UNIVERSITY OF TWENTE

Faculty of Engineering Technology
Minor Aircraft Engineering

Aircraft Structures (202000157)

Final Exam – January 2021

Available Time: Two hours

Permitted Materials: Calculator, Formula Sheet

Generic guidelines:

1. The front page lists the materials you can use during this exam. Any other materials are not allowed. This includes mobile devices.
2. When asked, elaborate your answers by providing the equations used or listing the assumptions made.
3. Please write clearly. I am an engineer not an archaeologist.

NB. This is an individual exam. Good luck!

Question 1 [15/100 points] The two dimensional stress state at a particular point in a structure equals $\sigma_x = 350$ MPa, $\sigma_y = 225$ MPa and $\tau_{xy} = 100$ MPa.

1. [10 points] Calculate the principal stresses and the orientation of the corresponding principal planes.

Answer

The principal stresses are: $\sigma_I = 405$ MPa and $\sigma_{II} = 170$ MPa, while the principal planes are oriented at $\theta = 0.51 \pm \pi/2$ or $\theta = 29° \pm 90°$.

As a reminder, the equations for the principal stresses are:

$$\sigma_{I,II} = \frac{\sigma_x + \sigma_y}{2} \pm \frac{1}{2}\sqrt{(\sigma_x - \sigma_y)^2 + 4\tau_{xy}^2},$$

while the principal planes can be found using:

$$\tan 2\theta = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}.$$

Points: Award 3 points for the correct equation for the principal stresses, 3 points for the correct equation for the principal planes and 2 points for each correct answer.

2. [5 points] What is the magnitude of the shear stress acting on the principal planes?

Answer

The shear stress on the principal planes equals 0 MPa.

Points: 5 points for the correct answer, otherwise 0.

Question 2 [15/100 points] The turbine blades in modern jet engines are subjected to intense heat and extreme loads...

End of Examination