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Mechanical Engineering
ENG 382

A plate (Plat) of mass m falling freely in air with velocity (v) is subject to a downward gravitational force, F_D is given by eqn (1)

$$F_D = \frac{0.3v^2}{500 + (1nv)^3} - 0.02v \quad \text{---(1)}$$

and the terminal velocity is reached when the drag force equals the gravitational force, that is, $F_D = Mg$ --- (2) taking the values of m and g to be 3.5kg and $9.8 m/s^2$ respectively, using a guess value of $V_0 = 0.5 m/s$ & employing, fixed-point iteration method, develop a MATLAB Program to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal to $1E-1$

Soln

$$F_D = \frac{0.3v^2}{500 + (1nv)^3} - 0.02v \quad \text{---(1)}$$

$F_D = Mg = 3.5 \times 9.8 = 34.3$ ------ (2)

evaluating eqn 1 & 2

$$mg = 34.3 = \frac{0.3v^2}{500 + (1nv)^3} - 0.02v$$

Make v^2 subject of formula

$$34.3 + 0.02v = \frac{0.3v^2}{500 + (1nv)^3}$$

$$0.3v^2 = (34.3 + 0.02v) * (500 + (1nv)^3)$$

$$V^2 = [(34.3 + 0.02v) * (300 + (1nv)^3]/0.3$$

$$V = \sqrt{[(34.3 + 0.02v) \times [500 + (1nv)^3]/0.3}$$

Initial guess value $\Rightarrow V_0 = 0.5 m/s$

Absolute % relative error, $\varepsilon_a(T+1) \leq 1E$

MATLAB

1)- Command window

2 - Clear

3 - Clc

4 - Close all

5 - format short g

6 - Syms V

7 - v = 0.5

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8 - for i = 1 : inf
9 -   iter (i+1) = i;
10 -  V(i+1) = [(34.3 + (0.02 * V(i)) * (500 + (log (V(i)))] ^ 3) / 0.3^0.5
11 -  Ea(i+1) = abs ((V(i+1) - V(i)) / V(i+1)) * 100;
12 -    if Ea (i+1) <= 1E--11
13 -      break
14 -    end
15 -  end
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table = [iter' v' Ea']

The estimated terminal velocity is 204.07 m/s.

Substituting in eqn (1) F_D = 34.3.