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Assignment #1 : chapter 1 & 4

Question 1 :

a) $F_U = -c'v$ @ rest $v=0$ $t=0$

$F_D = mg$

$$\frac{dv}{dt} = \frac{F}{m} = \frac{F_D + F_U}{m}$$

$$\frac{dv}{dt} = g - \frac{c'}{m}v$$

$v = v_H + v_P$

$$\frac{dv}{dt} + \frac{c'}{m}v = 0$$

$$0 + \frac{c'}{m}D = g \qquad v_P = D = \frac{mg}{c'}$$

$$\lambda + \frac{c'}{m} = 0 \qquad \lambda = -\frac{c'}{m}$$

$$v_H = Ce^{-\frac{c'}{m}t}$$

$$v(t) = Ce^{-\frac{c'}{m}t} + \frac{mg}{c'}$$

Inital velocity $v(0)$:

$$0 = C + \frac{mg}{c'} \Rightarrow C = -\frac{mg}{c'}$$

$$v(t) = -\frac{mg}{c'}e^{-\frac{c'}{m}t} + \frac{mg}{c'}$$

$$= \frac{mg}{c'}\left(1 - e^{-\frac{c'}{m}t}\right)$$

$\therefore$ IV is the best one.

b) I have attached an m. file with the submission on blackboard; it has a chart/plot of the solutions

Assignment#1 cont'd

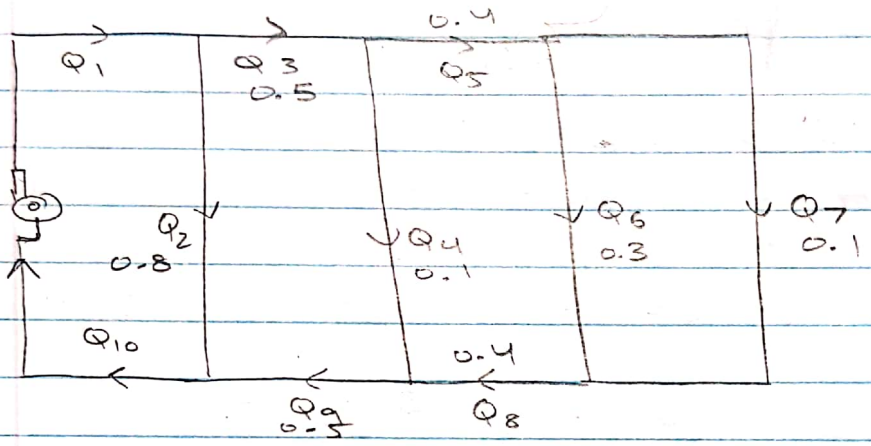
Question 2

$Q_2 = 0.8 \frac{m^3}{s}$

$Q_3 = 0.5 \frac{m^3}{s}$

$Q_7 = 0.1 \frac{m^3}{s}$

$Q_8 = 0.4 \frac{m^3}{s}$



$Q_1 = 0.8 + 0.5 = 1.3 \frac{m^3}{s}$

$Q_6 = 0.4 - 0.1 = 0.3 \frac{m^3}{s}$

$Q_5 = 0.3 + 0.1 = 0.4 \frac{m^3}{s}$

$Q_4 = 0.5 - 0.4 = 0.1 \frac{m^3}{s}$

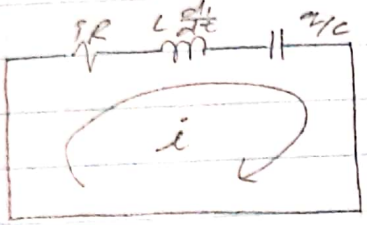
$Q_9 = 0.1 + 0.4 = 0.5 \ m^3/s$

$Q_{10} = 0.8 + 0.5 = 1.3 \ m^3/s$

Assignment 1 cont'd

Question 3

$$iR + L\frac{di}{dt} + \frac{q}{C} = 0 \qquad \frac{dq}{dt} = i$$



$t = 0.01\,s$ to $0.10\,s$

$\Delta t = 0.01\,s$

$$\left.\begin{aligned} &\frac{dq}{dt} = i \\ &iR + L\frac{di}{dt} + \frac{q}{C} = 0 \end{aligned}\right\} \text{D.E.}$$

$$\frac{q_{new} - q_{old}}{\Delta t} = i_{new}$$ Euler's

$$\Rightarrow q_{new} - i_{new}\Delta t = q_{old} \qquad q_{new} = q_{old} + i_{new}\Delta t$$

$$i_{new}R + L\frac{i_{new} - i_{old}}{\Delta t} + \frac{q_{new}}{C} = 0$$

$$i_{new}R(\Delta t C) + LC(i_{new} - i_{old}) + q_{new}\Delta t = 0$$

$$i_{new}(RC\Delta t + LC) + q_{new}\Delta t = LCi_{old}$$

$R = 200\,\Omega \quad L = 5\,H \quad C = 10^{-4}\,F$

$i(0) = 0 \quad q(0) = 1\,C$

$t: 0 \to 0.01$

$$i_{new}(200(10^{-4})(0.01s) + (5)(10^{-4})) + (1 + i_{new}(0.01)) = 0$$

$$i_{new}(0.0002 + 0.0005) + (1 + 0.01 i_{new})0.01 = 0$$

$$0.0008\, i_{new} = -0.01 \qquad q_{new} = (1 + 0.01(-12.5)) = -1.125$$

$$i_{new} = -12.5000$$

$t: 0.01 \to 0.02$

$$i_{new}(0.0007) + (-1.125 + i_{new}(0.01))(0.01) = 0.0005(-12.5) = -1.34375$$

$$0.0008\, i_{new} = -0.0175 \Rightarrow i_{new} = -21.875 \qquad q_{new} = (-1.125 + 21.875(0.01))$$

$t: 0.02 \to 0.03$

$$i_{new}(0.0007) + (-1.34375 + i_{new}(0.01))(0.01) = 0.0005(-21.875)$$

$$= (-1.34375 + 3.125(0.01))$$

$$0.0008\, i_{new} = 0.0025 \Rightarrow i_{new} = 3.125 \qquad q_{new} = -1.3125$$

$t: 0.03 \to 0.04$

$$0.0008\, i_{new} = 0.01468875 \Rightarrow i_{new} = 18.359375 \qquad q_{new} = -1.1289$$

$$= (-1.3125 + 18.359375(0.01))$$

$t: 0.04 \to 0.05$

$$0.0008\, i_{new} = 0.02046687 \Rightarrow i_{new} = 25.58585938 \qquad q_{new} = -0.87804$$

$t: 0.05 \to 0.06$

$$0.0008\, i_{new} = 0.02009629 \Rightarrow i_{new} = 25.1211621 \qquad q_{new} = -0.621825$$

$t: 0.06 \to 0.07$

$$0.0008\, i_{new} = 0.01877864 \Rightarrow i_{new} = 23.47358105 \qquad q_{new} = -0.38709289$$

$t: 0.07 \to 0.08$

$$0.0008\, i_{new} = 0.01560712 \Rightarrow i_{new} = 19.50964053 \qquad q_{new} = -0.191995\,7$$

$t: 0.08 \to 0.09$

$$0.0008\, i_{new} = 0.01167477 \Rightarrow i_{new} = 14.59347158 \qquad q_{new} = -0.0460608$$

$t: 0.09 \to 0.1$

$$0.0008\, i_{new} = 0.00775734 \Rightarrow i_{new} = 9.696682\,04 \qquad q_{new} = 0.50905836$$

Question 3 cont'd

time (s)	i_{new}	q_{new}
0.01 - 0.02	-21.8750	-1.3438
0.02 - 0.03	3.1250	-1.3125
0.03 - 0.04	18.3593	-1.1289
0.04 - 0.05	25.5859	-0.8730
0.05 - 0.06	25.1212	-0.6218
0.06 - 0.07	23.4736	-0.3871
0.07 - 0.08	19.5096	-0.1920
0.08 - 0.09	14.5935	-0.0461
0.09 - 0.1	9.6967	-0.5091

Question 4

a) $(1001110)_2$

$2^1 + 2^2 + 2^3 + 2^6 = (78)_{10}$

b) $(110.11100)_2$

$2^{-3} + 2^{-2} + 2^{-1} + 2^1 + 2^2 = (6.87500)_{10}$

c) $(66243)_8$

$(3 \times 8^0) + (4 \times 8^1) + (2 \times 8^2) + (6 \times 8^3) + (6 \times 8^4)$

$= 3 + 32 + 128 + 3072 + 24576$

$= (27811)_{10}$

d) $(3.26)_8$

$= (3 \times 8^0) + (2 \times 8^{-1}) + (6 \times 8^{-2})$

$= 3.34375$