University : *Menoufia* *Faculty* : *Electronic Engineering* *Department* : *Electronics&Communications* *Academic level* : *4* *Course Name* : *Elective course 6 : Numerical Techniques in Electromagnetics* *Course Code* : *ECE 426*		*Date* : *2/06/2019* *Time* : *3 Hours* *No. of pages* : *1* *Full Mark* : *70 Marks* *Exam* : *Final Exam* *Examiner* : *Prof. Adel Abdel Masieh Saeeb*

Question No 1 : **Choose the right answer** **(18 Marks)**

1. To model a dielectric medium, a/an.............. stub is used. (a) short circuited (b) open circuited (c) matched (d) none of the above
2. To model a dielectric medium, a stub of length .... Is used. (a) Δl (b) $\Delta l/2$ (c) $2\Delta l$ (d) $\Delta l/4$
3. To model a lossy medium, a .... stub is used. (a) short circuited (b) open circuited (c) matched (d) none of the above
4. To model a lossy medium with σ=3, a stub with characteristic admittance.......is used. (a) $\sigma \Delta l Z_o$ (b) $\sigma \Delta l Z_o/2$ (c) $2 \sigma \Delta l Z_o$ (d) $\sigma \Delta l Z_o/4$
5. To model a dielectric medium with ε_r=4, a stub with characteristic admittance..... is used. (a) 10 (b) 11 (c) 12 (d) 13
6. The phasor form is : $A_s = -j\, e^{-j3z}$, the corresponding time varying form is : (a) cos (wt – 3z+π/2) (b) cos (-π/2 -3z+wt) (c) sin(π/2 – 3z + wt) (d) sin(wt – 3z).
7. The time varying form is : 3 sin (wt + 3x), the corresponding phasor form is : (a) $3\, e^{j(3x-\pi/2)}$ (b) $3\, e^{-j(3x-\pi/2)}$ (c) $3\, e^{-j3x}$ (d) $3\, e^{+j3x}$
8. The equation $\frac{\partial^2\psi}{\partial x^2} = k\frac{\partial^2\psi}{\partial t^2}$ is (a) Poisson's equation (b) Wave equation (c) Diffusion equation (d) Laplace
9. The fields E_z , H_y , and H_x are (a) TE wrt Y-axis (b) TE wrt Z-axis (c) TM wrt Z-axis (d) TM wrt X-axis

Question No 2: Choose the right answer **(16Marks)**

1. When voltages ${}_kV_1^i = {}_kV_2^i = {}_kV_3^i = {}_kV_4^i = E_o/2$ are applied to a node (m,n) , an ...... is imposed (a) electric field with magnitude E_o in y-direction (b) electric field with magnitude $2E_o$ in y-direction (c) electric field with magnitude $E_o/2$ in y-direction (d) electric field with magnitude $2E_o$ in z-direction
2. To impose magnetic field $H_x = H_o$ at node (m,n), apply .... (a) ${}_kV_4^i = -{}_kV_2^i = H_o/2$ (b) ${}_kV_3^i = -{}_kV_1^i = H_o/2$ (c) ${}_kV_4^i = {}_kV_1^i = H_o$ (d) ${}_kV_4^i = {}_kV_2^i = H_o$
3. An impulse ${}_kV_1^r(z,x)$ reflected from terminal 1 of a node becomes automatically incident at the node .... (a) ${}_{k+1}V_3^i(z, x-\Delta l)$ (b) ${}_kV_3^i(z, x-\Delta l)$ (c) ${}_kV_3^i(z-\Delta l, x)$ (d) ${}_kV_3^i(z+\Delta l, x)$

4. To impose magnetic field $H_z = H_o$ at node (m,n), apply ....
   (a) ${}_{K}V_3^i = {}_{K}V_1^i = H_o/2$ (b) ${}_{K}V_3^i = -{}_{K}V_1^i = H_o/2$ (c) ${}_{K}V_4^i = {}_{K}V_1^i = H_o$
   (d) ${}_{K}V_4^i = {}_{K}V_2^i = H_o$
5. When terminal 4 of node (m,n) is terminated with a perfect electric conductor, the following condition applies : (a) ${}_{K}V_4^i(m,n) = {}_{K}V_4^r(m,n)$ (b) ${}_{K}V_4^i(m,n) = -{}_{K}V_4^r(m,n)$
   (c) ${}_{K+1}V_4^i(m,n) = -{}_{K}V_4^r(m,n)$ (d) ${}_{K+1}V_4^i(m,n) = {}_{K}V_4^r(m,n)$
6. An impulse $V_2^r(z,x)$ reflected from terminal 2 of a node becomes automatically incident at the node .... (a) ${}_{K}V_2^i(z,x)$ (b) ${}_{K}V_4^i(z-\Delta l,x)$
   (c) ${}_{K+1}V_4^i(z-\Delta l,x)$ (d) ${}_{K}V_4^i(z+\Delta l,x)$
7. An impulse $V_3^r(z,x)$ reflected from terminal 3 of a node becomes automatically incident at the node .... (a) ${}_{K}V_2^i(z,x)$ (b) ${}_{K}V_1^i(z,x-\Delta l)$
   (c) ${}_{K}V_1^i(z,x+\Delta l)$ (d) ${}_{K+1}V_1^i(z,x+\Delta l)$
8. An impulse $V_4^r(z,x)$ reflected from terminal 4 of a node becomes automatically incident at the node .... (a) ${}_{K}V_2^i(z-\Delta l,x)$ (b) ${}_{K+1}V_2^i(z+\Delta l,x)$
   (c) ${}_{K}V_1^i(z,x)$ (d) ${}_{K}V_2^i(z+\Delta l,x)$

Question No 3 : (18 Marks)

The dispersion of velocity of waves in a two-dimensional TLM network is given by :

$$\sin[(\pi/r)(\Delta l/\lambda)] = (2)^{1/2}\sin(\pi\,\Delta l/\lambda)$$

(a) Find the maximum value for $(\Delta l/\lambda)$ (b) Find the corresponding value for r.
(c) Draw r vs. $(\Delta l/\lambda)$

Question No 4 : (18Marks)

(a) For the one-dimensional TLM section shown find $(\partial I_z/\partial z)$ and $(\partial V_y/\partial z)$.
(b) For a propagating EM wave with components E_y and H_x use Maxwell's equations to find $(\partial E_y/\partial z)$ and $(\partial H_x/\partial z)$.
(c) From results of (a) and (b) find equivalences between network and field quantities.