UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
END OF SEMESTER ONE EXAMINATIONS

ACADEMIC YEAR 2022/2023

DEPARTMENT: ICT

SEMESTER: ONE

PROGRAMME(S): HIGHER EDUCATION CERTIFICATE – ENGINEERING (HECE)

YEAR OF STUDY: ONE

COURSE: PHYSICS I

COURSE CODE : HECE112

DATE: SUNDAY 19TH, MARCH 2023

TIME: 9:00 AM – 12:00 NOON

DURATION: 3 HOURS

INSTRUCTIONS:

(i) This paper contains two Sections: A (40 marks) & B (60 marks).
(ii) Attempt ALL questions in Section A, and ONLY THREE questions in Section B.
(iii) All questions in Section B carry equal marks.
(iv) Credit will be given for use of relevant examples and illustrations.
(v) Begin each number in Section B on a new page of the answer sheet.
(vi) DO NOT write on this question paper.

SECTION A [40 MARKS]

Attempt **ALL** the Questions in this Section.

Question 1

a) Define stress and strain **(4 marks)**

b) A steel wire of cross-section area 1mm^2 is cooled from a temperature of 60^{0}C to 15^{0}C, find the;
   (i) Strain **(4 marks)**
   (ii) Force needed to prevent it from contracting young's modulus = 2x10^{11}Pa, coefficient of linear expansion for steel = 1.1x10^{-5}K^{-1} **(4 marks)**

c) Define the following terms
   (i) Work **(2 marks)**
   (ii) Joule . **(2 marks)**

d) A horizontal force pulls a body of mass 3kg a distance of 20m across a rough horizontal surface, coefficient of friction $\frac{2}{7}$. The body moves with a uniform velocity and the only resitance is that due to friction. Find the work done **(4 marks)**

e) A car of mass 1000kg is driven along a level road against a constant resistance to motion of 200N. With the engine of car working at steady rate of 8kW, find
   (i) Acceleration of the car when its speed is 5m/s **(4 marks)**
   (ii) The maximum speed of the car **(3 marks)**

f) (i) Define the term thermometric property and give two examples **(3 marks)**
   (ii) State two qualities of a good thermometer property **(2 marks)**
   (iii) State two advantages and two disadvantages of the resistance thermometer. **(4 marks)**
   (iv) A resistance thermometer has a resistance of 21.42Ω at ice point, 29.10Ω at steam point and 28.11Ω at some unknown temperature θ. Calculate θ on the scale of this thermometer. **(4 marks)**

SECTION B [60 MARKS]

Attempt **ONLY THREE** Questions in this Section.

Question 2

a) What is meant by a
   (i) Brittle material? **(1 mark)**
   (ii) Ductile material? **(1 mark)**

b) Explain why bicycle frames are hollow. **(2 marks)**

c) (i) Sketch a labeled graph of stress against strain for a ductile material **(2 marks)**
   (ii) Explain the main features of the graph in (d) (i) **(4 marks)**

d) Derive the expression for the energy stored per unit volume in a rod of length, L, Young's modulus, Y, when stretched through distance, e. **(4 marks)**

e) A load of 5kg is placed on top of a vertical brass rod of radius 10 mm and length 50cm. If Young's modulus of brass is $3.5x10^{10}Nm^{-2}$. Calculate the;
   (i) Decrease in length **(3 marks)**
   (ii) Energy stored in the rod **(3 marks)**

Question3

(a) (i) What is meant by **Young's modulus** **(1 mark)**
   (ii) State **Hooke's law** **(1 mark)**

(b) A metal bar of length 50mm and square cross-sectional side 20mm is extended by 0.015mm under a tensile load of $30kN$, calculate
   (i) Stress
   (ii) Strain in specimen
   (iii) Value of young's modulus for that metal. **(9 marks)**

(c) With the aid of a labeled diagram, describe an experiment to determine the Young's Modulus of steel wire **(7 marks)**

(d) Explain the term plastic deformation in metals **(2 marks)**

Question 4

(a) State the principle of conservation of Energy. **(2 marks)**

(b) Show that for a particle projected vertically upwards Mechanical energy is conserved **(6 marks)**

(c) A bullet of mass 50g travelling horizontally at 100ms^{-1} strikes as stationary block of wood and coming to rests through a distance of 5m. Calculate the average resistance of the block to the motion of the bullet**.** **(4 marks)**

(d) A rough slope of length 10m is inclined at angle of $tan^{-1}\left(\frac{3}{4}\right)$ to the horizontal. A block of mass 50kg is released from rest at the top of the slope and travels down the slope, reaching the bottom of the slope with speed of 8m/s, find the
   (i) magnitude of the frictional force **(4 marks)**
   (ii) Work done by the frictional force **(4 marks)**

Question 5

a) Define Power and state its units **(4 marks)**

b) A lorry of mass 2000kg moving at 10m/s on a horizontal surface is brought to rest in a distance of 12.5m by the brakes being applied.
   (i) Calculate the average retarding force **(4 marks)**
   (ii) What power must the engine produce if the lorry is to travel up a hill of 1 in 10 at a constant speed of 10m/s, frictional resistance being 200N **(4 marks)**

c) (i) Describe how a liquid-in-glass thermometer can be used to measure temperature in degrees celcius **(4 marks)**

(ii) A thermometer is constructed with a liquid which expands according to relation

$$V_t = V_0(1 + \alpha t + \beta t^2)$$

Where V_t is the volume at t℃ and V_0 is the volume at 0℃ on the scale of the gas thermometer and α and β are constants. Given that $\alpha = 1000\beta$, what will the liquid thermometer read when the gas thermometer reads 50℃ **(4 marks)**

Question 6

(a) State the thermometric property used in the constant-volume gas thermometer **(2 marks)**

(b) **(i)** Describe the steps taken to set up a Celcius scale of temperature for a mercury-in-glass thermometer **(4 marks)**

(ii) State **four** disadvantages of mercury-in-glass thermometer. **(4 marks)**

(c) Describe with the aid of a labelled diagram the constant volume gas thermometer. **(6 marks)**

(d) A platinum resistance thermometer has a resistance of 5.42 Ω at triple point of water. Calculate its resistance at a temperature of 50.0℃ **(4marks)**