TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF APPLIED AND HEALTHY SCIENCES

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN MEDICAL ENGINEERING (BSMD)
BACHELOR OF TECHNOLOGY IN MEDICAL ENGINEERING (BTMD)

APS 4150: PHYSICS FOR MEDICAL ENGINEERING

SPECIAL/ SUPPLIMENTARY EXAMINATIONS

SERIES: September 2018

TIME: 2 HOURS

DATE: September 2018

INSTRUCTION TO CANDIDATES

You should have the following for this examination.
-Answer Booklet, examination pass and student ID.
This paper consists of FIVE questions.
Answer question ONE (COMPULSORY) and ANY other TWO questions.
The maximum marks for each question is shown.
Do not write on the question paper.
Mathematical tables and scientific calculators may be used.

Question One (30 marks)

a) With examples explain the difference between basic and derived quantities of measurements. (4marks)
b) An object moving on a circular path with constant speed is said to be accelerating. Explain why. (3marks)
c) State Hooke's law (3marks)
d) Explain the difference between oscillation and vibration (2marks)
e) What is a wave? State characteristics of a wave (5marks)
f) State and differentiate the three states of matter in terms of kinetic theory (7marks)
g) Describe the three modes of heat transfer. Which one of the three is faster and why? (6marks)

Question Two (20 marks)

a) Figure 1 below shows an object whirled in a circle

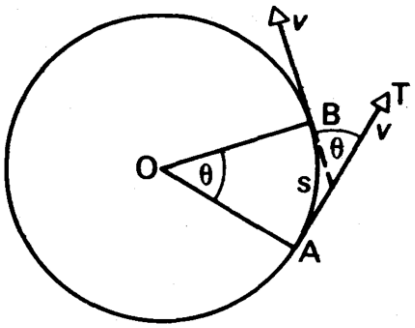

Figure1

i) Find its angular velocity ω at B from A after time t. (1mark)
ii) Determine the period T of the motion in terms of angular velocity (2marks)
iii) If the radius of the path is r, find the arc-length s in terms of θ and hence show that velocity v of the object is $v = r\omega$ (6marks)

b) Show that the acceleration of the object along the circular path described in (a) above is given by $a = \frac{v^2}{r}$ (8marks)
c) An object moves around the circle of radius 600cm at a constant speed of $2ms^{-1}$. Calculate the angular velocity and acceleration of the object (3marks)

Question Three (20 marks)

a) Explain the following terms as applies to optics
   i) Interference (2marks)
   ii) Diffraction (2marks)

b) Show that for the light emerging from two coherent sources which are at a distance *d* apart, making an angle θ to the horizontal, their path difference *x* will be given by $x = d\sin\theta$. State any assumption in your derivation. (9marks)

c) The width of the central maximum in the diffraction pattern is often of particular interest. Suppose that a slit $3x10^{-4}$m wide is illuminated by a yellow-green light (λ=500nm). Find the total width of the central maximum on a screen 2m from the slit. (7marks)

Question Four (20 marks)

a) What is surface tension? State its SI units (3marks)

b) Show that the height through which the liquid rises in a tube depends on the liquid's surface tension, its density and the radius of the capillary tube (10marks)

c) Show that for a solid object of mass m just about to slid on an inclined plane at an angle θ to the horizontal, its coefficient of static friction is equivalent to the tangent of the angle (7marks)

Question Five (20 marks)

a) Explain the following terms as used in structure of materials;
   i) Elasticity (2marks)
   ii) Ductility (2marks)
   iii) Brittle substance (2marks)

b) From elasticity point of view
   i) State Hooke's law (2marks)
   ii) Determine the tensile stress and strain of a 2m wire of diameter 0.64mm when a 2kg mass stretches it by 0.60mm. (take g = 9.8N/kg) (5marks)
   iii) What is the Young's modulus of elasticity in (ii) above? (2marks)

c) Show that the energy stored per unit volume of a material undergoing elasticity is half the product of tensile stress and strain (5marks)