



KENYATTA UNIVERSITY
UNIVERSITY EXAMINATIONS 2011/2012

**FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF
SCIENCE IN MANUFACTURING ENGINEERING**

EMM 210: ENGINEERING MECHANICS I

DATE: Monday 19th December 2011

TIME: 8.00a.m -10.00a.m

INSTRUCTIONS:

1. This paper contains **FIVE** questions
2. All questions carry **EQUAL MAXIMUM** marks
3. Attempt any **THREE** questions
4. Use clear and neat sketches
5. All symbols have the usual meaning unless specified otherwise.

QUESTION ONE (20 Marks):

- a) With the aid of diagrams state the following:
 - i) The parallelogram law of forces (2 Marks)
 - ii) The Lami's theorem (2 Marks)
 - iii) The parallel axis theorem (2 Marks)
- b) Determine the resultant in magnitude and direction of two forces shown in Figure Q1 b) using the parallelogram law and the triangle law. (8 Marks)
- c) Determine the resultant of the system of concurrent forces having the following magnitudes and passing through the origin and the indicated points: $P = 280\text{N}$ (12, 6, -4); $T = 520\text{N}$ (-3, -4, 12); $F = 270\text{N}$ (6, -3, -6). Also find direction angle of the resultant. (6 Marks)

QUESTION TWO (20 Marks)

- a) Define "Moment of a Force" (2 Marks)
- b) Define "Couple" (2 Marks)

- c) Compute the X and Y components of each of the forces shown in Figure Q2 a). Also determine the resultant of the forces and the resultant angle. (6 Marks)
- d) The block shown in Figure Q2 b) is acted on by its weight $W = 400 \text{ N}$, a horizontal force $F = 600 \text{ N}$ and the pressure P exerted by the inclined plane. The resultant R of these forces is parallel to the incline. Determine P and R . Does the block move up or down the incline? (7 Marks)
- e) Determine the amount and position of the resultant of the loads acting on the Fink truss shown in Figure Q2 e). (3 Marks)

QUESTION THREE (20 Marks)

- a) State five of the laws of friction (5 Marks)
- b) Find the least value of P that will just start the system of blocks shown in Figure Q3 b) moving to the right. The coefficient of friction under each block is 0.4. (9 Marks)
- c) A uniform ladder of length l and weight W is placed with one end on the ground and the other against a vertical wall. The angle of friction at all contact surfaces is 20 degrees. Find the minimum angle at which the ladder can be inclined with the horizontal before slipping occurs. (6 Marks)

QUESTION FOUR (20 Marks)

- a) State the difference between center of gravity and centroid (2 Marks)
- b) Locate the centroid of the shaded area in Figure Q4 a), created by cutting a semicircle of diameter r from a quarter circle of radius r (9 Marks)
- c) From the first principles, show that the centroid of a quarter circle, whose radius is r , is $\frac{4r}{3\pi}$ (9 Marks)

QUESTION FIVE (20 Marks)

Find the forces in all the members of the truss shown in Figure Q5 using the method of joints (20 Marks)

