

國立清華大學 101 學年度碩士班考試入學試題

系所班組別：生醫工程與環境科學系 甲組（分子生醫工程組）

考試科目（代碼）：電磁學(2201)

共 2 頁，第 1 頁 *請在【答案卷、卡】作答

1. (10%) A 10 mm collimated laser beam passing through the back aperture of 8 mm diameter of an objective with 0.9 numerical aperture ($NA=0.9$) is focused onto a 2 micro-meter spot. Assuming a silica bead of diameter 2 micro-meter is just in the focal point. Will the bead be pushed off or trapped by the laser beam? Explain in details.
2. (10%) Write the symbol, value, and unit, respectively, of the three universal constants in the electromagnetics, and what are their relations?
3. (10%) A light wave is traveling in glass of index 1.50. If the electric field intensity of the wave is known to be 100 V/m, find
 - a) the magnetic flux density B , and
 - b) the average power density
4. (10%) Assume that a very long copper tube with an outer radius 3 cm and inner radius 2 cm surrounds a line charge of 60 pC/m at its axis. Find
 - a) E at $r = 1$ m, 2.5 cm, and 1.5 cm; and
 - b) the potential difference between the inner and outer tube surface.
5. (10%) Consider the case of a positive point charge Q located at a distance d above a large grounded, zero potential, conducting plane. Find the potential at above the conducting plane.
6. (10%) A d-c voltage of 24 V applied to the ends of 100 m conducting wire of 1.0 mm radius results in a current of 1 A. Find
 - a) the conductivity of the wire,
 - b) the electric field intensity in the wire,
 - c) the power dissipated in the wire,
 - d) the electron drift velocity, assuming electron mobility in the wire to be $1.4 \times 10^{-3} (\text{m}^2/\text{V}\cdot\text{s})$.

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共 7 頁，第 2 頁 *請在【答案卷、卡】作答

7. (10%) Describe the principle of operation of d-c motor.
8. (10%) Einstein's theory of relativity stipulates that the work required to assemble a charge is stored as energy in the mass and is equal to mc^2 , where m is the mass and $c = 3 \times 10^8$ (m/s) is the velocity of light. Assuming the electron to be a perfect sphere, find its radius from its charge and mass (9.1×10^{-31} kg).
9. (10%) Compare transmission lines and ordinary electric networks. Also make a comparison between electrical cables of transmission and fiber-optic cables of transmission in the field of communications.
10. (10%) There is a continuing discussion on radiation hazards to human health. The U. S. standard for personal safety in a microwave environment is to be less than 10 (mW/cm²) for the power density. A cell-phone boost-station radiates energy at a rate of 50 kW. Calculate the corresponding standard in terms of electric and magnetic field intensities, respectively. Determine if the residents, who are living in a house located 50 meters away from the boost-station, receiving over exposure or not.