KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2011/2012

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE)

SPH 300: WAVE THEORY

DATE: TUESDAY 3RD APRIL 2012 **TIME: 11.00 A.M. – 1.00 P.M.**

INSTRUCTIONS: Answer question **ONE** and any other **TWO** questions. Question ONE carries 30 marks and others each carries 20 marks

QUESTION ONE

a) (i) Define term wave motion and illustrate it graphically. (2 marks)

(ii) Outline two examples of Simple Harmonic Motion. (2 marks)

b) (i) Explain briefly any two characteristics of wave. (2 marks)

(ii) Distinguish particle velocity, phase velocity and group velocity. (3 marks)

c) (i) State the principle of superposition of wave. (2 marks)

(ii) How are the beats produced? (2 marks)

(iii) When could spherical wavefronts be treated as plane wavefront? (1 marks)

d) (i) Explain the following terms as used in wave motion: wavelength, frequency and wave number. (3 marks)

e) A point moves in a circle a constant a constant speed of 50 cm/sec. The period of one complete oscillation around the circle is 6 seconds. At time t = 0, the to the point from the centre makes angle of 30^0

(i) Obtain the equation for the x coordinates of the point as a function of time, in the form

$$x = ACos(\omega t + \alpha),$$

giving the numerical values of symbols A, ω and α (3 marks)

(ii) Find the values of x, $\frac{dy}{dx}$, and $\frac{d^2y}{dx^2}$ at time t = 2 seconds. (5 marks)

f) (i) Explain briefly terms energy current and Intensity as used in wave motion. (2 marks)

(ii) Calculate the velocity of transverse wave travelling along a string of length 2.0 m and mass 0.06 kg under tension 500N. (3 marks)

QUESTION TWO

a) (i) Distinguish transverse and longitudinal waves, citing an example in each case. (3 marks)

(ii) Give reason why fluids do not execute transverse waves. (1 marks)

b) (i) Explain terms: Progressive wave and Stationary wave, giving an illustrative example how each is produced. (3 marks)

(ii) Outline any three differences between Progressive and Stationary waves. (3 marks)

c) One end of a string is continuously moved up and down through distance of 0.50 cm five times in one second to create transverse wave train along the string. If the line density of the spring is 0.64 g/cm and the tension on the spring is 1600 N

(i) Obtain the value of amplitude, frequency, velocity and wavelength of the wave. (5 marks)

(ii) Taking y = 0 at x = 0 and time t = 0, show that the equation of the wave is given by

$$Y = 0.25Sin(10\pi t - 0.2\pi x)$$

hence obtain the values of displacement, particle velocity and particle acceleration at when a distance 10 cm from the origin after time interval 0.4 seconds. (5 marks)

QUESTION THREE

a) State why the introduction of expression $Cos\theta + jSin\theta$ is such an essential contribution to the analysis of vibration. (8 marks)

b) Given that Z = Acos(ωt - α) + jAsin(ωt + α), determine:

(i) $\frac{dZ}{dt}$ (ii) $\frac{d^2Z}{dt^2}$;

explaining the meaning of the three vectors using a vector diagram (6 marks)

(iii) Evaluate the magnitude and direction of a vector $\left(\frac{5}{2} + j\sqrt{3}\right)^2$ (6 marks)

QUESTION FOUR

a) (i) Explain briefly two types of interference of wave giving the numerical validity under which each occurs. (5 marks)

(ii) Using exponential representation for $\text{Sin}\theta$ and $\text{Cos}\theta$, verify trigonometric identity

$$\text{Sin}\theta + \text{Sin}\theta = \text{Sin}2\theta(1 + 2\text{Cos}\theta)$$ (5 marks)

b) Given wave function $y = A \sin\frac{2\pi}{\lambda}(vt - x)$, where the symbols have their usual meaning, derive the one dimensional differential wave equation. (10 marks)

QUESTION FIVE

a) Show that energy density E of a plane progressive wave is given by

$$2\pi^2 n^2 A^2 \rho$$

where the symbols have their usual meaning (12 marks)

b) Hence or otherwise derive expressions for energy current C and intensity I of the wave.(8 marks)