. Find the wavelength of the wave you observe

i. When the train is at rest **[2 marks]**

ii. When the train is moving towards you at 15m/s **[3 marks]**

iii. When the train is moving away from you at 15m/s **[3 marks]**

QUESTION SIX

(a) A progressive wave travelling along a string has maximum amplitude A = 0.0821m, angular frequency ω = 100rad/s and wave number k = 22.0rad/m. If the wave has zero amplitude at t =0 and x =0 for its starting conditions

i. State the wave function that represents the progressive wave motion for this wave travelling in the negative x-direction. **[2 marks]**

ii. State the wave function for this wave travelling in the positive x-direction **[2 marks]**

iii. Find the wavelength (λ), period (T) and the speed (v) of this wave. **[3 marks]**

iv. (Find its amplitude at a time t = 2.5s at a distance x = 3.2m from its origin, for this wave travelling in the negative x-direction. **[2 marks]**

(b) A man standing in front of mountain at a certain distance beats a drum at regular intervals. The drumming rate is gradually increased and he finds the echo is not heard distinctly when the rate becomes 40/min. He then moves nearer to the mountain by 90m and finds that the echo is again not heard when the drumming rate becomes 60/min. **Calculate**

i. The distance between the mountain and the initial position of the man and the mountain **[3 marks]**

ii. The velocity of sound **[3 marks]**