AEN 2105Mechanics of Materials II
Course Code:
Course Level: Level 2
Course Credit: 4 CU
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                    Teaching Assistant

Brief Course Description
This course covers the principles of deflection of beams, elastic stability, thick cylinders, rotating discs and shafts, bending of circular plates, elastic stability of simple frames and more detailed discussion of stresses and displacements due to bending and shear.

This course introduces the students to advanced concepts of applying mechanics to engineering bodies

Course Objective
To study the behavior of solid bodies under load. The way in which they react to applied forces, the deflections resulting and the stresses and strains set up within the bodies are all considered in an attempt to provide sufficient knowledge to enable any component to be designed such that it will not fail within its service life.

By the end of this course, students will be able to apply principles of mechanics of materials in the design of objects

Course Outline
   1. **Deflection of Beams(8 hrs)**

        •   Integration method

        •   Macaulay method

        •   Area-moment method

        •   Method of superposition

   2. **Built-in and continuous beams(8hrs)**

        •   Built –in beams

        •   Built –in beam with central concentrated load

        •   Built –in beam with uniformly distributed load

        •   Built –in beam with concentrated load not at centre

        •   Superposition at different levels

        •   Continuous beams- 3 moments theorem

   3. **Elastic stability: struts(8hrs)**

- Euler's theory

- Validity limit for Euler's theory

- Rankine's theory

- Strut with eccentric load

- Strut with initial curvature

- Laterally loaded struts

- Alternative method for determining bending moment

- Eccentrically and transversely loaded tie- bars

4. **Thick cylinders(6hrs)**

   - Lame's theory

   - Comparison with thin cylinder theory

   - Longitudinal and shear stresses

   - The lame's line

   - Compound cylinders

   - Solid shaft subjected to external pressure

   - Shrinkage allowance

5. **Bending and shear stresses in beams(8hrs)**

   - Pure bending

   - Second moment of area

   - Parallel axis theorem

   - Perpendicular axis theorem

   - Stress due to bending

   - Modulus of section

   - Position of neutral axis and radius of curvature

   - Composite beams

   - Combined bending and direct stresses

   - Short column with eccentric load

- Bending beyond the limit of proportionality

- Shear stress distribution

- Built-up girders

- Deflection due to shear

- Total deflection

6. **Bending of circular plates(8hrs)**

- Stresses

- Bending moments

- General equation for slope and deflection

- General case of a circular plate or diaphragm subjected to

- combined uniformly distributed load q (pressure) and central

- concentrated load F

- Uniformly loaded circular plate with edges clamped

- Uniformly loaded circular plate with edges freely supported

- Circular plate with central concentrated load F and edges clamped

- Circular plate with central concentrated load F and edges freely

- supported

- Circular plate subjected to a load F distributed round a circle

- Application to the loading of annular rings

- Stress distributions in circular plates and diaphragms subjected to

- lateral pressures

- Other loading cases of practical importance

7. **Rotating discs and shafts(8 hrs)**

- Thick spherical shells
- Rotating discs
- Collapse of rotating rings.
- Combined rotational and thermal stresses

Assessment:
- Course work: assignments, laboratories and tests (40%)
- Final university examination (60%)

References

- Stephens R.C (1988). "Strength of Materials, Theory and Examples". Edward Arnold Educational, Academic and Medical Publishing Division of Hodder and Stoughton Limited, 41 Bedford Square, London, UK.

- Gere J.M and Timoshenko S.P (1990). "Mechanics of Materials, Second SI Edition. Van Nostrand Reinhold (International) Company Limited. 11 New Fetter Lane, London EC4P4EE.

- Case .J, Chilver. L and Ross C.T.F (1999). "Strength of Materials and Structures, Fourth Edition. John Wiley & Sons Inc., 605 Third Avenue, New York, NY10158-0012.
- Hearn J.E (1999). "Mechanics of Materials 2". An introduction to the mechanics of elastic and plastic deformation of solids and structural members. Third Edition. Butterworth-Heinemann Linacre House, Jordan Hill, Oxford OX2 225 Wildwood Avenues, Woburn, MA 01801-2041.A division of Reed Educational and Professional Publishing Ltd

Other Resources

- Computer laboratory with internet connectivity
- University library
- Faculty and department book banks
- Materials laboratory
- Solid Edge and unigraphics software