國立中山大學 106 學年度碩士暨碩士專班招生考試試題

科目名稱：電磁學【光電所碩士班】　　題號：435002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）　　共 1 頁第 1 頁

1. An electromagnetic wave $\vec{E}_1$ is incident at the interface of two mediums with permittivities ε_1 and ε_2, as shown in Fig. 1. The angle of the incident wave in medium 1 is θ_1. Please find the direction and magnitude of the refractive wave $\vec{E}_2$. Consider now if $\varepsilon_2 = \varepsilon_{2r} + i\,\varepsilon_{2i}$, what will happen to $\vec{E}_2$? (15%)
2. Please draw the equipotentials and electric field lines of two oppositely charged (+Q, -q) spheres with a separation distance d. (10%)
3. Please find the potential distribution in the space between the conductors of a very long coaxial cable, as shown in Fig. 2. The inner conductor has a radius a and is kept at a constant potential V_o. The outer conductor has an inner radius b and in grounded. (10%)
4. Consider the charge distribution of a metal-oxide-semiconductor system under a specific bias condition, as shown in Fig. 3. Q_t is the total positive charge at the metal-oxide interface, Q_n is negative charge due to accumulation of electron at the oxide-semiconductor interface, and Q_d is the depletion charge caused by the field at the metal. Q_n can be considered as a two dimensional electron gas. Please draw the electric field and potential distribution of this system for $x > 0$. (15%)

Fig. 1

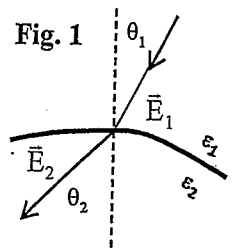


Fig. 2

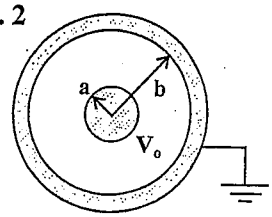
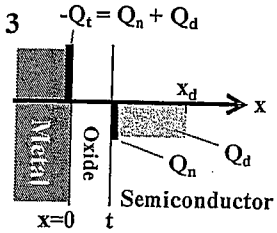


Fig. 3



5. Consider now a metal bar which is sliding with a constant velocity $\upsilon\,\hat{a}_x$ over a pair of metal rails in a uniform magnetic field $B\,\hat{a}_z$, as shown in Fig. 4. Please determine the open circuit voltage between terminals 1 and 2. If now frictions take place at both the metal rails causing the metal bar to deaccelerate with a constant acceleration velocity $-a\,\hat{a}_x$. Please find the open circuit voltage as a function of time. (15%)
6. Please find the magnetic field at point P beside a section of cable (from x = a to b) carrying a current I, as shown in Fig. 5. (10%)

Fig. 4

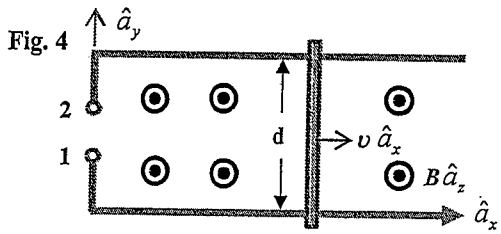
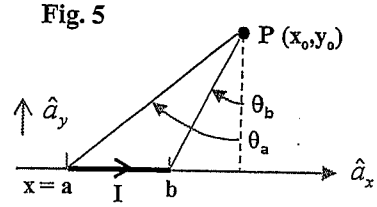


Fig. 5



7. A 5 GHz plane wave travels in free space with an electric field $E_x = 10$ V/cm. Please find the phase velocity, wavelength, and propagation constant. What is its magnetic field intensity? $\varepsilon_o = 8.854\times10^{-12}$ F/m and $\mu_o = 4\pi\times10^{-7}$ H/m. (10%)
8. Please find the potential distribution and electric field in the space above the conducting plane of infinite extent. Note that a point charge Q is positioned at a distance h above the conducting plane. Please also draw equipotentials and electric field lines above the conducting plane. (15%)