Q1. Multiple choice questions [10 marks]

(1) D
(2) C
(3) B
(4) E

Q2.

(a) 3 essential nodes

(b) 2, 3/4, 5/6/7/8

(c) 4 meshes

(d) one supernode 2 and 3/4

(e) Using supernode concept at Nodes 2 and 3, we have:

$$\frac{V_2-5}{R_1}+\frac{V_2}{R_2}+\frac{V_2-V_3}{R_3}+\frac{V_3}{R_4}+\frac{V_3-V_2}{R_3}-10mA=0$$

KVL in loop 23762: $V_3-V_2=14500i_x=14500\frac{V_2}{R_2}$

Write above two equations in standard form:

$\frac{V_2-5}{5k}+\frac{V_2}{1k}+\frac{V_3}{10k}=10mA \rightarrow 12V_2+V_3=110$

$$V_3-V_2=14500i_x=14500\frac{V_2}{R_2}\rightarrow 15.5V_2-V_3=0$$

Or:

Without using supernode concept, we can write two KCLs at Node 2 and 3.

At Node 2: $\frac{V_2-5}{R_1}+\frac{V_2}{R_2}+\frac{V_2-V_3}{R_3}+i=0$

At Node 3: $-i+\frac{V_3}{R_4}+\frac{V_3-V_2}{R_3}-10mA=0$

Note: *i* is the current flow through dependent source.

KVL in loop 23762: $V_3-V_2=14500i_x=14500\frac{V_2}{R_2}$

Above three equations lead to two standard form equations:

$$\frac{V_2-5}{5k}+\frac{V_2}{1k}+\frac{V_3}{10k}=10mA\rightarrow 12V_2+V_3=110$$

$$V_3-V_2=14500i_x=14500\frac{V_2}{R_2}\rightarrow 15.5V_2-V_3=0$$

(f) i_x=4mA

Q3.

(1) Equivalent capacitance: 0.12μF

(2) Time constant: 1.2ms

(3) Voltage between nodes a and b

$$\mathrm{V(t)}=10e^{-\frac{5t\times10^3}{6}}\mathrm{V}$$

(4)

$$\mathrm{P}=4e^{-\frac{5t\times10^3}{3}}\mathrm{mW}$$