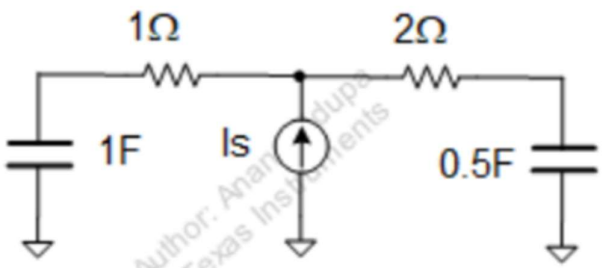
TI BYTE Simulation Exercise

Week 1 : RC Circuits

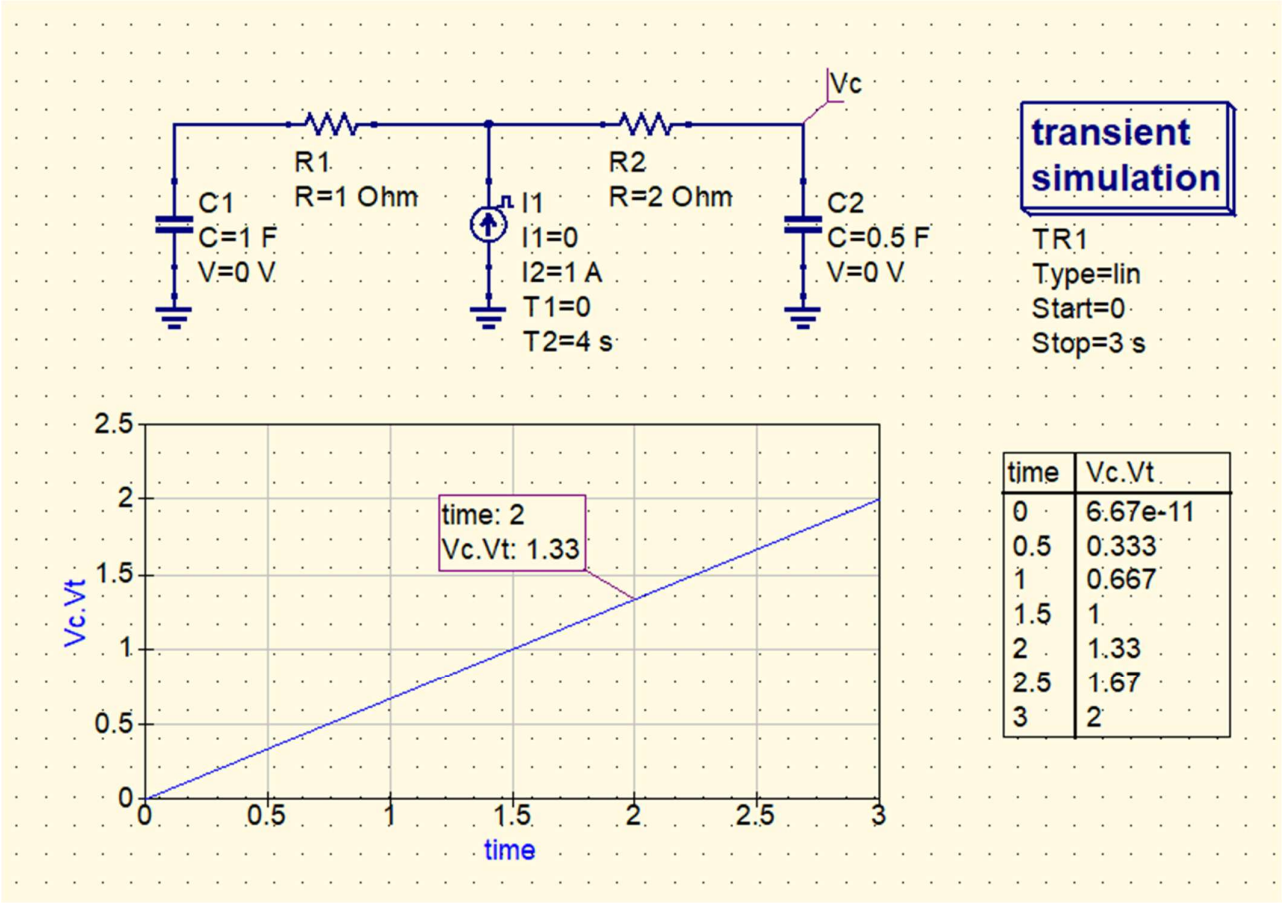
- **Question 1:**

507. Is=1.u(t). Voltage across 0.5F cap at t=2sec is:

(a) 1V
(b) 4V
(c) 0V
(d) 1.33V
(e) 2.66V
(f) 2V
(g) 0.5V
(h) 0.67V



➢ **QUCS Circuit:**



time	Vc.Vt
0	6.67e-11
0.5	0.333
1	0.667
1.5	1
2	1.33
2.5	1.67
3	2

- **V_c is used to label the node and find the voltage at that node.**
- **Both the capacitors are initially uncharged, and are charged using a 1A current source.**

➢ QUCS Result:

Therefore, from the simulation, we get our answer as:

V_c = 1.33V

Answer: (d)

➢ Conclusion:

- **The impedance of the right-half of the circuit is twice as compared to the left half.**
- **Thus, the current gets divided in the ratio 2:1 through the 2Ω resistor and 0.5F capacitor.**
- **At t = 2s, total charge delivered to the 0.5F capacitor is**

$$Q = \frac{1}{3} \times 2s = \frac{2}{3} C$$

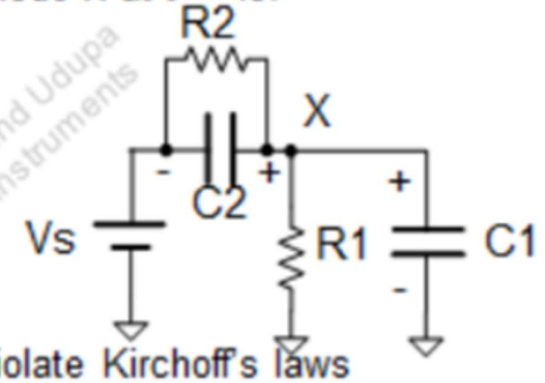
- **At t = 2s, voltage across the 0.5F capacitor is**

$$V = \frac{Q}{C} = \frac{2/3}{0.5} = 1.33\ V$$

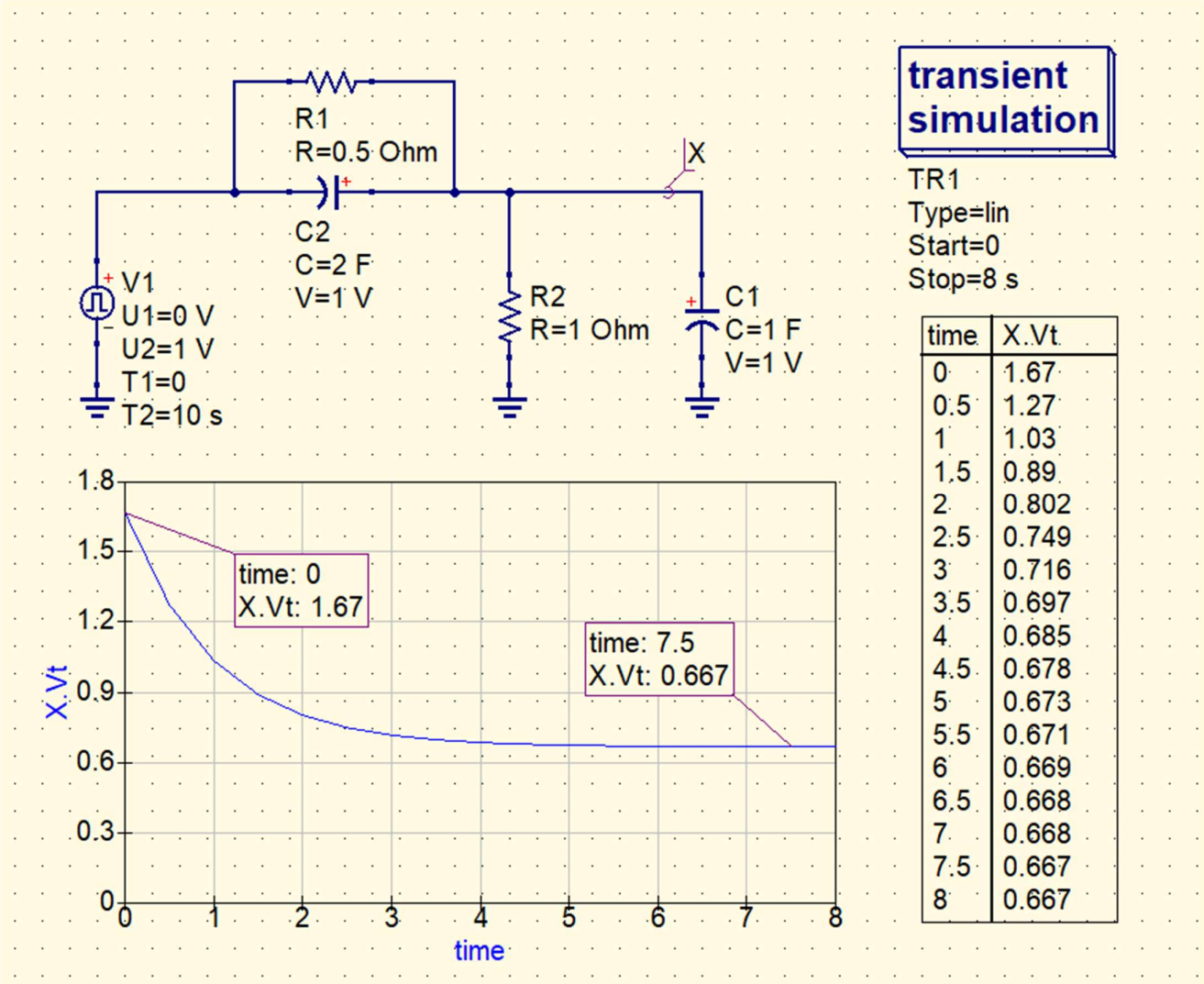
- **Question 2:**

511. C1=1F, C2=2F, R1=1Ω, R2=0.5Ω. At t=0-, charge across C1 is 1C, charge across C2 is 2C. Vs=1.u(t). Voltage at node X at t=∞ is:

(a) 0.33V
(b) 0.66V
(c) 1V
(d) 0V
(e) 0.5V
(f) 0.25V
(g) 0.75V
(h) Initial conditions violate Kirchoff's laws



- **QUCS Circuit:**



time	X.Vt
0	1.67
0.5	1.27
1	1.03
1.5	0.89
2	0.802
2.5	0.749
3	0.716
3.5	0.697
4	0.685
4.5	0.678
5	0.673
5.5	0.671
6	0.669
6.5	0.668
7	0.668
7.5	0.667
8	0.667

- **The node X is used to find out the resulting voltage at that node.**
- **Both the capacitors C1 and C2 are charged to 1V each.**

➢ QUCS Result:

Therefore, from the simulation, we get our answer as:

V_x = 0.667V

Answer: (b)

➢ Conclusion:

- **When the Vs = 1.u(t) V is given, the capacitors initially share charges.**
- **Thus, at t = 0, the voltage across C1 = 1.667 V,**

  and, voltage across C2 = 0.667 V.
- **Now the R_{eq} and C_{eq} of the circuit is,**

$$R_{eq} = R_1 \,||\, R_2 = {}^{1}/_{3}\ \Omega$$

$$C_{eq} = C_1 + C_2 = 3\ F$$

- **Thus, the time constant of the circuit,**

$$\tau = R_{eq} \times C_{eq} = 1\ s$$

- **When the circuit reaches a stable state, the capacitors act as open circuit.**
- **The final voltage at X =** $\frac{R_1}{R_1 + R_2} = \frac{1}{1.5} = 0.667$ **V**