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ELECT/ELECT, ENG 382: engineering maths IV 17/ENG04/027

ECE

Assignment I

1) A flat plate 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 eqn. (1)

$$f_D = \frac{0.3V^2}{500 + (\ln V)^3} - 0.02V$$

And the Terminal velocity is reached when the drag force equals the gravitational force, That is,

$$f_D = mg$$

Taking the values of m and g to be 3.5 kg and 9.8 m/s² respectively, using a guess value of $V_0 = 0.5$ m/s, and employing fixed-point iteration method develop a MATLAB program without using "function" command to estimate the terminal velocity. Take the absolute percentage relative error tolerance to be less than or equal to 1E-11

Soln

```
Commandwindow
  Clear
  Clc
  format long
  V=0.5;
  m=3.5;
  a=9.8;
  F=m*a;
V = Sqrt((CCF+0.02*V))*(log(V)^3)+(10*V)+17150)/0.3);
for i=1:20
  iter(i+1)=i
V(i+1) = Sqrt((((Cf+(0.02*V(i)))*(log(V(i)))^3+(10*V(i))+17150)/0.3);
error(i+1) = abs((((V(i+1)-V(i))/V(i+1))*100);
  if error(i+1) <= 1E-11, break, end
  end
  V'
  iter'
  Error'
  table(iter' V' error')
```

from the above matlab program, the terminal velocity (output) converges at $V = 304.067\,v$

$\Rightarrow$ To check $F_D = mg$ (verify our ans)

recall $F_D = \frac{0.3v^2}{500 + (\ln v)^3} - 0.02v$

$$f_D = \frac{0.3(304.067)^2}{500 + (\ln(304.067))^3} - 0.02(304.067)$$

$f_D = 34.299 \simeq 34.3$

$F_D = mg$

$f_D = 9.8 \times 3.5$

$f_D = 34.3$ ✓ES