Electromagnetics

2021 Homework 4

Deadline: 2021/4/20　10:15am

说明：
全用英文作答；
每题要对所有小问作答，要给出全部必要的推导过程，计算题要算出最终的数值结果，比如开根号之类的；
所有计算出来的结果如果是有单位的物理量，一定要写明单位；
每题的分数在括号中给出；
可以互相讨论，也可以上网查，但是不能抄袭，也不能找别人代做；
所有的解答必须全部是手写的原件，不接受扫描件与照片；
有问题请给老师或助教发邮件；

Textbook: Fundamentals of Applied Electromagnetics, 7th edition

Part I. Problems in textbook.

7.18 (20 points)
7.22 (10 points)
7.24 (20 points)
7.27 (20 points)
7.35(a) (10 points)
7.35(c) (10 points)
7.40(a) (10 points)
7.40(b) (10 points)
7.42 (20 points)

PART II. Homemade.

1. (20 points) The time-domain magnetic flux density in free space is given by $\vec{B} = \hat{x}B_x \cos(2y)\sin(\omega t - \pi z) + \hat{y}B_y \cos(2x)\sin(\omega t - \pi z)$, where B_x and B_y are constants. Assuming no conduction current exists, determine the electric displacement current density.

2. (50 points) If a material has conductivity of 0.4 S/m at 5 GHz and wavelength in it is 2 cm, calculate its complex permittivity and loss tangent. Assuming the material is non-magnetic ($\mu = \mu_0$), calculate the phase velocity and wave impedance. How big is the phase difference between the electric field and magnetic field of a plane wave propagating in this material? Is this material a good conductor at 5 GHz? Calculate its complex propagation constant. How many percentage of the electric field intensity is lost after a plane wave propagates 5 cm in this material?