INTI International University & Colleges

FINAL
Examination Paper

(COVER PAGE)

Session	:	**January 2018**
Programme	:	Diploma In Mechanical Engineering (DMEN)
Course	:	**EGR1174 : Engineering Statics**
Date of Examination	:	March 8, 2018 (Thursday)
Time	:	5:00 pm – 7:00 pm Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Materials permitted :

Calculator

Materials provided :

Center of Gravity and Mass Moment of Inertia of Homogeneous Solids
Geometric Properties of Line and Area Elements

Examiner (s)	:	**Jaisatia Varthani** & Iylia Elena
Moderator	:	Ir Gerald Victor Richard Joseph

*This paper consists of **8** printed pages, including the cover page.*

DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGR1174: ENGINEERING STATICS
FINAL EXAMINATION: JANUARY 2018 SESSION

Instructions : This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provide. All questions carry equal marks.

Question 1

(a) The pole is subjected to the force **F**, which has components acting along the x, y, z axes as shown in Figure Q1a. If the magnitude of **F** is 3 kN, $\beta = 30°$, and $\gamma = 75°$, determine the magnitudes of its three components.

(10 marks)

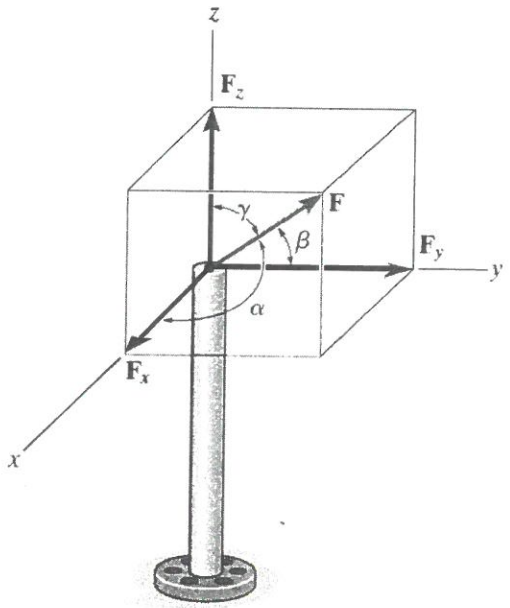

Figure Q1 (a)

(b) Determine the stretch in springs AC and AB for equilibrium of the 2-kg block shown in Figure Q2 (b). The springs are shown in the equilibrium position.

(15 marks)

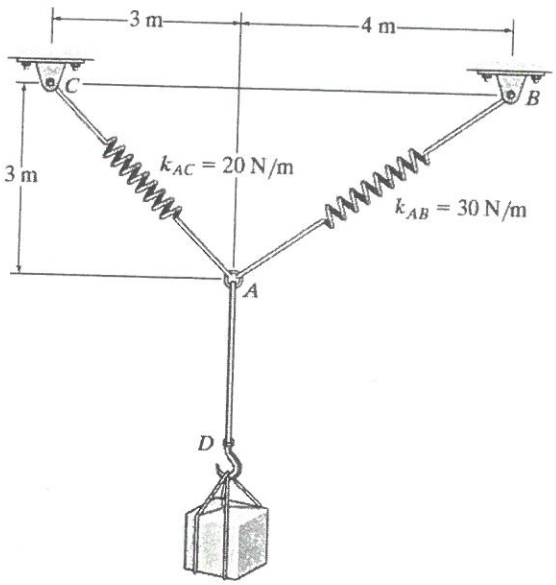

Figure Q2 (b)

Question 2

(a) Determine the moment produced by force $\mathbf{F}_C$ about point O. Express the result as a Cartesian vector.

(18 marks)

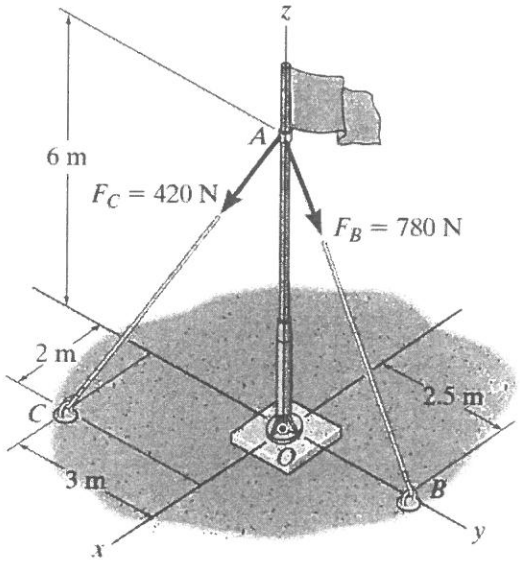

Figure Q2 (a)

(b) Based on Figure Q2 (b), the 70-N force acts on the end of the pipe at B.

(i) Determine the moment of this force about point A. Take $\theta = 60°$.

(ii) Calculate the magnitude and direction of a horizontal force, applied at C, which produces the same moment.Take $\theta = 60°$.

(7 marks)

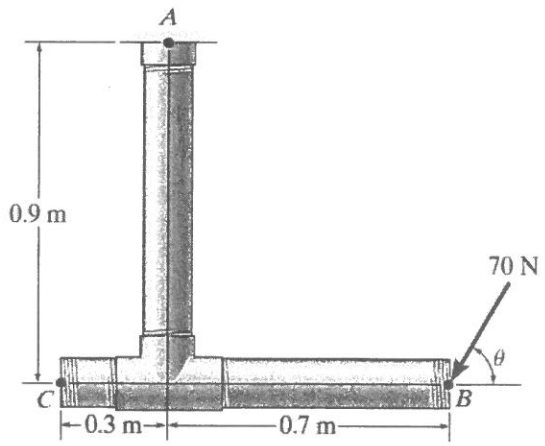

Figure Q2 (b)

Question 3

(a) From Figure Q3 (a), determine

(i) the tension developed in cable BC

(ii) horizontal and vertical components of reaction at the pin A and used to support the steel frame.

(9 marks)

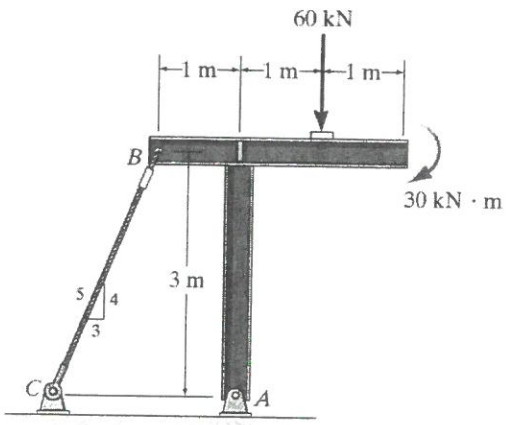

Figure Q3 (a)

(b) The shaft in Figure Q3 (b) is supported by three smooth journal bearings at A, B, and C. Determine the components of reaction at these bearings.

(16 marks)

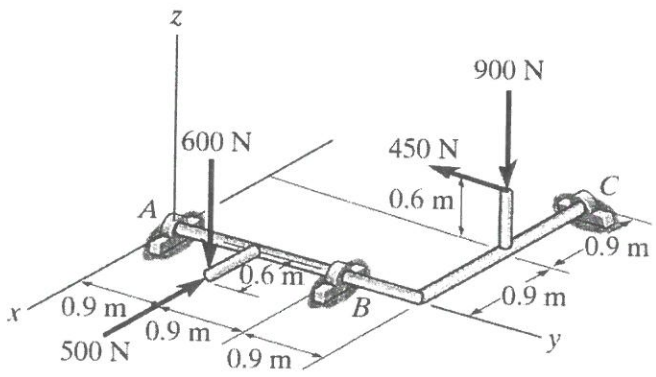

Figure Q3 (b)

Question 4

Determine the force in each member of the truss in Figure Q4, and state if the members are in tension or compression. Sketch the free body diagram for each member.

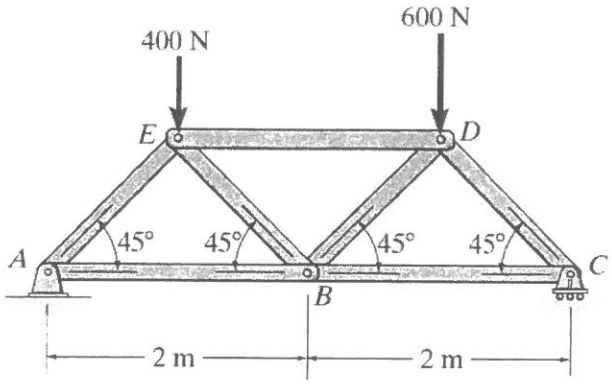

Figure Q4

(25 marks)

Question 5

(a) In Figure Q5 (a), a horizontal force of 100 N is just sufficient to hold the crate from sliding down the plane, and a horizontal force of 350 N is required to just push the crate up the plane.

(i) Determine the coefficient of static friction between the plane and the crate.

(ii) Find the mass of the crate.

(12 marks)

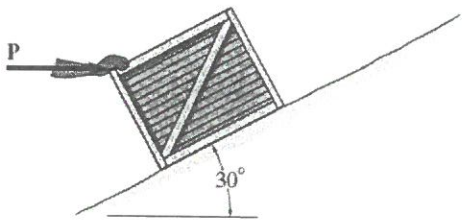

Figure Q5 (a)

(b) Figure Q5 (b) shows a double-hand over beam.

(i) Determine the internal normal force at point C.

(ii) Calculate the shear force at point C.

(iii) Find the moment at point *C*.

(13 marks)

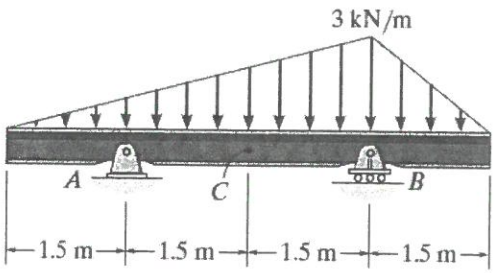

Figure Q5 (b)

Question 6

(a) A uniform parabolic-shaped rod is shown in Figure Q6 (a), where the mass per unit length is 2kg/m.

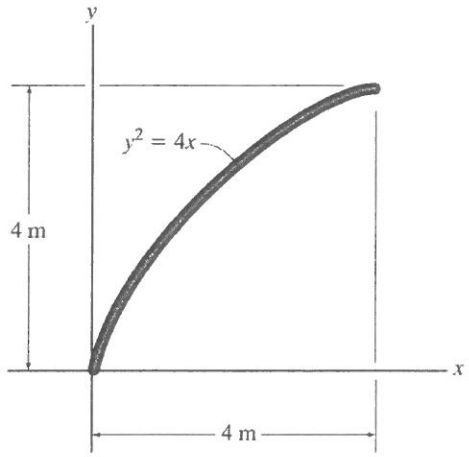

Figure Q6 (a)

(i) Determine the mass of the rod.

(ii) Find the location of the center of mass of the rod.

(13 marks)

(b) A beam is shown in Figrue Q6 (b).

(i) Determine its moment of inertia I_x about the centroidal x axis.

(ii) Determine its moment of inertia I_y about the centroidal y axis.

(12 marks)

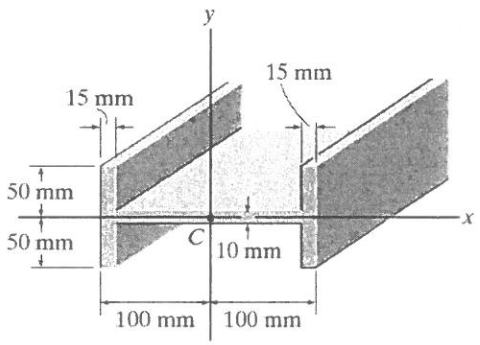

Figure Q6 (b)

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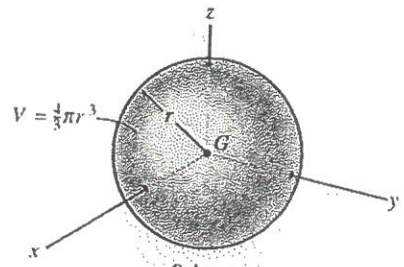
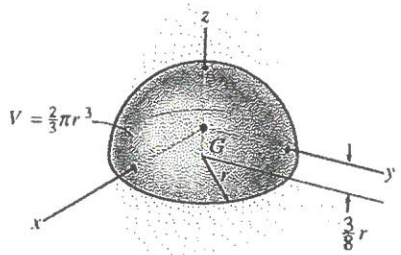
Center of Gravity and Mass Moment of Inertia of Homogeneous Solids



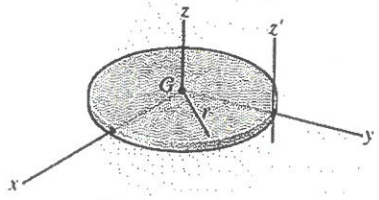
Sphere

$I_{xx} = I_{yy} = I_{zz} = \frac{2}{5}mr^2$



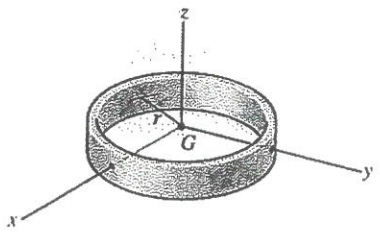
Hemisphere

$I_{xx} = I_{yy} = 0.259mr^2 \quad I_{zz} = \frac{2}{5}mr^2$



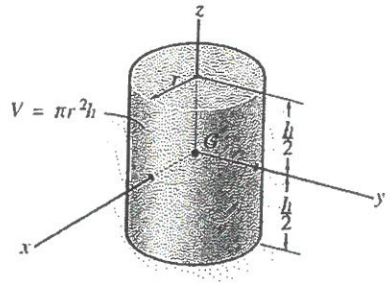
Thin Circular disk

$I_{xx} = I_{yy} = \frac{1}{4}mr^2 \quad I_{zz} = \frac{1}{2}mr^2 \quad I_{z'z'} = \frac{3}{2}mr^2$



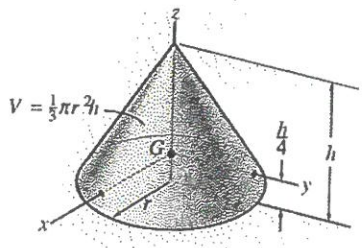
Thin ring

$I_{xx} = I_{yy} = \frac{1}{2}mr^2 \quad I_{zz} = mr^2$



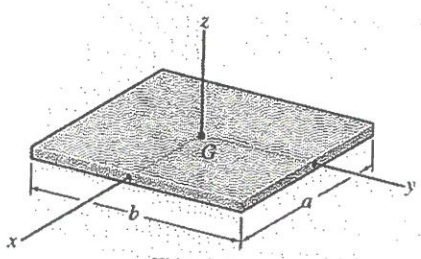
Cylinder

$I_{xx} = I_{yy} = \frac{1}{12}m(3r^2 + h^2) \quad I_{zz} = \frac{1}{2}mr^2$



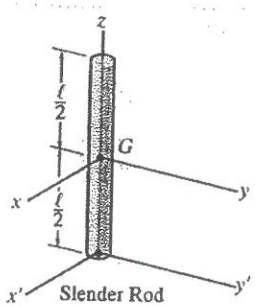
Cone

$I_{xx} = I_{yy} = \frac{3}{80}m(4r^2 + h^2) \quad I_{zz} = \frac{3}{10}mr^2$



Thin plate

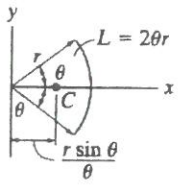
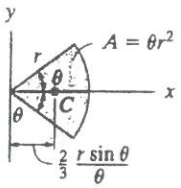
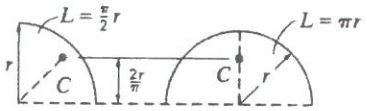
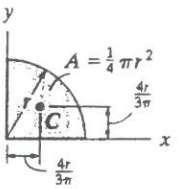
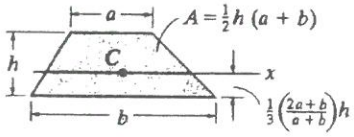
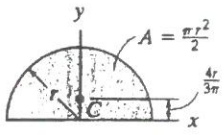
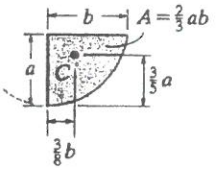
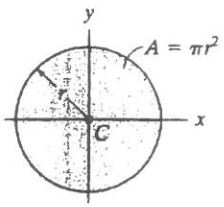
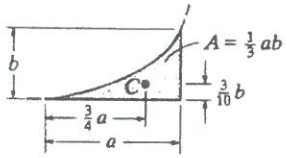
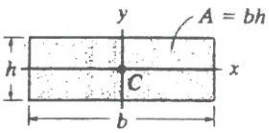
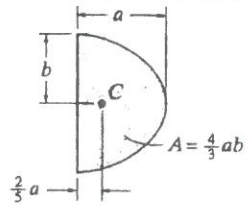
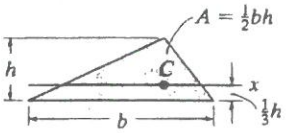
$I_{xx} = \frac{1}{12}mb^2 \quad I_{yy} = \frac{1}{12}ma^2 \quad I_{zz} = \frac{1}{12}m(a^2 + b^2)$



Slender Rod

$I_{xx} = I_{yy} = \frac{1}{12}m\ell^2 \quad I_{x'x'} = I_{y'y'} = \frac{1}{3}m\ell^2 \quad I_{z'z'} = 0$

Geometric Properties of Line and Area Elements

Centroid Location	Centroid Location	Area Moment of Inertia
 Circular arc segment	 Circular sector area	$I_x = \frac{1}{4} r^4 (\theta - \frac{1}{2} \sin 2\theta)$ $I_y = \frac{1}{4} r^4 (\theta + \frac{1}{2} \sin 2\theta)$
 Quarter and semicircle arcs	 Quarter circle area	$I_x = \frac{1}{16} \pi r^4$ $I_y = \frac{1}{16} \pi r^4$
 Trapezoidal area	 Semicircular area	$I_x = \frac{1}{8} \pi r^4$ $I_y = \frac{1}{8} \pi r^4$
 Semiparabolic area	 Circular area	$I_x = \frac{1}{4} \pi r^4$ $I_y = \frac{1}{4} \pi r^4$
 Exparabolic area	 Rectangular area	$I_x = \frac{1}{12} bh^3$ $I_y = \frac{1}{12} hb^3$
 Parabolic area	 Triangular area	$I_x = \frac{1}{36} bh^3$