Code: 9A21402

1

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AEROSPACE VEHICLE STRUCTURES - I

(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 (a) Derive equations of equilibrium.
(b) Derive compatibility equations.
(c) A simply supported beam span 'I' subjected to point load 'W' at middle of the beam. Find out maximum slope and deflection.

2 (a) What do you mean by beams on elastic foundation?
(b) An aluminum alloy I-beam (depth 100 mm, Ix = 2.45 x 106 mm^4, E = 70 GPa) has a length L = 7 m and is supported by 8 springs (k = 100 N/mm) spaced at a distance I = 1.0 m centre to centre along the beam. A load P = 15 kN is applied at the centre of the beam over one of the springs. Determine the deflection of the beam under the load, the maximum bending moment and the maximum bending stress in the beam.

3 (a) Derive the Rankine's formula.
(b) A cast iron hollow cylinder 6 m long with hinged ends carries an axial load of 400 kN. The ratio of external to internal diameter is 1.25. Use factor of safety of 4. Take σ_c= 560 N/mm^2 and Rankin's constant a = 1/1600. Determine the section of cylinder.

4 (a) What is an Airy's stress function in theory of elasticity?
(b) Prove that the following are Airy's stress function and examine the stress distribution represented by them:
(i) $\phi = AX^2 + BY^2$
(ii) $\phi = AX^3$
(iii) $\phi = A(X^4 - 3X^2Y^2)$

5 Derive all stress on an oblique section of a body subjected to direct stress in two mutually perpendicular directions.

6 (a) Define and give the proof of Castigliano's first theorem.
(b) A simply supported beam length 6 mts subjected to a UDL of 3 KN/m throughout the beam. Take Young's modulus of the beam material is E and I is moment of inertia. Find the maximum deflection by using unit load method.

7 Explain Rayleigh Ritz method with suitable examples and also explain some important characteristics of Rayleigh Ritz method.

8 Explain the torsion of thin walled multi-cell structure section subjected to twisting.

*****

Code: 9A21402

2

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AEROSPACE VEHICLE STRUCTURES - I

(Aeronautical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 (a) A beam subjected to simple bending and has a uniform stress 65 N/mm^2. Find the deflection of simply supported beam at mid span. Take depth of the beam as 400 mm. $E = 2 \times 105\ N/mm^2$, span 'I' is 7000 mm.

(b) Derive equations of equilibrium and compatibility equations.

2 (a) What do you mean by beams on elastic foundation?

(b) A rail road uses steel rails (E = 200 GPa) with a depth of 184 mm. The distance of the top of the rail to its centroid 99.1 mm, and the moment of inertia of the rail is 36.9 x 106 mm^4. The rail is supported by ties, ballast and a road bed that together are assumed to act as an elastic foundation with spring constant k = 14.0 N/mm^2. Determine the maximum deflection, maximum bending moment, and maximum stress in the rail for a wheel load of 170 kN.

3 (a) What are the assumptions made in Euler's theory?

(b) What are the limitations of Euler's theory?

(c) How are the crippling load calculated for the following conditions?

(i) One end is fixed and other end is free.

(ii) Both ends are provided with frictionless hinges.

4 (a) What is an Airy's stress function in theory of elasticity?

(b) Prove that the following are Airy's stress function and examine the stress distribution represented by them:

(i) $\phi = AX^2 + BY^2$

(ii) $\phi = AX^3$

(iii) $\phi = A(X^4 - 3X^2Y^2)$

5 Principal tensile stresses at a point across two perpendicular planes are $80\ N/mm^2$ and $40\ N/mm^2$. Find the normal, tangential and resultant stress and its obliquity on a plane at 20° with the major principal plane. Find also the intensity of stress which acting alone can produce the same maximum strain. Take Poisson's ratio = 0.25. Also draw the Mohr's circle for the above values and explain construction details.

6 Define and prove Maxwell's reciprocal theorem and unit load method.

7 Explain what the important characteristics of Rayleigh Ritz method are. And explain Rayleigh Ritz method with suitable examples also.

8 Explain the torsion of thin walled multi-cell structure section subjected to twisting.

*****

Code: 9A21402

3

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AEROSPACE VEHICLE STRUCTURES - I

(Aeronautical Engineering)

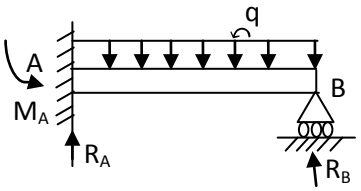
Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 A proved cantilever beam AB of length L supports a uniform load of intensity q as shown. Analyze the beam by solving the second order differential equation of the deflection curve. Determine the reactions, shear force, bending moments, slopes and deflections of the beam.



2 Derive equation for the deflection of a continuous beam under elastic foundation. Find the expressions for maximum deflection and bending moment of beam under concentrated load.

3 (a) Derive formula for a column both ends fixed and loading P.

(b) A hollow cylindrical cast iron of 150 mm external diameter and 15 mm thickness, 3 m long and is hinged at one end and fixed at other. Find

(i) The ration of Euler and Rankin load.

(ii) For what length, the critical load by Euler's and Rankin's formula will be equal. Assume E = 2.01 x 10^5.

4 Show that the Airy's stress function ϕ = A(xy^3 - ¾)xh^2 represents the stress distribution in a cantilever beam loaded at the free end with load P and the value of A if $\tau_{xy} = 0$ at y = $\pm/2$ where 'b' and 'h' are width and depth of the cantilever beam respectively.

5 What is principal planes and principal stress? Determine the principal stresses of oblique sections of a body subjected to direct stress in two mutually perpendicular direction accompanied by a simple shear stress: also find out locations of principal plains and maximum shear stress: draw neat sketches.

6 Define and prove Maxwell's reciprocal theorem and unit load method.

7 Explain what the important characteristics of Rayleigh Ritz method are. And explain Rayleigh Ritz method with suitable examples also.

8 Explain and derive the Bredt-Batho formula, explain how to find out the shear flow in single cell closed box beam. Draw the neat sketch of shear flow distribution.

*****

Code: 9A21402

4

B.Tech II Year II Semester (R09) Regular & Supplementary Examinations, April/May 2013

AEROSPACE VEHICLE STRUCTURES - I

(Aeronautical Engineering)

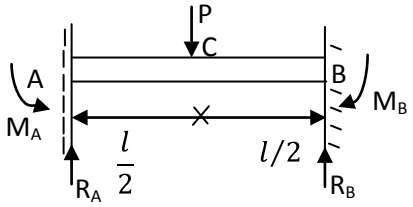
Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

*****

1 The fixed beam ACB as shown in fig. Supports a concentrated load p at the midpoint. Analyze the beam by solving the fourth order differential equation of the deflection curve. Determine the reactions, shear force, bending moments, slopes and deflections of the beam.



2 (a) What do you mean by beams on elastic foundation?

(b) A rail road uses steel rails (E = 200 GPa) with a depth of 184 mm. The distance of the top of the rail to its centroid is 99.1 mm, and the moment of inertia of the rail is $36.9 \times 106\ mm^4$. The rail is supported by ties, ballast and a road bed that together are assumed to act as an elastic foundation with spring constant k = 14.0 N/mm^2. Determine the maximum deflection, maximum bending moment, and maximum stress in the rail for a wheel load of 170 kN.

3 (a) What are the assumptions made in Euler's theory?

(b) What are the limitations of Euler's theory?

(c) How are the crippling load calculated for the following conditions?

(i) One end is fixed and other end is free.

(ii) Both ends are provided with frictionless hinges.

4 (a) Derive the deferential equations of equilibrium in 2D polar coordinates in theory of elasticity.

(b) Define the relation between stress function and stresses in 2D polar coordinate problem and verity that this choice of stress function satisfies the deferential equation of equilibrium.

5 Explain the construction of Mohr-circle in four cases, with figures.

6 (a) Define and give the proof of Castigliano's first theorem.

(b) A simply supported beam length 6 m subjected to a UDL of 3 KN/m throughout the beam. Take Young's modulus of the beam material is E and I is moment of inertia. Find the maximum deflection by using unit load method.

7 Explain what the important characteristics of Rayleigh Ritz method are. And explain Rayleigh Ritz method with suitable examples also.

8 Explain and derive the Bredt-Batho formula, explain how to find out the shear flow in single cell closed box beam. Draw the neat sketch of shear flow distribution.

*****