Problems Based on Pure Bending of Beams

2005–2006 (Sem. I) (TME101)

1. What do you mean by simple bending? What assumptions are made in simple bending stress analysis?
2. A wooden beam of rectangular cross-section is subjected to a bending moment of 5 kNm. If the depth of the section is to be twice the breadth and stress in wood is not to exceed 60 N/cm^2, find the dimension of the cross-section of the beam.

2005–2006 (Sem. II) (TME201)

1. What do you understand by Pure bending of beams and how it differs from simple bending? Plot the variation of bending stress across the cross section; of a solid circular beam, a T section beam and a rectangular beam, indicating the salient features on it.

2006–2007 (Sem. II) (TME201)

1. Determine the dimensions of a simply supported rectangular steel beam 6 m long to carry a brick wall 250 mm thick and 3 m high, if the brick work weights 19.2 kN/m^3 and maximum permissible bending stress is 800 N/cm^2. The depth of beam is 3/2 times its width.

2006–2007 (Sem. II) (ME201)

1. A cantilever beam has a rectangular cross section 50 mm wide and 150 mm deep. The cantilever is 2 m long and carries a concentrated force of 10^4 N at the free end. Calculate the maximum bending stress in the beam.
2. Define the following terms: (i) Section modulus, (ii) Pure bending.

2006–2007 (Sem. I & II) (TME101/TME201) [SCOP]

1. Stating the assumptions in the theory of simple Bending, derive bending equation

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}.$$

Where M is bending moment, I = Moment of inertia, σ = Stress, y = distance of fibre from N.A., E = Modulus of elasticity, R = Radius of Neutral surface after bending.

2007–2008 (Sem. I) (TME101)

1. A CI pipe of wall thickness 10 mm and outside diameter 120 mm carries water and is supported at a distance of 9 m. Calculate the value of maximum bending stress and its nature when water is running full. Take density of water as 1 g/cc and that for CI as 7 g/cc.

2007–2008 (Sem. II) (TME201)

1. Derive the simple bending equation.

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}.$$

Also mention the assumptions made in the derivation.

2. Determine the dimensions of a rectangular simply supported steel beam 5 m long to carry an UDL of 10 kN/m, if the maximum permissible bending stress is 1000 N/cm^2. The depth of the beam is 1.5 times its width.

2008–2009 (Sem. I) (EME102)

1. Why I-section beam is preferred over a rectangular-section beam?
2. A simply supported beam, 2 cm wide by 4 cm high and 1.5 m long is subjected to a concentrated load of 2 kN (perpendicular to beam) at a point 0.5 m from one of the supports. Determine: (i) the maximum fiber stress and (ii) the stress in a fiber located 1 cm from the top of the beam at mid-span.

2008–2009 (Sem. II) (EME202)

1. What do you understand by the term neutral and neutral surface?
2. A steel beam of hollow square section of 60 mm outer side and 50 mm inner side is simply supported on a span of 4 meters. Find the maximum concentrated load the beam can carry at the middle of the span if the bending stress is not to exceed 120 N/mm^2.

2009–2010 (Sem. I) (EME102)

1. A cast iron test beam 20 mm × 20 mm in section and 1 m long and supported at the ends fails when a central load of 640 N is applied. What uniformly distributed load will break a cantilever of the same material 50 mm wide, 100 mm deep and 2 m long?
2. Write the assumptions made in the theory of simple bending.
3. A beam of I-section is 250 mm deep. The flanges are 15 mm thick, 100 mm wide while the web is 8 mm thick. Compare the flexural strength of this beam section with a rectangular section of the same material and area whose width is two-third depth.

2009–2010 (Sem. I) (TME101) [COP]

1. A simply supported beam, 2 cm wide by 4 cm high and 1.5 m long is subjected to a concentrated load 2 kN (perpendicular to beam) at a point 0.5 m from one of the supports. Determine: (i) the maximum fiber stress and (ii) the stress in a fiber located 1 cm from the top of the beam at mid-span.

2009–2010 (Sem. II) (EME202)

1. A 300 mm deep rectangular beam is simply supported over a span of 6 m. What uniformly distributed load per meter the beam can carry if bending stress is not to exceed 110 N/mm^2. Take $I = 8.5 \times 10^6$ mm^2.

2009–2010 (Sem. II) (TME201) [COP]

1. A simply supported rectangular beam, 2 cm wide by 5 cm high, carries a uniformly distributed load of 5 kN/m over its entire length. What is the maximum length of the beam of the flexure stress limited to 25 MPa?

2010–2011 (Sem. I) (EME102)

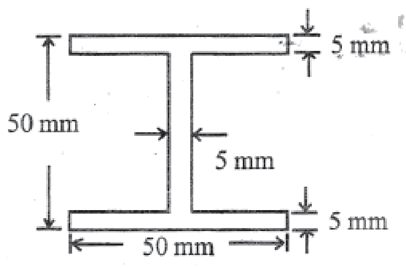
1. What do you understand by "Pure Bending"?
2. Determine the dimensions of a simply supported rectangular steel beam 6 m long to carry a brick wall 250 mm thick and 3 m high, if the brick weighs 20 kN/m^3 and maximum permissible bending stress is 800 N/cm^2. The depth of a beam is 1.50 times its width.

2010–2011 (Sem. I) (TME101) [COP]

1. A simply supported beam, 4 cm wide by 8 cm high and 3 m long is subjected to a concentrated load of 20 kN (perpendicular to beam) at a point 1 m from one of the supports. Determine (i) the maximum fiber stress and (ii) the stress in a fiber located 2 cm from the top of the beam at mid-span.

2010–2011 (Sem. II) (EME202)

1. A simply supported beam of I section (as shown in figure) caries a uniformly distributed load of 50 kN/m over its entire span. If the value of flexural stress is limited to 10^7 Pa, find the maximum possible length of the beam.



2010–2011 (Sem. II) (EME202) (MTU)

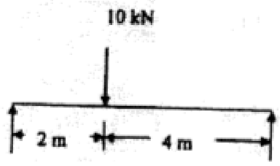
1. Three beams have the same length, same allowable stress and the same bending moment. The cross-sections of the beam are square, a rectangle with depth twice the width, and a circle. Find the ratios of weights of rectangular and circular cross-section beams with respect to the square beam.
2. What do you understand by the term neutral axis and neutral surface?
3. A rectangular beam 300 mm deep is simply supported over a span of 4 m. Determine the uniformly distributed load per meter, which the beam can carry, if the bending stress does not exceed 120 N/mm^2. Take $I = 8.5 \times 10^6$ mm^2.

2010–2011 (Sem. II) (TME201) [COP]

1. A simply supported beam, 5 cm wide by 10 cm high and 5 m long is subjected to a concentrated load of 50 kN (perpendicular to beam) at a point 5 m from one of the supports. Determine (i) the maximum fiber stress and (ii) the stress in a fibre located 2 cm from the top of the beam at mid-span.

2011–2012 (Sem. I) (EME102)

1. Discuss the significance of section modulus of beam.
2. The beam in Fig. has rectangular cross-section whose width is 100 mm and depth is 150 mm. Calculate the maximum bending stress in the beam.

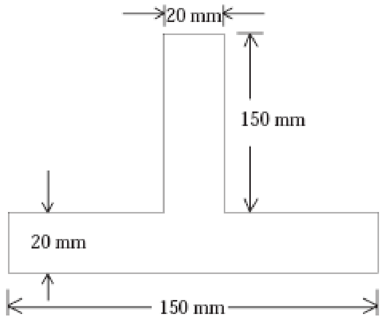


2011–2012 (Sem. I) (EME102) (MTU)

1. What do you understand by the term neutral axis and neutral surface?
2. A steel beam of hollow square section of 60 mm outer side and 50 mm inner side is simply supported on a span of 4 meters. Find the maximum concentrated load the beam can carry at the middle of the span if the bending stress is not to exceed 120 N/mm^2.

2011–2012 (Sem. II) (EME202)

1. The cross section of a 4 m simply supported beam is shown in Fig. Determine the central concentrated load, which will cause a tensile stress of 15 MPa. Also determine corresponding compressive stress.



2011–2012 (Sem. II) (EME202) (MTU)

1. Define the term pure bending. Also write bending formula.
2. Prove that the ratio of depth to width to the strongest beam that can be cut from a circular log of diameter d is $\sqrt{2}$.

2012–2013 (Sem. I) (EME102)

1. A uniform beam is subjected to a couple of 20 Nm. The moment of inertia of the section of the beam about Neutral axis is 3.54×10^4 cm^4. Radius of curvature of the beam is 50 m. Determine Young's modulus of material of the beam.
2. Bending stress in a beam cross section at a distance of 15 cm from neutral axis is 50 MPa. Determine the magnitude of bending stress at a distance of 10 cm from neutral axis.
3. A rectangular section beam of length 6 m is simply supported at its ends. Section of the beam is 60 mm wide and 150 mm deep. Beam carries a concentrated force of 15 kN in downward direction at a distance of 2 m from one support. Find the maximum bending stress in the beam.

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

1. What do you understand by the term 'neutral axis and neutral surface'?

2. A rectangular beam 300 mm deep is simply supported over a span of 4 m. Determine the uniformly distributed load per meter, which the beam can carry, if the bending stress does not exceed 120 N/mm^2. Take $I = 8.5 \times 10^6$ mm^2.

2012–2013 (Sem. I) (TME101) [COP]

1. Derive the bending equation:

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}.$$

Also state the assumptions.

2012–2013 (Sem. II) (TME201) [COP]

1. Derive the Bending Equation $M/I = \sigma/y = E/R$, also enumerate the assumptions made.

2. A rectangular beam with depth 150 mm and width 100 mm is subjected to a maximum bending moment of 300 kNm. Calculate the maximum stress in the beam.

2013–14 (Sem. I) (NME102)

1. Determine the maximum bending moment in a simply supported beam having span of 5 m and carrying a uniformly distributed load of 10 kN/m throughout its span.

2. Differentiate between neutral axis and neutral plane.

3. A simply supported beam of 8 m length is subjected to a uniformly distributed load of 6 kN/m over the half of the span length of the beam from the left support. Select a suitable beam of rectangular cross section having depth to width ratio of 1 : 2 considering the allowable stress for the beam material not to exceed 40 MPa.

4. A hollow rectangular beam 50 mm deep and 200 mm wide and wall thickness of 5 mm is simply supported over a span of 6 m. Determine the maximum bending stress in the beam if a uniformly distributed load of 11 kN/m is applied over the span of the beam. The bending stress is not to exceed 90 N/mm^2.

2013–14 (Sem. I) (EME102) [COP]

1. What do you mean by pure bending of beams? Write the bending equation.

2. A rectangular beam 50 mm deep and 200 mm wide is simply supported over a span of 5 m. What uniformly distributed load per meter the beam may carry, if the bending stress not to exceed 120 N/mm^2.

2013–14 (Sem. I) (TME101) [COP]

1. Derive an expression for beam subjected to pure bending.

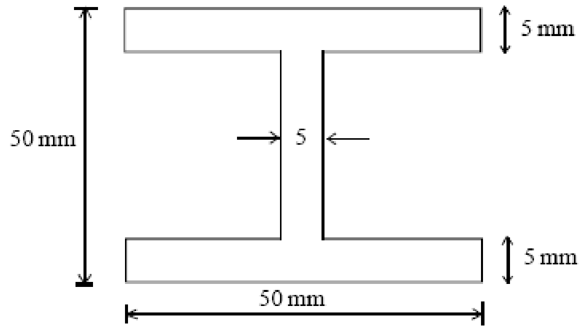
2. Write short notes on: Natural axis.

2013–14 (Sem. II) (NME202)

1. A rectangular beam 400 mm deep and 80 mm wide is simply supported over a span of 5 m. What uniformly distributed load per meter the beam may carry, if the bending stress is not to exceed 125 N/mm^2?

2013–14 (Sem. II) (EME202) [COP]

1. What is a beam of uniform strength?
2. A simply supported beam of I section (as shown in fig.) carries a uniformly distributed load of 120 kN/m over its entire span. If value of flexural stress is limited to 10 Pa, find the maximum possible length of beam.



3. State the assumptions made in theory of pure bending. Derive the bending formula.

2014–15 (Sem. I) (NME102)

1. What do you mean by simple bending or pure bending? What are the assumptions made in the theory of simple bending?

2014–15 (Sem. I) (EME102) [COP]

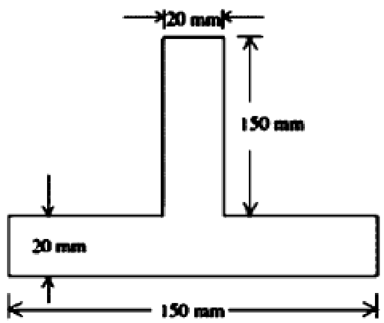
1. What is neutral layer?

2014–15 (Sem. II) (NME202)

1. A steel beam of hollow square section having outer side of 60 m and inner side of 50 mm is simply supported on a span of 4 m. Find the maximum point load that the beam can carry at the middle of the span if the bending stress is not to exceed 120 N/mm^2.

2014–15 (Sem. II) (EME202) [COP]

1. The cross section of a 4 m simply supported beam is shown in figure. Determine the central concentrated load, which will cause a tensile stress of 15 MPa. Also determine corresponding compressive stress.



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

1. What do you mean by pure bending in Beams?
2. Derive the Bending equation for pure bending in beams with assumptions. Also define the neutral axis & section modulus for a beam.

2015–16 (Sem. I) (NME102)

1. Derive the Bending equation.
2. A cast iron water main 500 mm external diameter and 25 mm thickness is running full and is simply supported 30 m apart. Determine the bending stress produced in the material if the specific weight of cast iron and water are 18500 kg/m^3 and 1000 kg/m^3 respectively.

2015–16 (Sem. I) (EME102) [COP]

1. Write down the assumption in pure bending?
2. What do you mean by simple and pure bending?
3. Determine the dimensions of a simply supported rectangular steel beam 6 m long to carry a brick wall 250 mm thick and 3 m high. If the brick weight is 20 kN/m^3 and the maximum stress is 800 N/cm^2. The depth of beam is 1.5 times of it's width.

2015–16 (Sem. II) (NME202)

1. Define section modulus.
2. Prove that the ratio of depth to width to the strongest beam that can be cut from a circular log of diameter *d* is $\sqrt{2}$.

2015–16 (Sem. II) (EME202) [COP]

1. A rectangular section beam of length 6 m is simply supported at its ends. The section of the beam is 60mm wide and 150 mm deep. Beam carries a concentrated force of 15 kN in downward direction at a distance of 2 m from one support. Find the maximum bending stress in the beam.

2016–17 (Sem. I) (RME101)

1. Derive pure bending equation. And describe the assumptions taken in the theory of pure bending.

2016–17 (Sem. II) (RME201)

1. A wooden beam of rectangular cross section is subjected to a bending moment of 5 kNm. If the depth of the section is to be twice the breadth and stress in wood is 60 N/cm^2. Find the dimensions of the cross section of the beam.

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

1. Derive the bending equation: $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$.

2017–18 (Sem. I) (RME101)

1. Explain polar modulus and section modulus with the help of suitable example.
2. Derive the following equation. Also mention the assumptions made in the derivation.

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}.$$

Where M is bending moment, I is moment of inertia, σ is bending stress on a fiber at a distance of y from neutral axis, E is elastic modulus and R is the radius of curvature.

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

1. State assumptions for Bending. Derive an expression for bending Equation.
2. A simply supported beam, 2 m wide by 4 m high and 12 m long is subjected to a concentrated load of 2000 N at a point 3 m from one of the supports. Determine the maximum fiber stress.

2017–18 (Sem. II) (RME201)

1. What is meant by pure bending? List the assumptions made for the theory of pure bending. Also derive bending equation.

2017–18 (Sem. II) (NME202) [COP]

1. Derive the "Bending Equation" $(M/I) = (\sigma/y) = (E/R)$. What do you mean by Section Modulus?
2. What do you understand by the term neutral axis and neutral surface?
3. A steel beam of hollow square section of 80 mm outer side and 60 mm inner side is simply supported on a span of 6 meters. Fine the uniformly distributed load that the beam can carry at the middle of the span if the bending stress is not to exceed 125 N/mm^2.

2017–18 (Sem. II) (EME202) [COP]

1. Prove that in case of pure bending, the stress in any layer of the beam is directly proportional to its distance from the neutral axis.
2. Define section modulus. How it is related to moment of inertia.
3. A beam weighing 500 N is held in horizontal position by three wires. The outer wires are of brass of 1.2 mm dia. and attached to each end of the beam. The central wire is of steel of 0.6 mm diameter and attached to the middle of the beam. The beam is rigid and the wires are of the same length and unstressed before the beam is attached. Determine the stress induced in each wire. Take Young's modulus for brass as 80 GPa and for steel 200 GPa.
4. The moment of inertia of a beam section 50 cm deep is 69490 cm^4. Find the longest span over which a beam of this section, when simply supported, could carry a uniformly distributed load of 50 kN/m run. The maximum flange stress in the material is not to exceed 110 N/mm^2.
5. Prove that in case of pure bending, the neutral axis passes through the centroid of the section.
6. A circular log of timber has diameter D. It is used as a beam. Find the dimensions of the strongest rectangular section which can be cut from it.

2017–18 (Sem. II) (ME201) [COP]

1. Define Neutral axis and pure bending.
2. Derive the Bending equation and state the assumption made while deriving the bending equation.

2018–19 (Sem. I) (RME101)

1. Define neutral axis and neutral layer.
2. A simply supported rectangular beam with symmetrical section 200 mm in depth has a moment of inertia of 2.5×10^5 m^4 about its neutral axis. Determine the largest span over which the beam would carry a uniformly distributed load of 4 kN/m run such that the stress due to bending does not exceed 125 MN/m^2.

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

1. Determine the dimensions of a simply supported rectangular steel beam 6 m long to carry a brick wall 250 mm thick and 3 m high. If the brick weight is 20 kN/m^3 and the maximum stress is 800 N/cm^2. The depth of beam is 1.5 times of it's width.

2018–19 (Sem. II) (RME201)

1. Explain concept of pure bending, also define section modulus.
2. State the assumptions made in deriving bending equation. Also derive bending equation.

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

1. List the assumptions made in simple bending theory. Derive the simple bending equation.

2019–20 (Sem. I) (RME101)

1. A rectangular beam with depth 150 mm and width 100 mm is subjected to a maximum bending moment of 300 kNm. Determine
   (i) Maximum stress in the beam,
   (ii) Radius of curvature when the bending is maximum, and
   (iii) Bending stress at a distance of 40 mm from the top of the surface of the beam.

   Take modulus of elasticity of the beam material $E = 200$ GPa

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

1. List the assumptions made in simple bending theory. Derive the simple bending equation.