Electromagnetics Spring

2020 Homework 1

Deadline: 3.12 24:00 pm

说明:
全用英文作答;
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;
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.

1.4 (20 points)
1.5 (10 points)
1.7 (20 points)
1.8 (20 points)
1.11 (10 points)
1.15 (10 points)
1.26 (20 points)
1.27 (20 points)
1.28 (20 points)

Part II.Problems in quiz.

1. (**6 points**)
(a) (**2 points**) Write out the symbols and units of permittivity and permeability.
(b) (**2 points**) Write out the units of electric field intensity and magnetic field intensity.
(c) (**2 points**) Write out the relationship between electric field intensity and electric flux density, and the relationship between magnetic field intensity and magnetic flux density.

2. (**6 points**)
(a) (**2 points**) Write out the expression of the magnitude (no direction is needed) of the electric force between two charges $+q_1$ and $+q_2$ separated by R in free space. Need to give the unit.
(b) (**2 points**) Write out the expression of the magnitude of the electric field due to a charge $+q_1$ in free space evaluated at a distance *R* from the charge. Need to give the unit.
(c) (**2 points**) Is the magnitude of the electric field due to a charge $+q_1$ in free space greater than, equal to or smaller than that due to the same charge in a dielectric material? Please also explain the reason.

3. (**10 points**) The magnitude of the electric field intensity of a sinusoidal electromagnetic wave can be expressed as $E = A\cos(Bt - Cx + D)$.

(a) (**1 point**) Write out the relationship between B and the period T.

(b) (**1 point**) Write out the relationship between C ($C > 0$) and the wavelength λ.

(c) (**1 point**) If $C < 0$, which direction is the wave travelling in?

(d) (**2 points**) Express the phase velocity in terms of λ and T. Also express the phase velocity in terms of B and C ($C > 0$).

(e) (**2 points**) What is D usually called? If two waves have the same A, B, C, but $D_1 > D_2 > 0$, which wave has phase leading that of the other?

(f) (**2 points**) If this electromagnetic wave is travelling in a lossy medium with attenuation factor of α, write out the new expression of the electric field intensity. Use $C > 0$.

(g) (**1 point**) If the expression of the electric field intensity of a travelling wave has a factor of e^{3z}, which direction is the wave travelling in?

4. (**4 points**)

(a) **(2 points)** If a voltage in time domain has the form of $v(t) = A\,sin\,(\omega t + \phi)$, write out its phasor form V.

(b) **(2 points)** Write out the phasor forms of $dv(t)/dt$ and $\int v(t)dt$.