

## SEMESTER 3

### MECHANICS OF AIRCRAFT MATERIALS

|                                            |                          |                    |                |
|--------------------------------------------|--------------------------|--------------------|----------------|
| <b>Course Code</b>                         | <b>PCAOT303</b>          | <b>CIE Marks</b>   | 40             |
| <b>Teaching Hours/Week<br/>(L: T:P: R)</b> | 3:1:0:0                  | <b>ESE Marks</b>   | 60             |
| <b>Credits</b>                             | 4                        | <b>Exam Hours</b>  | 2 Hrs .30 Min. |
| <b>Prerequisites (if any)</b>              | ENGINEERING<br>MECHANICS | <b>Course Type</b> | Theory         |

#### Course Objectives:

1. To understand the concepts of stress, strain, and deformation under the influence of various loads.
2. To assess the stresses and deformation in simple structural members like beams, bars and shafts.

### SYLLABUS

| <b>Module No.</b> | <b>Syllabus Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Contact Hours</b> |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>1</b>          | <b>Introduction:</b> Stress & Strain, Poisson's ratio. Stress – strain curves for mild steel in tension, aluminium alloy, hard and soft rubber, brittle material and copper in compression. Hooke's law for linearly elastic isotropic material under axial and shear deformation, Bulk modulus, biaxial and triaxial deformations. Relationship between material constant (Derivations). Stress and strain tensors and its components, Factor of safety, Margin of safety. | <b>11</b>            |
| <b>2</b>          | <b>Deformation in axially loaded bars:</b> Principle of superposition. Calculation of stresses in straight, Stepped and tapered sections, Composite sections, Stresses due to temperature change Deformation of prismatic and conical bar under its self-weight. Strain energy, resilience and toughness – for pure axial loading, prismatic and conical bar under self-weight.                                                                                             | <b>11</b>            |
| <b>3</b>          | <b>Beams:</b> Types of Loads, types of Support, types of Beams, bending couple and twisting couple (Concept Only). Determination of support reaction, Shear force and bending moments, Relationships between loads-shear force-bending moments (Derivation for all the cases). Bending moment and shear force diagrams of beams (cantilever and simply supported) subjected to                                                                                              | <b>11</b>            |

|          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|          | concentrated load, uniformly distributed loads, uniformly varying loads, couples and their combinations, Point of contra flexure, point and magnitude of maximum bending point and maximum shear force.                                                                                                                                                                                                                                                                                                           |           |
| <b>4</b> | <b>Flexural stresses:</b> Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses (rectangular, square, triangular, solid circular and hollow circular sections only). Torsion - Derivation of equation of torsion, Assumptions, application of torsional equation to solid and hollow circular shaft, torsional rigidity. Stresses on inclined planes – Principal Stresses and Principal Planes – Maximum shear stress – Mohr’s circle method. | <b>11</b> |

**Course Assessment Method**  
(CIE: 40 marks , ESE: 60 marks)

**Continuous Internal Evaluation Marks (CIE):**

| <b>Attendance</b> | <b>Assignment/<br/>Microproject</b> | <b>Internal<br/>Examination-1<br/>(Written)</b> | <b>Internal<br/>Examination- 2<br/>(Written )</b> | <b>Total</b> |
|-------------------|-------------------------------------|-------------------------------------------------|---------------------------------------------------|--------------|
| <b>5</b>          | <b>15</b>                           | <b>10</b>                                       | <b>10</b>                                         | <b>40</b>    |

**End Semester Examination Marks (ESE)**

*In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions*

| <b>Part A</b>                                                                                                                                                                                     | <b>Part B</b>                                                                                                                                                                                                                                                                                                      | <b>Total</b> |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <ul style="list-style-type: none"> <li>• 2 Questions from each module.</li> <li>• Total of 8 Questions, each carrying 3 marks</li> </ul> <p style="text-align: center;"><b>(8x3 =24marks)</b></p> | <ul style="list-style-type: none"> <li>• Each question carries 9 marks.</li> <li>• Two questions will be given from each module, out of which 1 question should be answered.</li> <li>• Each question can have a maximum of 3 sub divisions.</li> </ul> <p style="text-align: center;"><b>(4x9 = 36 marks)</b></p> | <b>60</b>    |

## Course Outcomes (COs)

At the end of the course students should be able to:

| Course Outcome |                                                                                                                                                            | Bloom's Knowledge Level (KL) |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| <b>CO1</b>     | Understand the basic principles of stress and strain, deformations, and their relationship.                                                                | <b>K2</b>                    |
| <b>CO2</b>     | Discuss the effects of axial loads on stresses, strains, and elongations in axially loaded bars and columns under different boundary conditions.           | <b>K3</b>                    |
| <b>CO3</b>     | Construct the shear force and bending moment diagrams for various members under varying loading conditions and to identify critical points in a structure. | <b>K3</b>                    |
| <b>CO4</b>     | Apply the bending and torsional concepts to find out the flexural stress on various cross sections.                                                        | <b>K3</b>                    |

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

### CO-PO Mapping Table:

|            | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|
| <b>CO1</b> | 2   | 2   | 1   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    |
| <b>CO2</b> | 3   | 3   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    |
| <b>CO3</b> | 3   | 3   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    |
| <b>CO4</b> | 3   | 3   | 2   | 1   | -   | -   | -   | -   | -   | -    | -    | 2    |

| Text Books |                                                           |                               |                                |                                |
|------------|-----------------------------------------------------------|-------------------------------|--------------------------------|--------------------------------|
| Sl. No     | Title of the Book                                         | Name of the Author/s          | Name of the Publisher          | Edition and Year               |
| <b>1</b>   | Mechanics of Materials                                    | James Gere & Barry Goodno.    | Thomson-Engineering            | 9 <sup>th</sup> Edition, 2022. |
| <b>2</b>   | Strength of Materials                                     | S. Ramamrutham & R. Narayanan | Dhanpat Rai Publishing Company | 20 <sup>th</sup> Edition, 2020 |
| <b>3</b>   | A Textbook of Strength of Materials - Mechanics of Solids | Bansal R. K.                  | Laxmi Publications             | 6 <sup>th</sup> Edition, 2022  |
| <b>4</b>   | Mechanics of Materials                                    | James Gere & Barry Goodno.    | Thomson-Engineering            | 9 <sup>th</sup> Edition, 2022. |

| Reference Books |                                  |                      |                                |                                |
|-----------------|----------------------------------|----------------------|--------------------------------|--------------------------------|
| Sl. No          | Title of the Book                | Name of the Author/s | Name of the Publisher          | Edition and Year               |
| 1               | Strength of Materials            | S. S. Rattan         | 2e McGraw Hill Education India | 2011                           |
| 2               | Aircraft Materials and Processes | Titterton.G          | Pitman Publishing Company      | 5 <sup>th</sup> Edition, 1995  |
| 3               | Strength of Materials            | R. Subramanian       | Oxford University              | 3 <sup>rd</sup> Edition, 2016. |

| Video Links (NPTEL, SWAYAM...) |                                                                                                                                                    |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| Module No.                     | Link ID                                                                                                                                            |
| 1                              | <a href="https://youtu.be/jyLIqUvwdtY">https://youtu.be/jyLIqUvwdtY</a><br><a href="https://youtu.be/Q1ON3aYVgPc">https://youtu.be/Q1ON3aYVgPc</a> |
| 2                              | <a href="https://youtu.be/HP3N7IVjfz0">https://youtu.be/HP3N7IVjfz0</a>                                                                            |
| 3                              | <a href="https://youtu.be/mgQU04-ilCA">https://youtu.be/mgQU04-ilCA</a>                                                                            |
| 4                              | <a href="https://youtu.be/5gRCClIP2IA">https://youtu.be/5gRCClIP2IA</a>                                                                            |