UGANDA INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY

END OF SEMESTER II EXAMINATIONS

DEPARTMENT	:	**ICT**
YEAR	:	**ONE**
SEMESTER	:	**TWO**
PROGRAM	:	**HIGHER EDUCATION CERTIFICATE-PHYSICAL**
COURSE	:	**MECHANICS**
COURSE CODE	:	**HECE 124**
DATE	:	**JUNE 28, 2024**
TIME	:	**09:00 AM – 12:00 NOON**
DURATION	:	**3 Hours**

INSTRUCTIONS

- The paper consists of two Sections A and B
- Answer **ALL** questions in Section A and **ANY THREE** questions in Section B
- Credit will be given to relevant examples and illustrations
- Don Not Write anything on this question paper

Section A

Question one

(a) For vectors $\underline{p} = 4\underline{i} + 2\underline{j} + \underline{k}$, $\underline{q} = \underline{i} - 2\underline{j} + \underline{k}$ and $\underline{r} = 3\underline{i} - 3\underline{j} + 4\underline{k}$. Evaluate

(i) $\underline{p} \times \left(\underline{q} \times \underline{r}\right)$ (ii) $\underline{p}.\left(\underline{q} \times \underline{r}\right)$

(06marks)

(b) Find the area of the triangle with vertices at the point with coordinates (1,2,3), (4,-3,2) and (8,1,1) (05marks)

(c) The force $\underline{F} = 2\underline{i} - 3\underline{j} + \underline{k}$ acts at the point (1,5,2). Find the torque due to F about the origin (05marks)

(d) (i) What is meant by **moment** of a **force** (2marks)

(ii) State clearly the principle of moments (2marks)

(e) A rod AB 2.5 m long is supported at A and B. The rod is carrying a point load of 5kN at a distance of 1 m from A. What are the reactions at A and B (6marks)

(f) (i) What is a **couple?** (2marks)

(i) State four characteristics of a couple (4marks)

(g) (i) What do you understand by the term **friction** (2marks)

(ii) An object of weight 100N is kept in position on a plane inclined at 30^0 to the horizontal by a horizontal force F. if the coefficient of friction of the surface of the inclined plane is 0.25, determine the minimum magnitude of the force F. (6marks)

Section B

Question two

(a) Point P has coordinates (7,8). Point Q has coordinate (-2,4). Find

(i) an expression for $\overrightarrow{PQ}$ (ii) $\left|\overrightarrow{PQ}\right|$

(6marks)

(b) Find the angle between two vectors $\underline{p} = 3\underline{i} - \underline{j}$ and $\underline{q} = -4\underline{i} + 6\underline{k}$ (7marks)

(c) Given two vectors $\underline{A} = 2\underline{i} - \underline{j} + 4\underline{k}$ and $B = 5\underline{i} + 2\underline{j} - 2\underline{k}$

(i) Show that the A and B are orthogonal (perpendicular)

(ii) Find a unit vector which is perpendicular to both $\underline{A}$ and $\underline{B}$

(7marks)

Question three

(a) (i) Define the term **force** (2marks)

(ii) State clearly the four effects of force (4marks)

(iii) State four characteristics of a force (4marks)

(b) The following forces act at a point

(i) 20 N inclined at 30^0 towards North East

(ii) 25 N towards North

(iii) 30 N towards North west and

(iv) 35 N inclined at 40^0 towards South of West

Find the magnitude and direction of the resultant force (10marks)

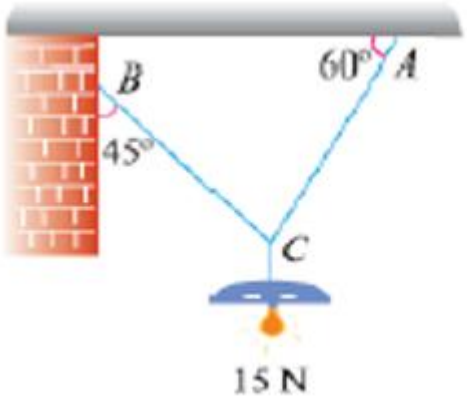
Question four

(a) (i) Enunciate three principles of equilibrium (6marks)

(ii) State Lami's theorem (2marks)

(b) Explain clearly the difference between clockwise moments and anti-clockwise moments (4marks)

(c) An electric light fixture weighing 15N hangs from a point C, by two strings AC and BC. The string AC is inclined at 60^0 to the horizontal and BC at 45^0 to the vertical as show be low



Find the tension in the strings AC and BC. (6marks)

(d) Explain the conditions for equilibrium (2marks)

Question five

(a) A force $\underline{F} = \underline{i} + 3\underline{j} + 2\underline{k}$ acts at the point (1,1,1). Find the torque due to F

(i) About the point (2,-1,5)

(ii) About the line $r = 2\underline{i} - \underline{j} + 5\underline{k} + (\underline{i} - \underline{j} + 2\underline{k})t$

(10marks)

(b) Find the area A of the parallelogram with sides $a = i + 2j + 3k$ and $b = 4i + 5j + 6k$ (5marks)

(c) Find the volume of the parallelepiped with sides $a = i + 2j + 3$, $b = 4i + 5j + 6k$ and $c = 7i + 8j + 10k$ (5marks)

Question six

(a) Distinguish between static friction and dynamic friction (4marks)

(b) State the laws of friction (4marks)

(c) What is meant by; angle of friction and angle of repose (4marks)

(d) An inclined plane shown below is used to unload a body weighing 400N from a truck 1.2m high into the ground. The coefficient of friction between the underside of the body and the

plank is 0.3. State whether it is necessary to push the body down the plane or hold it back from sliding down. What force parallel to the plane is required for this purpose. (8marks)

END