Unit 13 - Week 10

Course outline

Assignment 10

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2019-10-09, 23:59 IST.

Instructions:
The objective of these questions is to assess your understanding of this week's content. You are not expected to memorize any of the questions, rather, you should derive the answers from first principles based on what you have learnt so far

1) A perfectly matched layer (PML) implemented in FDTD simulation with adiabatic loss. To minimize the width of PML layer, the loss as a function of layer width varies as *1 point*

- Constant
- Linear
- Non-linear
- All of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
Non-linear

2) After coordinate stretching with gradient operators ∇_e and ∇_h in a PML with electric field $E_x = e^{jk_z z}$, $h_z = 2$ and $e_z = 3$, the value of magnetic field H_y is given by *1 point*

- $(-k_z/3)e^{jk_z z}/\omega\mu$
- $(-k_z/2)e^{jk_z z}/\omega\mu$
- $(-2k_z/3)e^{jk_z z}/\omega\mu$
- $(-3_z/2)e^{jk_z z}/\omega\mu$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$(-k_z/3)e^{jk_z z}/\omega\mu$

3) For generating evanescent waves for a matched medium in PML, the conditions to be satisfied is *1 point*

- $e_x = h_x, e_y = h_y, e_z = h_z$ with real e_z
- $e_x = e_y, h_x = h_y, e_z = h_z$ with real e_z
- $e_x = h_x, e_y = h_y, e_z = h_z$ with complex e_z
- $e_x = e_y, h_x = h_y, e_z = h_z$ with complex e_z

No, the answer is incorrect.
Score: 0
Accepted Answers:
$e_x = h_x, e_y = h_y, e_z = h_z$ *with complex* e_z

4) For a wave traveling in TM polarization, with medium 1 ($z < 0$) being air and medium 2 ($z > 0$) with permittivity 3, the tangential boundary conditions (with coordinate stretching parameters h_{1z}, h_{2z} and propagation constants k_{1z}, k_{2z}) gives the value of reflection coefficient at the interface as *1 point*

- $R = (3k_{1z}h_{2z} - k_{2z}h_{1z})/(3k_{1z}h_{2z} + k_{2z}h_{1z})$
- $R = (k_{1z}h_{2z} - 3k_{2z}h_{1z})/(k_{1z}h_{2z} + 3k_{2z}h_{1z})$
- $R = (3k_{1z}h_{2z} + k_{2z}h_{1z})/(3k_{1z}h_{2z} - k_{2z}h_{1z})$
- $R = (k_{1z}h_{2z} + k_{2z}h_{1z})/(k_{1z}h_{2z} - 3k_{2z}h_{1z})$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$R = (3k_{1z}h_{2z} - k_{2z}h_{1z})/(3k_{1z}h_{2z} + k_{2z}h_{1z})$

5) What are the values of coordinate strectching factors s_x, s_y and s_z required for generating PML in a 2D computational domain ? *1 point*

- $s_x = 0.5, s_y = 0.5, s_z = 1 + j\sigma/\omega\epsilon_0$
- $s_x = 1, s_y = 1, s_z = 1 - j\sigma/\omega\epsilon_0$
- $s_x = 0.5, s_y = 0.5, s_z = 1 + \sigma/\omega\epsilon_0$
- $s_x = 1, s_y = 1, s_z = 1 - \sigma/\omega\epsilon_0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$s_x = 1, s_y = 1, s_z = 1 - j\sigma/\omega\epsilon_0$

6) PML can be interpreted as *1 point*

- an absorbing material which is isotropic
- an absorbing material which is anisotropic
- a lossless material which is isotropic
- a lossless material which is anisotropic

No, the answer is incorrect.
Score: 0
Accepted Answers:
an absorbing material which is anisotropic

7) Consider a bandlimited current source, i.e. $J(f) = 0 \quad \forall |f| > f_0$. How should one choose Δt in a FDTD simulation with this source? *1 point*

- $\Delta t \geq \frac{1}{f_0}$
- $\Delta t \geq \frac{1}{2f_0}$
- $\Delta t \leq \frac{1}{f_0}$
- $\Delta t \leq \frac{1}{2f_0}$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\Delta t \leq \frac{1}{2f_0}$

8) For volume current excitation, we need to know the current $\vec{J}$ at __________ time instances and __________. *1 point*

- half integer, E-field locations
- integer, E-field locations
- half integer, H-field locations
- integer, H-field locations

No, the answer is incorrect.
Score: 0
Accepted Answers:
half integer, E-field locations

9) What is the first order absorbing boundary condition to minimize numerical reflection for a wave traveling at an angle of 60^o with the normal at the right most boundary of the computational domain? *1 point*

- $\partial E/\partial x + 1/c\partial E/\partial t = 0$
- $\partial E/\partial x + \sqrt{3}/2c\partial E/\partial t = 0$
- $\partial E/\partial x - 1/c\partial E/\partial t = 0$
- $\partial E/\partial x + 1/2c\partial E/\partial t = 0$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$\partial E/\partial x + 1/2c\partial E/\partial t = 0$

10) What are the limitations of the absorbing boundary condition which are overcome in PML? *1 point*

- It nullifies reflection only in finite number of directions
- It can't be used with lossy media
- Both A and B
- None of the above

No, the answer is incorrect.
Score: 0
Accepted Answers:
Both A and B