

國立清華大學 100 學年度碩士班入學考試試題

系所班組別：生醫工程與環境科學系 甲組(分子生醫光電組)

考試科目(代碼) 電磁學(2501) 共 1 頁第 1 頁 \*請在【答案卷】作答

1. (10%) Does  $A \times B = A \times C$  imply  $B = C$ ? Explain.
2. (10%) What are the three universal constants in the electromagnetics?
3. (10%) Sketch the electric field lines of an electric dipole and the magnetic flux lines of a magnetic dipole respectively.
4. (10%) An infinitely long, straight, solid, nonmagnetic conductor with a circular cross section of radius  $b$  carries a steady current  $I$ . Determine the magnetic flux density both inside and outside the conductor.
5. (10%) In a time-varying situation how do we define a good conductor? A lossy dielectric?
6. (10%) Two orthogonal linearly polarized waves are combined. State the conditions under which the resultant will be
  - a) another linearly polarized wave (3%)
  - b) a circularly polarized wave (3%)
  - c) an elliptically polarized wave. (4%)
7. (10%) A spaceship in lunar orbit (the Earth-Moon distance is  $\sim 380$  Mm) transmits plane waves with an antenna operating at 1 GHz and radiating a total power of 1 MW isotropically. Find
  - a) the time-average power density on the earth's surface (3%)
  - b) the peak electric field on the earth's surface (4%)
  - c) the time it takes for these waves to travel from the spaceship to the earth. (3%)Hint: the intrinsic impedance  $\eta_0 = 377 (\Omega)$
8. (10%). Explain why a single-conductor waveguide can not support TEM waves.
9. (10%) Assume that the standard for personal safety in a microwave environment is that the power density be less than  $10 \text{ mW/cm}^2$ . A cell-phone boost station emits EM-wave at 1.8 GHz with 300 V/m in amplitude of electric field intensity. Determine whether the boost station is allowed to be used under the standard or not. You have to show your calculation. If the station stands on the top of a 5-floor building and you are living in 4<sup>th</sup> floor of that building, estimate your exposure.
10. (10%) A quarter-wave transformer is used to match a  $75 \Omega$  transmission line with a  $120 \Omega$  load. Find the characteristic impedance of the quarter-wave transformer.