MACHAKOS UNIVERSITY

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL AND MANUFACTURING ENGINEERING.

SECOND SEMESTER EXAMINATION FOR DIPLOMA IN MECHANICAL ENGINEERING

MEDPR216 :STRENGTH OF MATERIAL I

DATE: /5/2019 **TIME: 2HRS**

INSTRUCTIONS:

-Section A is compulsory

-Attempt any TWO other questions from section B

SECTION A (COMPULSORY)

1 (a) (I) Define the terms couple and torque.

(II) Differentiate between coplanar and concurrent forces

(III) State the triangle of forces rule (7 Marks)

(b) (I) A steel brake rod is 1.2m long and it is subjected to a maximum load of 4.5KN.If the extension of the rod is not to exceed 0.384mm, determine the suitable diameter for the rod, take E=200GPa (5 Marks)

(II) The maximum pressure on an engine piston of 80mm diameter is 3500Kpa.The hollow gudgeon pin is 24mm outside diameter and 12mm inside diameter. Calculate the maximum force on the piston and the shear stress in the material. (5 Marks)

(c) (I) State the theorems of Parallel and Perpendicular axes (4 Marks)

(II) Show that the polar moment of inertia of a circular lamina is given by;

(6 Marks)

$$I_P = \frac{\pi D^4}{32}$$

(d) (I) State the principles of moments

(II) Give two conditions for a body to be under the state of equilibrium (3 Marks)

SECTION B: (ATTEMPT ANY TWO QUESTIONS IN THIS SECTION)

2 (a) (I) Name three characteristics of a force
(II) State the parallelogram law of forces
(III) Explain three effects caused by a force (9 Marks)

(b) Four coplanar forces are in equilibrium and act at a point on a body as follows;

Force A, 900N acting horizontally to the left
Force B, 220N inclined at 30^0 clockwise to force A and towards the meeting point
Force X, inclined at 90^0 clockwise to force to force A and towards the meeting point
Force Y, inclined at 60^0 clockwise to force X and away from the meeting point

Determine graphically the magnitude of the forces X and Y. (11 Marks)

3 (a) A tensile force of 800N is applied on a handbrake cable whose initial length is 2m and a Cross-sectional area of $20mm^2$.Determine the;

(I) Stress in the cable
(II) Strain in the cable when it is extended by 0.4mm
(III) Modulus of elasticity for the material (6 Marks)

(b) In a tensile test to destruction on a specimen of black mild steel of diameter 12mm, the following results were obtained for a gauge length of 60mm.

Load W (KN)	5	10	15	20	25	30	35	40
Extension x (10^{-3}mm)	14	27.2	41	54	67.6	81.2	96	112

When tested to destruction, the following were observed;

Maximum load = 65KN
Load at fracture = 50KN
Diameter at fracture = 7.5mm
Total extension on gauge length = 17mm

Determine the ;

(I) Young's modulus
(II) Ultimate tensile stress
(III) Breaking stress
(IV) True stress at fracture
(V) Stress at the limit of proportionality (14 Marks)

4 A beam A, E, D, B, C carries the following loadings, a uniformly distributed load of 4KN/m from A to B ,a concentrated load of 5KN a metre from A and a 7KN load 3 metres from E, and a concentrated load of 2KN at point C.DB=BC=1m,the beam is simply supported at A and B. Draw to scale the S.F and B.M diagrams and determine the;

(a) Position and magnitude of the maximum B.M (14 Marks)

(b) Position of any point of contra flexure (6 Marks)

5 (a) A compound bar consists of four brass wires of 2.5mm diameter and one steel wire of 1.5mm diameter .Determine the stresses in each of the wires when the bar supports a load of 500N.Assume all of the wires are of equal lengths. (8 Marks)

(c) Calculate the "equivalent" or "combined" modulus for the compound bar and determine its total extension if it is initially 0.75m long.
For brass $E=100GN/m^2$ and for steel $E=200GN/m^2$
(12 Marks)