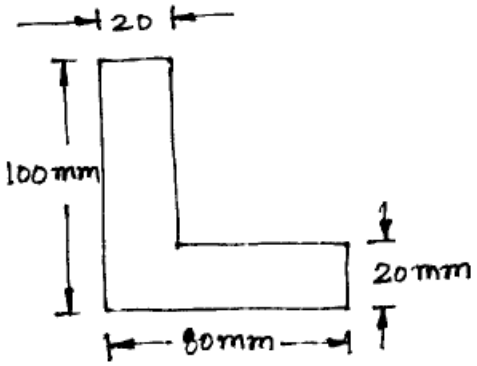
Problems Based on Centroid & Moment of Inertia

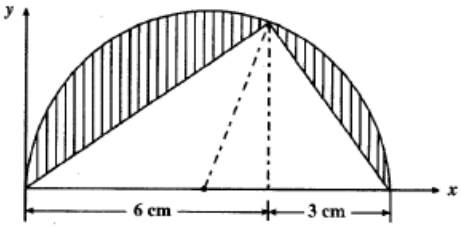
2006–2007 (Sem. II) (ME202)

1. Find the centroid of a uniform wire bent in form of a quadrant of the arc of a circle of radius *R*.
2. State the parallel axis theorem.
3. What is product of inertia? What will the product of inertia of a circular disc about its centroidal axis?
4. Find the second moment of area of the given L-section about the centroidal *x* axis as shown in Fig.



2008–2009 (Sem. I) (EME102)

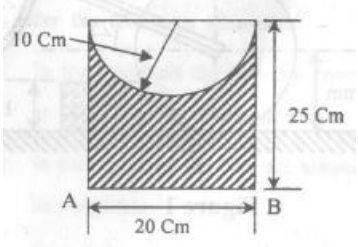
1. A triangle is removed from a semicircle as shown in figure. Locate the centroid of the remaining object.



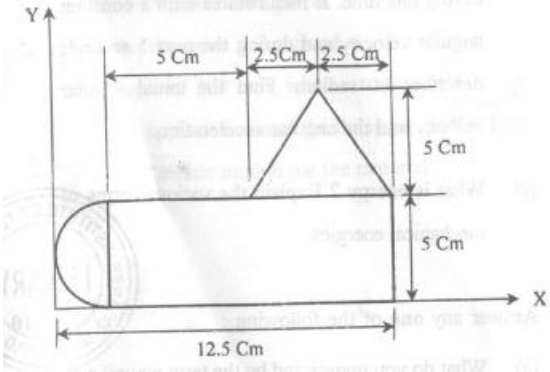
2. Derive an expression for the centroid of semicircular arc.
3. Explain any three of the following :
   (i) Second moment of area.
   (ii) Radius of Gyration.
   (iii) Parallel axis theorem.
   (iv) Perpendicular axis theorem.
4. Derive an expression for mass moment of inertia of solid sphere about axis passing through its center.

2008–2009 (Sem. II) (EME202)

1. Find the moment of inertia of the area shown shaded in Figure about edge *AB*.



2. Find the centroid of Figure.



3. Derive an expression of mass moment of inertia of a cylinder about the longitudinal axis.

4. Explain any two of the following :

(i) Parallel axis theorem

(ii) Product of inertia of an area about its axis of symmetry.

(iii) Centre of gravity.

2009–2010 (Sem. I) (EME102)

1. For the *z*-section as shown in Fig., the moment of inertia with respect to *x* and *y* axes are given as I_x = 1548 cm^4 and I_y = 2668 cm^4. Determine the principal axes of the section about *O* (centroid of vertical section and point O coincides) and values of the principal moments of inertia.

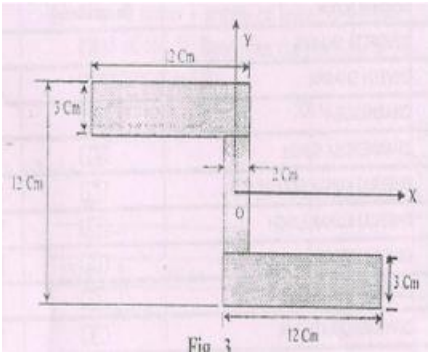
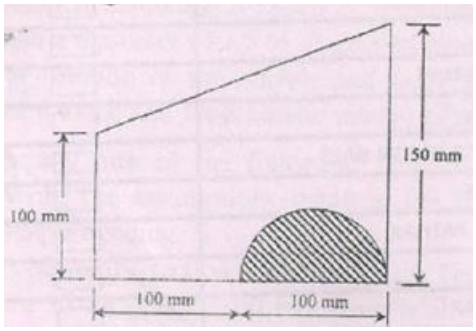


Fig. 3

2. A semicircular area is removed from the trapezoid as shown in Fig. Determine the centroid of remaining area:



3. Derive an expression of mass moment of inertia of a circular lamina about the central axis.

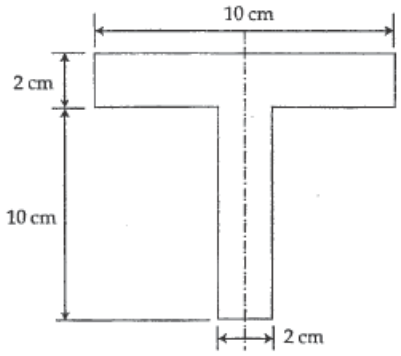
4. Explain the following:

(i) Product of inertia.

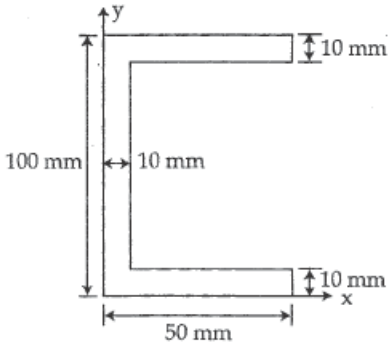
(ii) Principal moment of inertia.

2009–2010 (Sem. II) (EME202)

1. Determine the moment of inertia of T section about the horizontal and vertical axes, passing through the CG of the section as shown Figure.



2. Locate the centroid of channel section as shown in Figure.

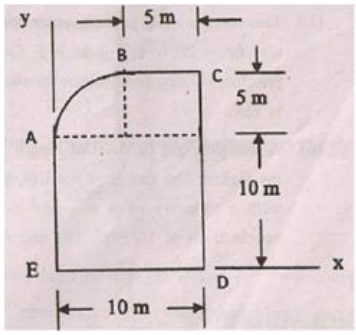


3. Determine the mass moment of inertia of a rectangular plate of size $a \times b$ and thickness t about the centroidal axis.

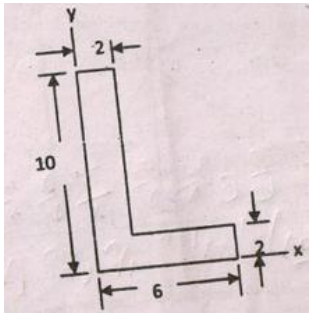
4. Explain the following: (i) Product of inertia, (ii) Mass moment of inertia.

2010–2011 (Sem. I) (EME102)

1. A wire is bent into a closed loop *A-B-C-D-E-A* as shown in figure in which portion *AB* is circular arc. Determine the centroid of the wire.



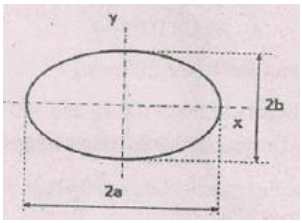
2. Find the principal moment of inertia about the origin of the area shown in figure. All dimensions are in mm.



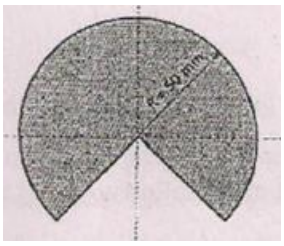
3. Derive an expression for moment of inertia of a solid sphere about its diameter.

2010–2011 (Sem. II) (EME202)

1. Determine the area moment of inertia of an ellipse about its centroidal axes.

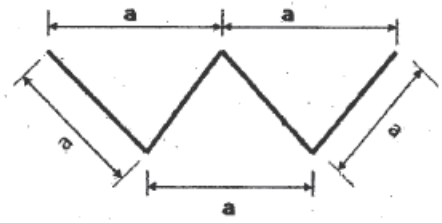


2. Determine the centroid and moment of inertia of the area shown about centroidal *x*-axis.



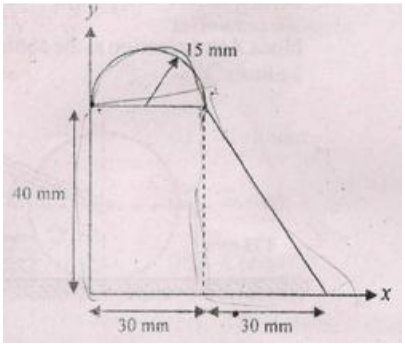
3. Determine the mass moment of inertia of a solid cylinder of radius R and height h about its longitudinal axis.

4. Determine the centroid of a thin wire bent in shape of 'W' as shown in figure.



2010–2011 (Sem. II) (EME202) (MTU)

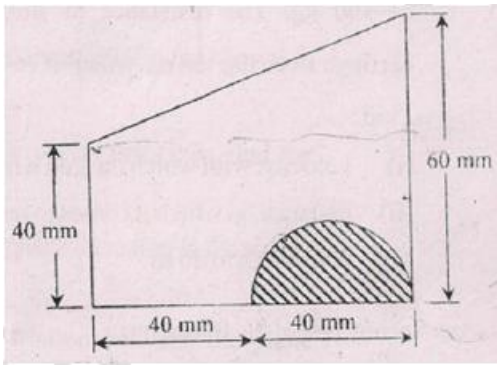
1. Calculate the moment of inertia of the composite area, shown in fig about the centroidal axis.



2. State and prove the theorems of parallel and perpendicular axis with suitable example.

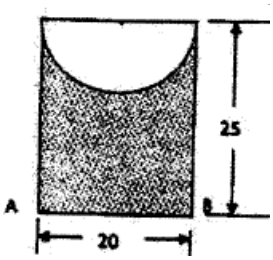
3. Derive an expression for the mass moment of inertia of a circular disc of radius R and thickness t about its centroidal axis.

4. A semicircular area is removed from the trapezoid as shown in fig. Determine the centroid of the remaining area.



2011–2012 (Sem. I) (EME102)

1. What is the importance of axis of symmetry in determination of center of gravity of a body?
2. Explain principal Axis of inertia,
3. Determine the centroid of the area shown in Fig. All dimensions are in mm.



4. Find the mass moment of inertia of a hollow cylinder about its axis. The mass of cylinder is 5 kg inner radius 10 cm, outer radius 15 cm and height 20 cm.
5. Find the moment of inertia of T section as shown in Fig about the centroidal *xx* and *yy* axis. All dimensions are in mm.

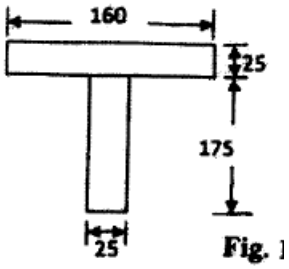
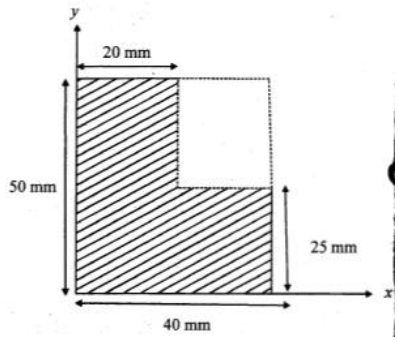


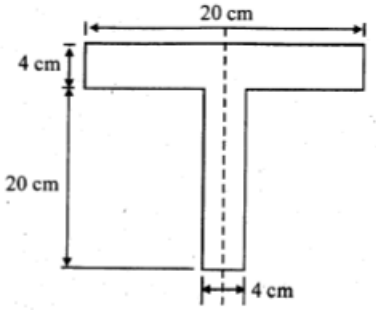
Fig. 1

2011–2012 (Sem. I) (EME102) (MTU)

1. State the theorem of perpendicular axis.
2. Define centre of gravity and centroid.
3. Calculate the moment of inertia of the hatched section shown in fig about the centroidal XX axis.

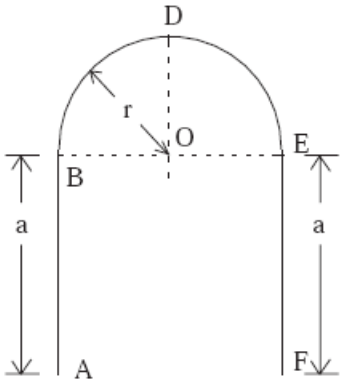


4. State and prove the theorems of parallel and perpendicular axis.
5. Derive an expression for the mass moment of inertia of a right circular cone about its axis.
6. Determine the moment of inertia of T section about the horizontal and vertical axes, passing through the C.G. of the section as shown in Fig.

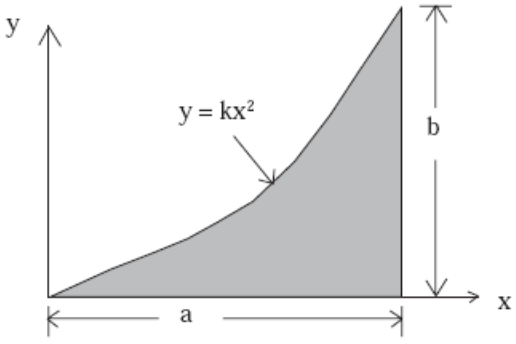


2011–2012 (Sem. II) (EME202)

1. Product of inertia of an area about an axis is zero. Explain.
2. What is the moment of Inertia of a square plate of side '*a*' about its diagonal?
3. Determine mass moment of inertia of a solid cylinder of radius *R* and height h about its centroidal axis.
4. Determine length of wire such that centroid is located at point '*O*'. Find the length in terms of '*r*' Fig.

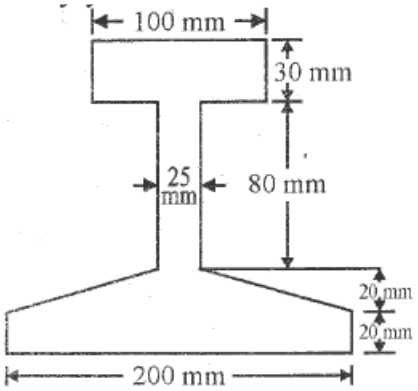


5. Explain the product of Inertia and principal moment of Inertia.
6. Determine the mass moment of inertia of a solid cylinder of radius *R* and height *h* about its centroidal axis.
7. Determine the moment of Inertia of the shaded area with respect to *x* and *y* axis. Fig.



2011–2012 (Sem. II) (EME202) (MTU)

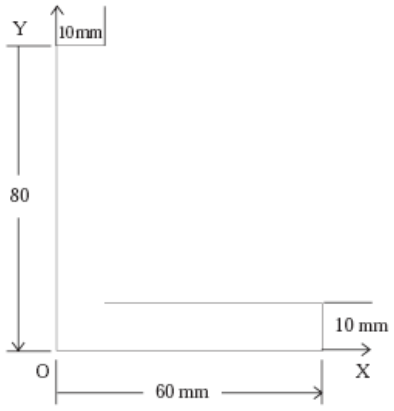
1. Define product moment of Inertia and polar moment of Inertia.
2. Differentiate between centroid and center of gravity.
3. Determine the moment of Inertia of the built-up section shown in Fig about its centroidal axis *x-x* and *y-y*.



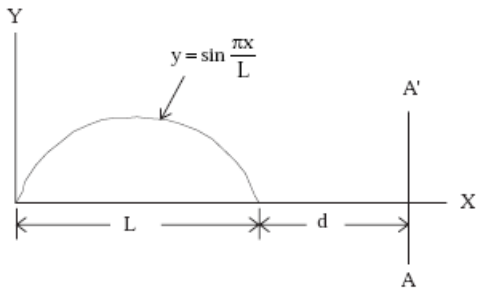
4. Write short note on Principal moment of Inertia and Mass moment of Inertia.
5. Determine the centroid of a sector of a circle of radius R and central angle 2α.
6. Determine the moment of Inertia of a solid sphere of radius R about its diametral axis.

2012–2013 (Sem. I) (EME102)

1. A uniform rod of length 20 cm is bent at an angle of 90° from the middle. Find the distance of C.G. of the rod from its middle point about which the rod is bent.
2. Determine the principal moment of inertia of the area shown in Fig for axes through origin.



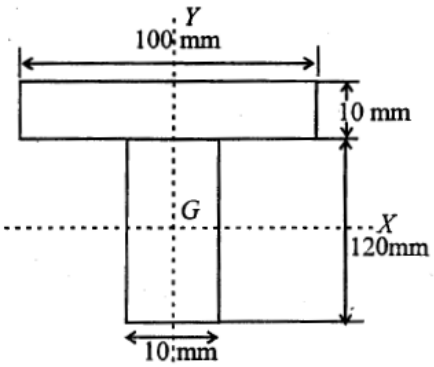
3. Find the centroid of the area under half sine curve shown in Fig. Find the centroid of this area about axis *A*—*A′*.



4. Compute the mass moment of inertia of right circular cone of radius r and height h about an axis passing through apex and normal to its base.

2012–2013 (Sem. I) (ME101) (MTU)

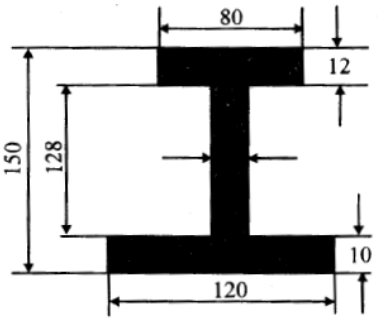
1. Give centroid of quarter circle arc.
2. Define radius of gyration with respect to x-axis of an area.
3. Find the moment of area of the diagram shown in Fig, about its centroidal axes.



4. Determine the centroid of semicircular area of radius r using method of integration.
5. Explain: (i) Parallel axes theorem (ii) Perpendicular axes theorem.

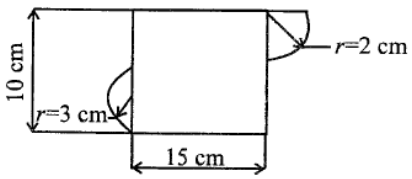
2012–2013 (Sem. I) (EME102) (MTU) [COP]

1. State parallel axis theorem and perpendicular axis theorem.
2. What do you mean by polar moment of inertia?
3. Derive expression of mass moment of inertia for a sphere about its centroidal axis.
4. Derive an express ion for mass moment of inertia of right circular solid cone about its axis of rotation having base radius R and height H.
5. Find the polar moment of inertia for the I section as shown in Fig.

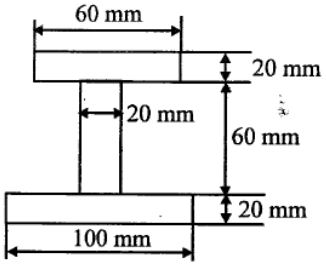


2012–2013 (Sem. II) (ME201) (MTU)

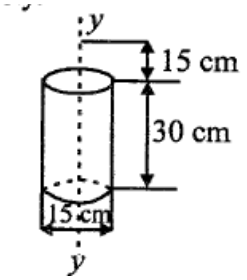
1. Define centre of gravity and centroid.
2. State parallel axis theorem.
3. Locate the centroid of the lamina shown in Fig.



4. Find the moment of inertia of I-section shown in Fig, about its centroidal axes.

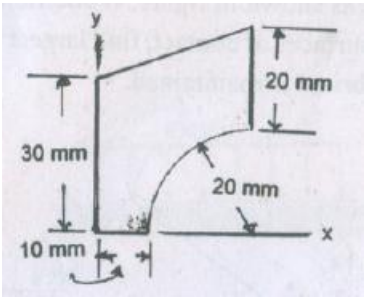


5. Calculate the mass moment of inertia of the body shown in Fig, with respect to vertical geometrical axis. Assume density of cone and cylinder are 6500 Kg/m^3 and 7850 kg/m^3 respectively.

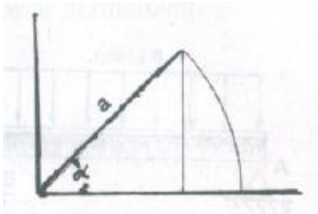


2013–14 (Sem. I) (NME102)

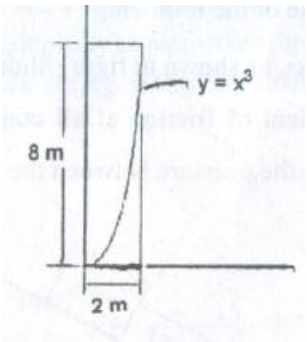
1. Determine the centroid of a circular arc having radius 20 mm and central angle 180°.
2. Determine the area moment of inertia of the composite area shown in figure about x and y axis.



3. Determine the centroid of a semicircular segment given that a = 100 mm and α = 45°.



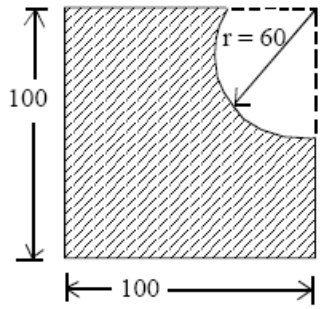
4. Find the moment of inertia of the section shown in figure about y axis.



5. Determine the mass moment of inertia of a right circular solid cone of base radius R and height h about the axis of rotation.

2013–14 (Sem. I) (EME102/EME202) [COP]

1. Calculate the centroid of an arc of radius 5 cm and angle 120°.
2. Explain the terms: Product moment of inertia and Principal moment of Inertia.
3. The cross section of a machine part is shown in Fig. Determine its moment of Inertia and radius of gyration about the horizontal centroidal axis.

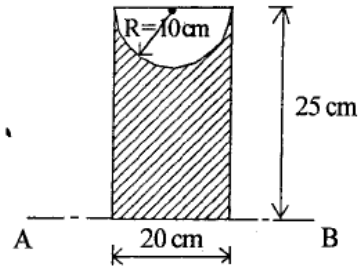


All dimensions in mm

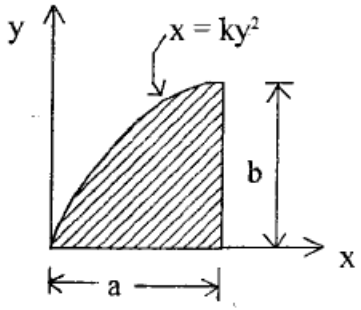
4. Determine the centroid of a solid hemisphere of radius r from its diametral axis.
5. *ABCD* is a square section of side 100 mm. Determine the ratio of moment of Inertia of the section about centroidal axis parallel to a side to that about diagonal *AC*.
6. Find the mass moment of Inertia of the solid cylinder of height h and base radius R about its axis of rotation.

2013–14 (Sem. I) (ME101) [COP]

1. Write down the statement of parallel axis theorem with figure.
2. For the shaded area shown in figure, find the moment of inertia about the line *AB*.



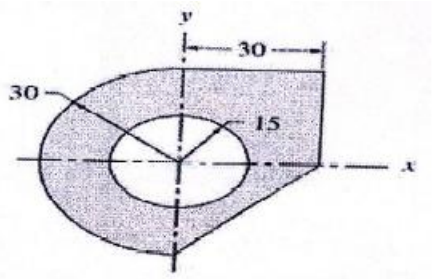
3. Find the centroid of the shaded area with respect to x and y axis by direct integration method. (Ref. figure).



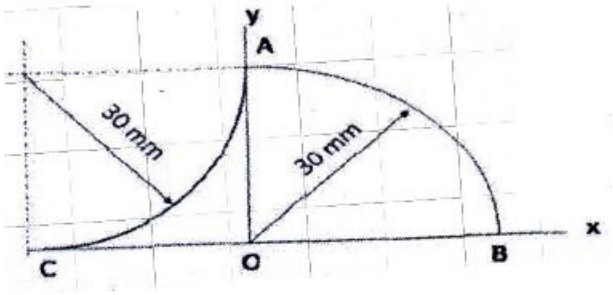
4. Find the mass M.I. (Moment of inertia) of a rectangular plate of mass m, base b and height h about the centroidal axis parallel to the base.

2013–14 (Sem. II) (NME202)

1. What is the centroid of segment of a circular disc of radius 5 cm and subtended angle of 120°?
2. Explain the polar moment of inertia.
3. Find area moment of inertia of the planar area about given x and centroidal x axis.



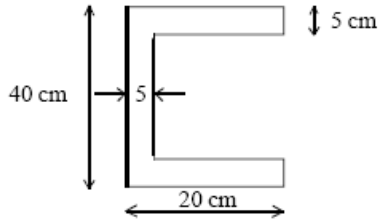
4. Determine the area moment of inertia of the composite area *ABOC* about given *x* and *y* axis.



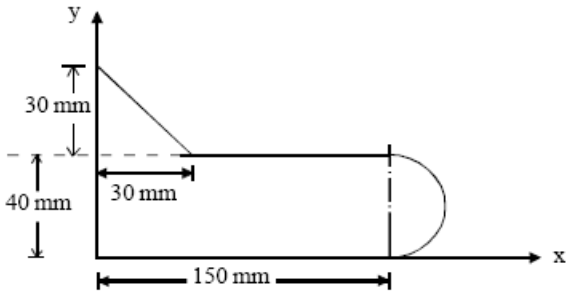
5. Determine the mass moment of inertia of uniform density sphere of radius 5 cm about its centroidal axes.

2013–14 (Sem. II) (EME202) [COP]

1. State the perpendicular axis theorem.
2. Prove that centre of gravity of a right circular cone lies at $h/4$ from the base.
3. Calculate the moment of Inertia of section about the centroidal axis:

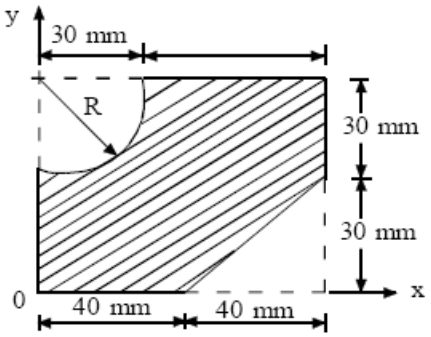


4. Determine the centroid of given figure (Lamma) about the given axis:

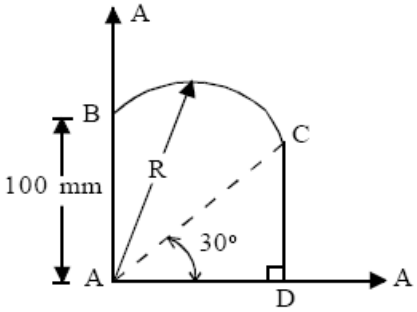


2013–14 (Sem. II) (ME201) [COP]

1. When is parallel axis theorem used?
2. Define Polar moment of inertia and radius of gyration.
3. Find the moment of inertia of plane lamina about *x*-axis and also find its radius or gyration k_x (Figure):



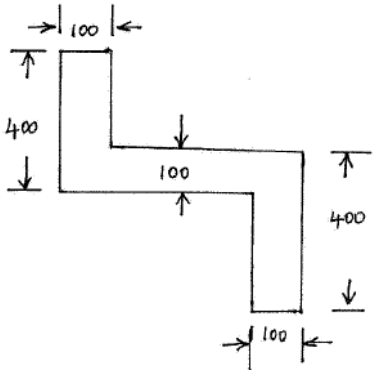
4. Find the centroid of a wire bent in a shape *ABCDA* as shown in Figure:



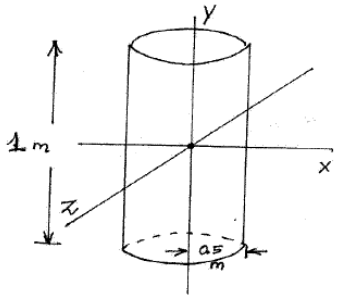
5. Derive an expression for M.I. of a right circular cone of base radius '*R*' and mass '*M*' about its symmetrical axis.

2014–15 (Sem. I) (NME102)

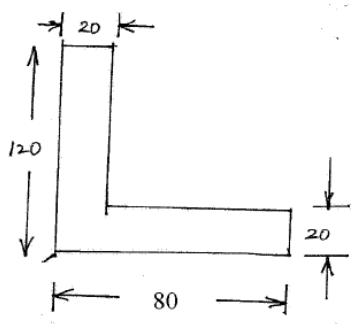
1. Determine the moment of inertia of beam's cross sectional area as shown in Fig about the *XX* and *YY* centroidal axes. All dimensions are in mm.



2. Calculate the mass moment of inertia of the cylinder of radius 0.5 m, height 1 m and density 2400 kg/m^3 about the centroidal axis.



3. Find out the centroid 120 mm × 80 mm × 20 of an L - Section of mm.

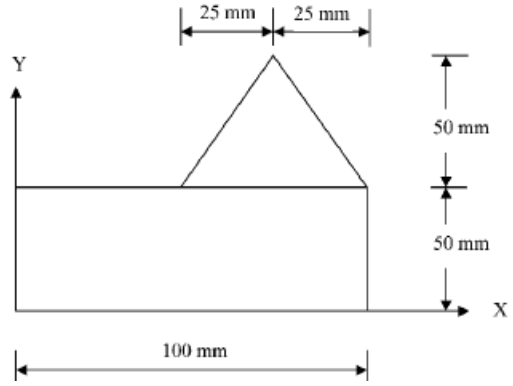


2014–15 (Sem. I) (EME102) [COP]

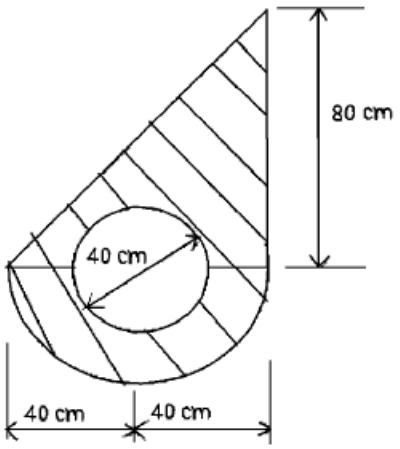
1. From a rectangular sheet of metal *ABCD*, in which *AB* = 40 cm and *BC* = 60 cm, a triangular piece *ABX* is removed, such that *AX* = *BX* = 25 cm. Calculate the distance of center of gravity of the remainder.
2. Derive an expression for mass moment of inertia of a circular lamina about the centroidal axis.
3. Derive an expression for mass moment of inertia of a circular disc of radius *R* and thickness '*t*' about its centroidal axis.

2014–15 (Sem. I) (ME101) [COP]

1. Determine the centroid of a uniform lamina as shown in figure.



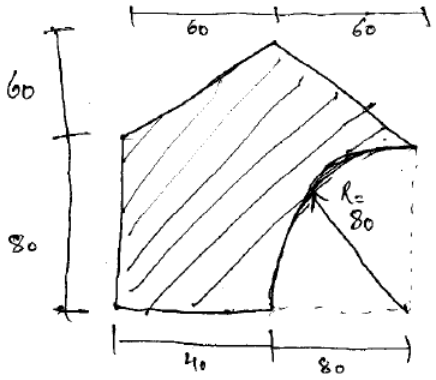
2. Determine the M.I. of the shaded area as shown in figure about the centroidal axis *X-X*.



3. Determine the mass moment of inertia of a solid right circular cone of base radius '*R*' and height '*h*' about its axis of rotation.

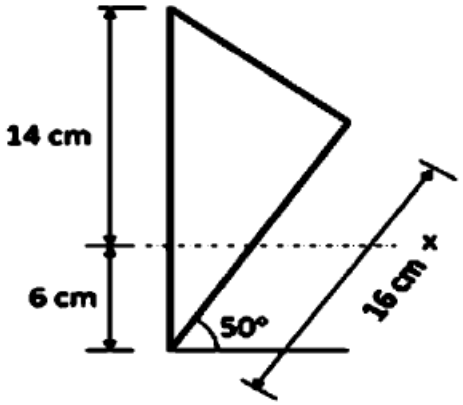
2014–15 (Sem. II) (NME202)

1. What is the difference between centroid and center of gravity?
2. State and explain perpendicular axis theorem.
3. Derive the expression of mass moment of inertia for a circular disc about its diametral axis.
4. Show that the product of inertia of an area about two mutually perpendicular axis is zero if the area is symmetrical about one of these axis.
5. Locate the centroid of the shaded area shown in fig. All dimensions are in meters.

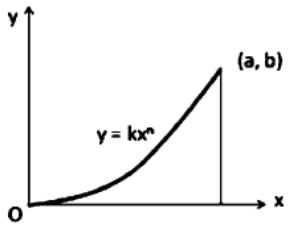


2014–15 (Sem. II) (EME202) [COP]

1. What is the difference between centroid and center of gravity?
2. For a thin disc of mass m, the polar moment of inertia about an axis passing through its center and normal to the plane of disc is given as $\pi r^4/2$. Determine its mass moment of inertia about the same axis.
3. Determine the centroid of a wire bent in shape of a triangle as shown in figure about the given x axis.



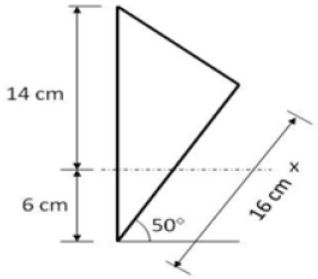
4. Calculate area moment of inertia of area under curve $y = kx^n$ about x and y axis.



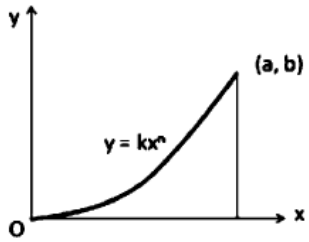
5. Determine the mass moment of inertia of a right circular cylinder about its centroidal axes.

2014–15 (Sem. II) (ME201) [COP]

1. What is the difference between centroid and center of gravity?
2. For a thin disc of mass m, the polar moment of inertia about an axis passing through its center and normal to the plane of disc is given as $\pi r^4/2$. Determine its mass moment of inertia about the same axis.
3. Determine the centroid of a wire bent in shape of a triangle as shown in figure about the given x axis.



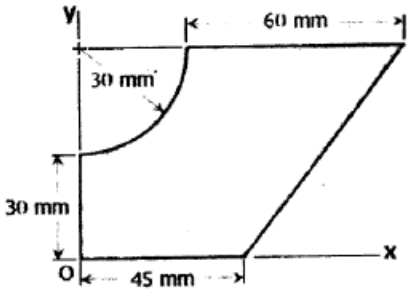
4. Determine the centroid of the area given under the curve shown in figure.



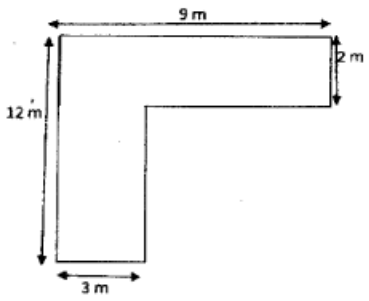
5. Determine the mass moment of inertia of a right circular cylinder about its centroidal axes.

2014–15 (Sem. I) (NME202/NME102/EME202/EME102) [SCOP]

1. Define Mass Moment of Inertia & Area Moment of Inertia.
2. Calculate the Moment of Inertia about X-X axis for given area shown in figure.



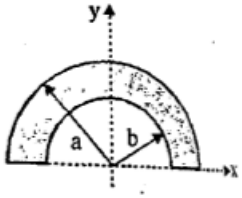
3. Determine the moment of inertia of the L section with respect to centroidal X-X and Y-Y axis Section as shown in figure. Also find its radius of gyration from both Centroidal axes.



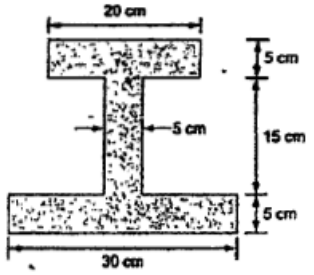
4. Derive an expression for mass moment of inertia about axis of symmetry for a right solid circular cone.

2015–16 (Sem. I) (NME102)

1. State perpendicular axis theorem.
2. What do you understand by radius of gyration?
3. For the semi-annular area shown in fig, determine the ratio of a to b so that $y = 3b/4$.

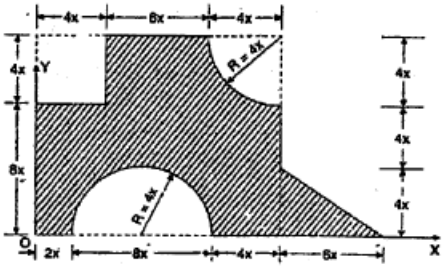


4. Derive the expression for mass moment of inertia of a sphere about centroidal axis.
5. Determine the moment of inertia about x-x and y-y axis passing through the centroid of the unsymmetrical I- section as shown in fig.



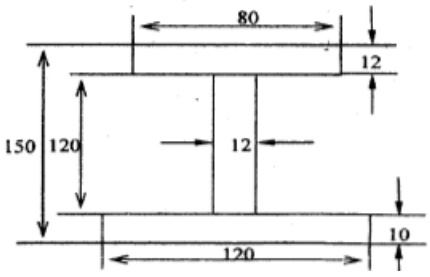
2015–16 (Sem. I) (EME102) [COP]

1. Define product of inertia and area moment of inertia.
2. Locate centroid of a wire bent in the form of quarter-circular arc.
3. Derive the relation for mass moment of inertia of cylinder about it's transverse centriodal axis.
4. Find out centroid of given section Fig. Also find out MOI about base. Take $X = 40$ mm.



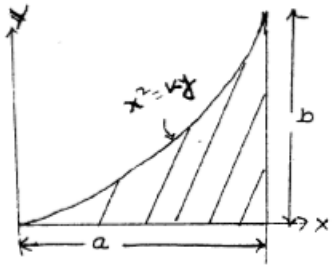
2015–16 (Sem. I) (ME101) [COP]

1. Distinguish between centroid and centre of gravity.
2. State the perpendicular axis theorem.
3. Derive an expression for mass moment of inertia for a sphere about its centroidal axis.
4. Determine the moment of inertia of a circle of radius R about its centroidal axis.
5. Find the moment of inertia of I section shown in fig about its centroidal axis.

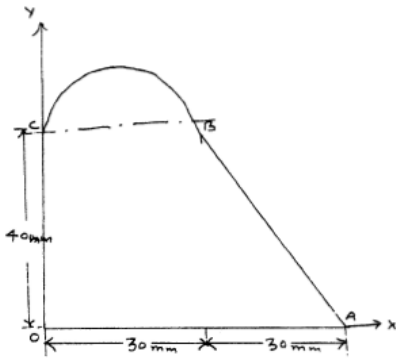


2015–16 (Sem. II) (NME202)

1. Define polar moment of inertia and radius of gyration.
2. Determine the co-ordinates of the centroid *C* of the shaded area as shown in figure.

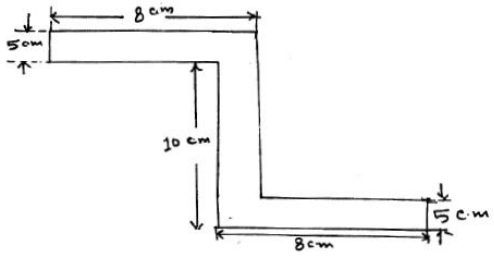


3. Derive the mass moment of inertia a sphere of radius *R* about centroidal axis.
4. Calculate the moment of inertia of composite section as shown in figure about its centroidal axis.

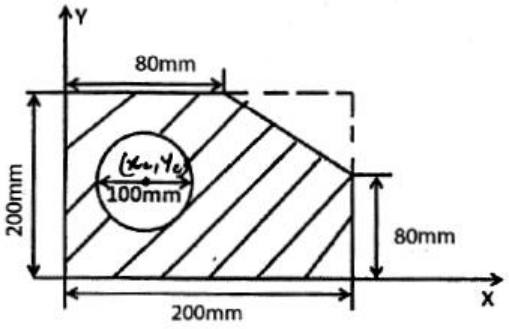


2015–16 (Sem. II) (EME202) [COP]

1. Define radius of gyration of a rigid body.
2. Derive the mass moment of inertia of right circular cylinder.
3. Find the moment of inertia about centroidal axis *X*-*X* and *Y*-*Y* of the section as shown in fig.

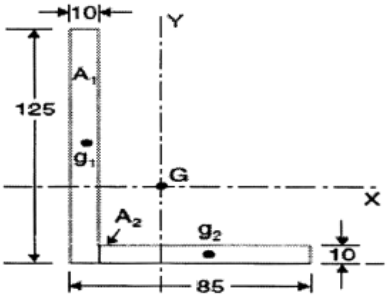


4. Determine the X_c and Y_c of the center of 100 mm diameter circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area shown in fig.



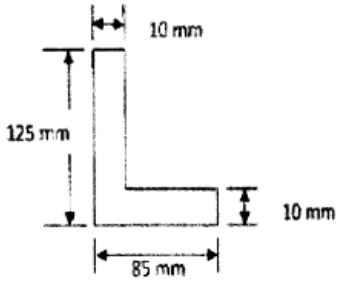
2015–16 (Sem. II) (ME201) [COP]

1. Write down the statements of (i) Parallel axis theorem, (ii) Perpendicular axis theorem.
2. Differentiate between centroid and centre of gravity.
3. Define radius of gyration of a rigid body.
4. Find the moment of inertia about centroidal axis *XX* and *Y-Y* of the section shown in fig.



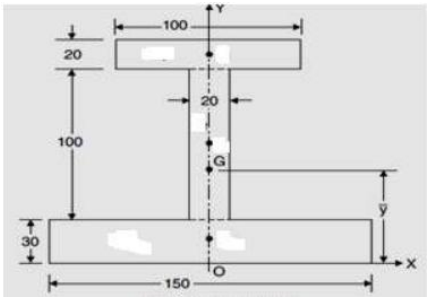
2016–17 (Sem. I) (RME101)

1. State parallel axis theorem.
2. Determine the moment of inertia of the L section shown in fig, about its centroidal axis parallel to the legs. Also find the polar moment of inertia.



2016–17 (Sem. II) (RME201)

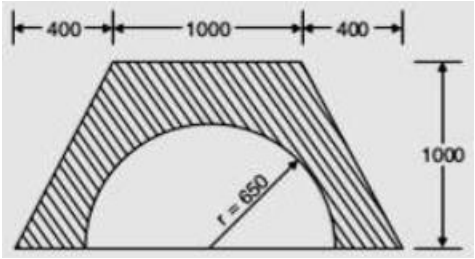
1. State and explain perpendicular axis theorem.
2. Determine the MOI about centroidal *X* and *Y* axis of the I-section as shown in fig. below. All dimension in mm.



2016–17 (Sem. II) (NME202/EME202/ME201) [COP]

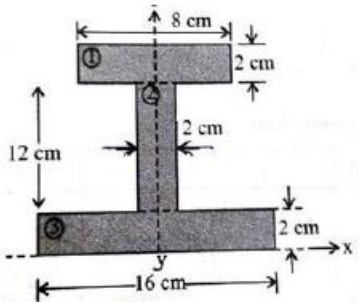
1. State and explain parallel axis theorem.

2. Where does the position of centre of gravity of cone and hemisphere lie?
3. Determine mass moment of inertia of the cone of radius r and mass m about its centroidal axis.
4. The cross-section of a plain concrete culvert is as shown in Fig. Determine the moment of inertia of the shaded area about the horizontal centroidal axes. All the dimensions are in mm.



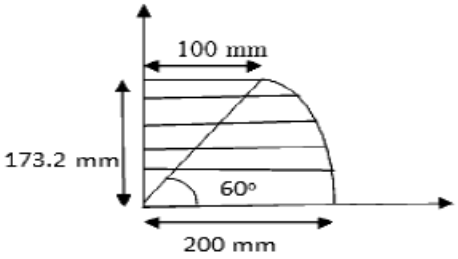
2017–18 (Sem. I) (RME101)

1. Differentiate centroid and center of gravity.
2. State and prove parallel axis theorem.
3. Find the moment of inertia of I section as shown in Fig about its centroidal x and y axes.

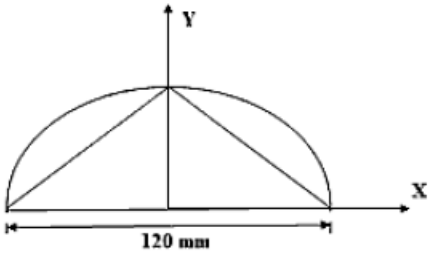


2017–18 (Sem. I) (NME102/EME102) [COP]

1. Find the centroid for a triangle and sector of a circle as shown in figure.



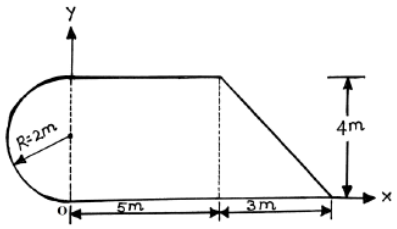
2. Find the polar moment of inertia of a semicircle about its center from which a triangle base 120 mm and height 60 mm is removed as shown in the figure.



3. Find the mass moment of inertia of a sphere about its centroidal axis.

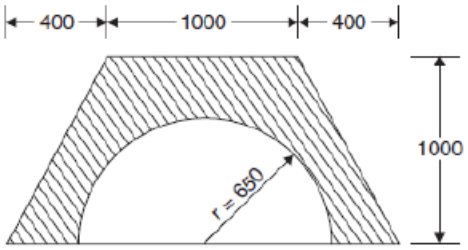
2017–18 (Sem. II) (RME201)

1. State and explain Perpendicular axis theorem.
2. Differentiate between centroid and centre of gravity.
3. State and prove parallel axes theorem also describe radius of gyration.
4. Find the moment of inertia about the axis *OX* for the lamina as shown in figure.

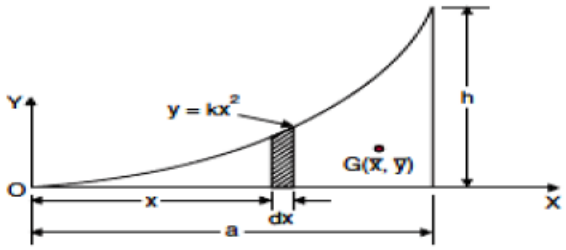


2017–18 (Sem. II) (NME202) [COP]

1. State and prove the parallel axis theorem.
2. Define the moment of inertia and its physical significance.
3. Find the moments of inertia about the centroidal axes of section shown in figure.

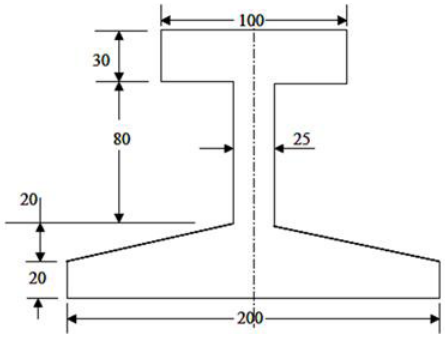


4. Determine the mass moment of inertia of a solid cylinder of radius R and height h about the axis of symmetry.
5. Find the Centroid of the parabolic spandrel shown in figure.



2017–18 (Sem. II) (EME202) [COP]

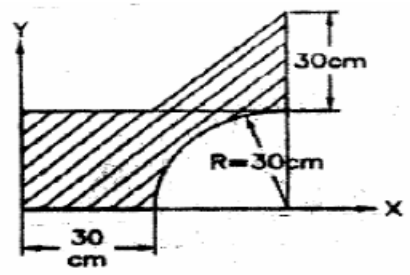
1. Differentiate between 'polar moment of inertia' and 'product of inertia'.
2. Determine the moment of inertia of the section as shown below about centroidal *Y* axis (dotted line). All dimensions are in mm.



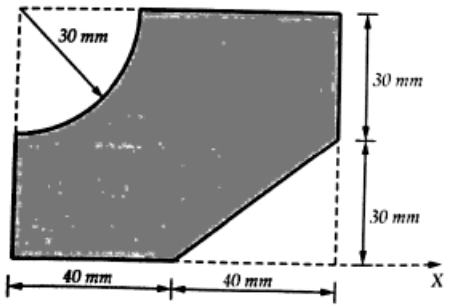
3. Determine the area moment of inertia of an ellipse about its two centroidal axes, and its polar moment of inertia.
4. For a solid right circular cone of base radius R, height h and mass M, derive an expression for its mass moment of inertia with respect to (a) a diameter of its base, (b) centroidal axis parallel to its base, and (c) an axis parallel to its base and passing through its vertex.

2018–19 (Sem. I) (RME101)

1. State parallel axis theorem.
2. Determine the co-ordinates of centroid of the shaded area shown in figure.

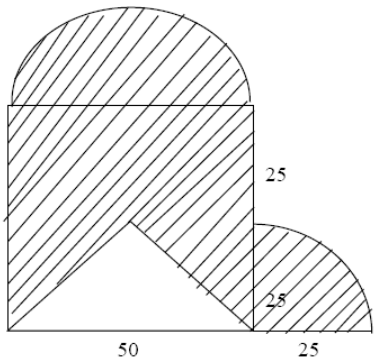


3. Determine the area Moment of inertia and radius of gyration of the shaded area about centroidal X-axis.

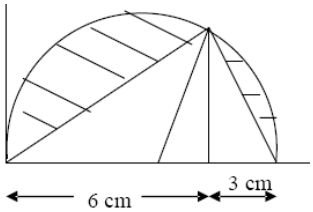


2018–19 (Sem. I) (NME102/EME102) [COP]

1. Discuss term moment of inertia and it's significance.
2. Locate centroid of a wire bent in the form of semi circle.
3. Locate centroid of given plane figure. Also find out MOI about base.



4. Derive an expression for mass moment of inertia of solid sphere about it's axis.
5. Find out centroid of a given composite section, where triangle is removed from a semi circle.



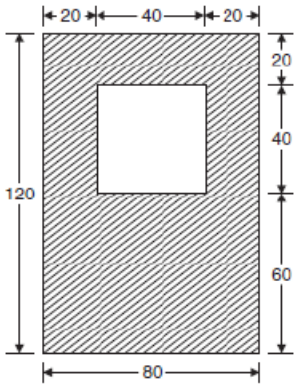
6. Define parallel axis and perpendicular axis theorem.

7. Derive an expression for mass moment of inertia of a cylinder about it's transverse centroidal axis.

2018–19 (Sem. II) (RME201)

1. Define the term centroid, center of gravity and axis of symmetry.

2. The cross-section of a prestressed concrete beam is shown in Fig. Calculate the moment of inertia of this section about the centroidal axes parallel to and perpendicular to top edge. Also determine the radius of gyration.



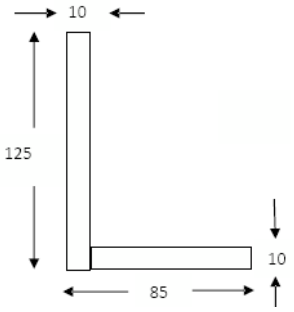
3. Locate the centroid of a semicircle from its diametral axis using the method of integration.

2018–19 (Sem. II) (NME202/EME202) [COP]

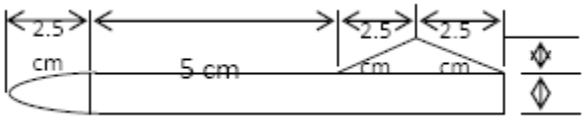
1. Differentiate between centroid and centre of gravity.

2. Define moment of inertia. State and prove parallel axis theorem.

3. Determine the moment of inertia of the L-section as shown in figure about its centroidal axis parallel to the legs. Also find the polar moment of inertia. All dimensions are in mm.



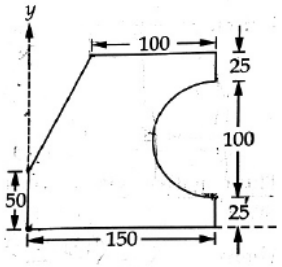
4. Determine the center of gravity of the plane uniform lamina shown in fig.



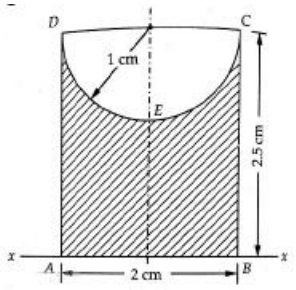
2019–20 (Sem. I) (RME101)

1. Write the expression for MOI of rectangle and triangle about their centroidal axes.

2. Locate the centroid ot the area shown in fig. All the dimensions are in mm.



3. Determine the moment of inertia of the area shown shaded in fig. about the axis passing through its base.



2019–20 (Sem. I) (NME102/EME102) [COP]

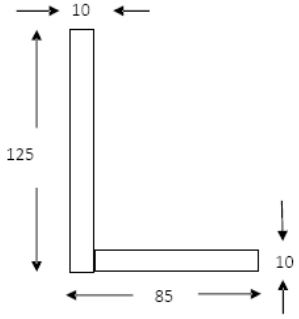
1. State and explain parallel axis theorem.

2. Differentiate between centroid and centre of gravity.

3. Where does the position of centre of gravity of cone and hemisphere lie?

4. Define moment of inertia. State and prove parallel axis theorem.

5. Determine the moment of inertia of the L-section as shown in figure about its centroidal axis parallel to the legs. All dimensions are in mm.



6. Locate the coordinate X_c and Y_c of the center of a 100 mm diameter circular hole cut in a thin plate so that this point will be the centroid of the remaining shaded area as shown in fig.