AWANBA CHIBUIKEM

16/ENG06/012

EIE 382

ASSIGNMENT I

① A plate (flat) of mass m falling freely in air with velocity v is subjected to a downward gravitational force and an upward frictional drag force due to air. If the drag force, F_D is given by equ (1)

$$F_D = \frac{0.3v^2}{500 + (1.1v)^3} - 0.02v \quad -(1)$$

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 9.8m/s² respectively; Using a guess value of $v_0 = 0.5$m/s and employing fixed-point iteration method, develop a MATLAB program to estimate the terminal velocity. Take the absolute percentage relative tolerance to be less than or equal to $1E-11$

Soln

$$F_D = \frac{0.3v^2}{500 + (1.1v)^3} - 0.02v \quad -(1)$$

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

Equating ① and ②

$$mg = 34.3 = \frac{0.3v^2}{500 + (1.1v)^3} - 0.02v$$

making v^2 subject of formular

$$34.3 + 0.02v = \frac{0.3v^2}{500 + (1.1v)^3}$$

$$0.3v^2 = (34.3 + 0.02v) * (500 + (1.1v)^3)$$

$$v^2 = (34.3 + 0.02v) * (500 + (1.1v)^3) / 0.3$$

$$v = \sqrt{(34.3 + 0.02v) * (500 + (1.1v)^3) / 0.3}$$

Initial guess value $\Rightarrow v_0 = 0.5$m/s

Absolute % relative error, $\varepsilon_a(i+1) \leq 1E-11$

MATLAB ASSIGNMENT I

```
1- Command Window
2- Clear
3- Cls
4- Close all
5- format shortg
6- syms v
7- v = 0.5
8- for i = 1:int
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
```

table = [iter' v' Ea']

The estimated terminal velocity is 304.07mb,

Substituting in eqn(1) $\bar{t}_0 = 34.3$,