Electromagnetics

Deadline: 2022/11/4　8:15am

说明：
全用英文作答，中文作答不给分；
每道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，否则要扣分；
如果是矢量，一定要在字母上面加箭头；
如果相位的计算结果是比较特殊的数（比如π，π/6 之类的），可以用弧度表示，如果是很奇怪的数，就用度°表示，不要再换算成弧度；
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；
所有的解答可以是手写的原件，或者平板电脑上写的手写版的打印件，因疫情等原因无法返校的同学可以提交电子版；
所有教材上的题号都是英文原版第七版的，不要用中文翻译版第六版的题号；
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.

7.7 (20 points)
7.8 (20 points)
7.10 (30 points)
7.11 (10 points)
7.13 (10 points)
7.15 (10 points)
7.16 (10 points)
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)
7.41(a) (10 points)
7.41(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 percentages of the electric field intensity is lost after a plane wave propagates 5 cm in this material?

3. (40 points) For an infinitely large surface with uniform negative charge of ρ_s that resides on the *xoy* plane in free space, derive the corresponding electric fields in both the $z > 0$ and $z < 0$ regions by the **integration method**.

4. (40 points) For a steady surface current density $\hat{y}J_s$ on an infinitely large sheet residing in the *xoy* plane, obtain the magnetic field intensity generated by this source in both the $z > 0$ and $z < 0$ regions by the **integration method**.