1. A particular aircraft has the data given below. Plot a ‘trim’ curve (i.e. of) for an equivalent air speed (EAS) range of 80m/s to 220m/s, at a weight of 400kN.

State giving reasons; whether or not this aircraft is statically stable (stick fixed).

Data: Main plane area  =100

Wing lift slope,  =4.5 *per radian*

Mean chord  = 4.1 *m*

Tail plane area  = 30

Tail lift curve slope,  = 3.5 *per radian*

Elevator effectiveness,  = 2.0 *per radian*

Tail arm,  =8.0*m*

Downwash at zero lift,  =0.0

Tail setting angle,  =-3.0 degrees

 =-0.02

 =0.10

Assume that the aircraft pitching moment about the centre of gravity is given by:

 7marks

Solution

Data: Main plane area  =100

Wing lift slope, =4.5 *per radian*

Mean chord  = 4.1 *m*

Tail plane area = 30

Tail lift curve slope, = 3.5 *per radian*

Elevator effectiveness,  = 2.0 *per radian*

Tail arm,  =8.0*m*

Downwash at zero lift,  =0.0

Tail setting angle,  =-0.0524 radians

 =-0.02

 =0.10

At trim

Varying velocity from 80m/s to 220m/s

|  |  |  |
| --- | --- | --- |
|  |  |  |
| 80 | -0.0125 | -0.72 |
| 94 | 0.011518 | 0.66 |
| 108 | 0.02682 | 1.54 |
| 122 | 0.03726 | 2.13 |
| 136 | 0.0445 | 2.55 |
| 150 | 0.04984 | 2.86 |
| 164 | 0.05389 | 3.09 |
| 178 | 0.057022 | 3.27 |
| 192 | 0.0595 | 3.41 |
| 206 | 0.06148 | 3.52 |
| 220 | 0.06309 | 3.62 |

2 (a) The pitching moment of an aircraft is given by the equation:



Where is in degrees.

Using the data given below, plot a trim curve (i.e. elevator angle to trim against EAS) for this aircraft for an EAS range from stalling up to 200m/s. Take sufficient intermediate points to define the curve clearly. 10marks

(b) Sketch the way in which the curve would be progressively modified as the CG is moved rearwards until it reaches the neutral point. 5marks

Additional data:

Aircraft weight W=150 kN

Wing area S=37 

=1.25

W= 150

S=37 m

=1.25

Taken sea level conditions, assume straight and level flight





V=72.75m/s



In trim 



But 







 1

|  |  |
| --- | --- |
|  |  |
| 72.75 | -4.06 |
| 86.89 | -1.88 |
| 101.03 | -0.55 |
| 115.17 | 0.32 |
| 129.31 | 0.92 |
| 143.45 | 1.35 |
| 157.59 | 1.67 |
| 171.73 | 1.92 |
| 185.87 | 2.11 |
| 200 | 2.26 |

Substitute the EAS into equation 1.

At V=72.75





From the range of stalling velocity to 200m/s

1. Consider the number of points you intend to plot, deduct the lower limit from the upper limit and divide the difference with the number of points. Add the answer to lower limits to generate the subsequent velocities.

