THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A CONSTITUENT COLLEGE OF JKUAT)

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

CERTIFICATE IN MECHANICAL ENGINEERING

EME 1101 MECHANICAL SCIENCE I

YEAR I SEMESTER I

SUPPLEMENTARY/SPECIAL EXAMINATIONS

SERIES: MAY, 2011

TIME: 2 HOURS

Instructions to Candidates:

1. You should have the following for this examination:
    - Answer booklet
    - Drawing instruments
    - Calculator
2. This paper consist of **FIVE** Questions.
3. Answer **THREE** Questions.
4. Question **ONE** is **COMPULSORY**.
5. Maximum marks for each part of a question are as shown.

Question ONE

(a) Define the following terms:
(i) Displacement
(ii) Velocity
(iii) Acceleration

(3 Marks)

(b) A motor car accelerates from rest. The time to reach the various speeds is shown in the table below.

T(s)	0	1.1	2.5	4.4	7.0	10.7	15.6	24
Speed m/s	0	6	11	17	22	28	34	39

Draw a speed-time graph and use it to determine:

(i) The distance travelled in first seven seconds.
(ii) The average acceleration in the time interval 15.6 – 24.
(iii) Total distance travelled (i.e. in the first 24 seconds).
(iv) Average speed for the whole journey.

(17 Marks)

(c) An electric train weighs 300tonne. Determine the total driving force required to accelerate it at the rate of 1.5m/s^2, assuming the resistance to motion is uniform amounting to 75N/tonne. (5 Marks)

(d) An object is dropped from a helicopter and strikes the ground 12s later. Determine:

(i) The height of the helicopter.
(ii) The velocity with which the body strikes the ground.

(8 Marks)

Question TWO

(a) State the principle of moments. (2 Marks)

(b) A uniform beam 6m long and 40kg is supported at the paints P 1m from left hand end and Q 1½m from the other end of beam. Considering the mass of beam as a concentrated load at the centre of the beam, determine:

(i) The reactions at the supports when a man of 80kg stands at a point 1m in from Q.

(ii) How far past Q can the man walk before the beam overturns.

(11 Marks)

(c) Determine the centroid of the I section of beam shown in figure I.

Fig. 1

(7 Marks)

Question THREE

(a) State the **THREE** Newtons laws of motion. (6 Mark)

(b) A man of mass 70kg stands in a lift cage. Determine the tension in the cage rope when:

(i) The lift is stationary.
(ii) The lift is accelerating up at $6m/s^2$.
(iii) The lift is accelerating down at $6m/s^2$.

(14 Marks)

Question FOUR

(a) Define the following terms:

(i) Stress
(ii) Strain
(iii) Youngs Modulus of elasticity

(3 Marks)

(b) State Hookes law. (2 Marks)

(c) During the tensile test on a mild steel test-piece of diameter 11.3mm two points on the straight line portion of the load extension graph were:

1000N Extension 0.01mm

15000N Extension 0.05mm

The original length was 56.5mm, determine the value of the Youngs modulus of elasticity.

(10 Marks)

(d) A mild steel towing bar is to be designed to carry a maximum load of 250KN with a factor of safety of 4. The tensile strength o the steel is 540MN/m^2 and Youngs modulus is 200GN/m^2. Determine:

(i) A suitable diameter of a solid circular shaft.
(ii) The amount of stretch, if original length is 3m.

(5 Marks)

Question FIVE

(a) Define the following:

(i) Resultant force
(ii) Triangle of force rule
(iii) Polygon of force rule

(3 Marks)

(b) Determine the magnitude and direction of the resultant of the following forces acting at a point.

10N at 0˚
8N at 120˚
6N at 225˚
12N at 300˚

(10 Marks)

(c) Two forces F_1 and F_2 act at 90˚ to each other. If F_1 is 15N and the resultant of F_1 and F_2 is 25. Determine F_2. (3 Marks)

(d) A 4 tonne lorry A, travelling at 18m/s runs into the back of another 6tonne lorry B travelling at 7m/s in the same direction. Find:

(i) The momentum of each vehicle before impact.
(ii) The final velocity of the vehicles after impact assuming vehicles remain locked together.

(5 Marks)