II. Questions (50%):

1. An EM field oscillated at 1 GHz is excited in a lossy medium. The amplitude of the field is 100 V/m. The resistivity of the medium is 1000 Ωm. Please find the power dissipated per unit volume in the medium (6%).
2. For a rectangular waveguide having sides a and b, please draw the surface current of TE_{10} mode on the guide walls (8%).
3. Please define the magnetic susceptibility and relative permeability (5%).
4. The attenuation of a 50 Ω distortionless transmission line is 0.0002 dB/cm. The line has a capacitance of 50 μF. Please find the velocity of wave propagation(6%).
5. Please plot the E-plane and H-plane radiation pattern of a Hertzian dipole (6%).
6. Dry air, glass, mineral oil, water (resistivity ~ 100 kΩ/cm) and Mica, please choose the two materials from above list with the highest dielectric strength (8%).
7. A battery can deliver 1A of current for 100 hours. How much transfer of charges does this correspond to (5%)?
8. Please draw the electrical field lines of an electric dipole and magnetic flux line of a magnetic dipole (6%).

I. Problems (50%) :

1. In Fig. 1, an TE polarized EM wave is propagating from medium 1 toward medium 2. The indices of the mediums are n_1 and n_2, respectively. If the incident angle θ_i is larger than the critical angle, please find the energy of the wave propagating along the x and z directions. Use Poynting theorem to verify your answers (20%).

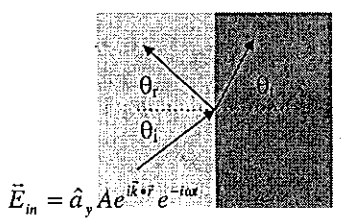


Fig. 1

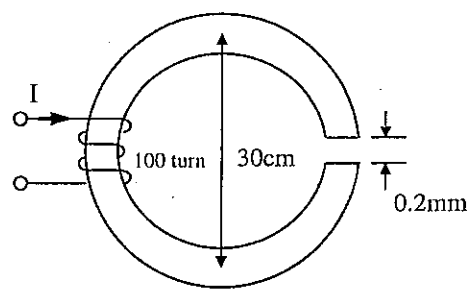


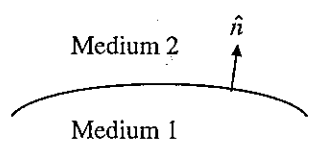
Fig. 2

2. As shown in Fig. 2, a coil of 100 turns is wound around an iron ring ($\mu_r = 4000$). The diameter and cross section of the ring are 30 cm and 16 cm^2, respectively. The ring contains an 0.2 mm wide air gap. If the gap is small enough so that the fringing effects in the air gap can be ignored, please calculate the force acting between the pole pieces of the ring when I = 1A (15%).

3. As shown in Fig. 3, S is the surface which bounds medium 1 from medium 2. Please shown that the conservation of charge requires that

$$-\frac{\partial \rho_s}{\partial t} = (\vec{J}_2 - \vec{J}_1)\bullet\hat{n} + \nabla\bullet\vec{K}$$

Where $\vec{J}_{1,2}$ are the volume current density, $\vec{K}$ is the surface current density, ρ_s is the surface charge density and $\hat{n}$ is the unit normal vector pointing from medium 1 to medium 2 (15%).



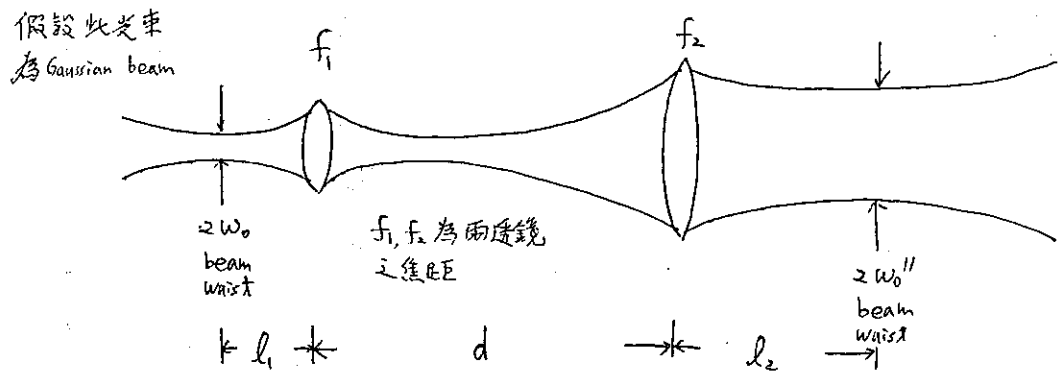
（橫書式）

國立中山大學八十七學年度碩博士班招生考試試題

科　目：光學

光電工程研究所　共 1 頁 第 1 頁

一、考慮如下圖之光束放大器（beam expander），若 $d = f_1 + f_2$，試計算其 beam size 的放大率（$\frac{w_0''}{w_0}$）。（20分）



二、試說明何謂光波片（wave retarder），及其工作原理。（20分）

三、以 1mW 之雷射穿過二個理想之線極化器（linear polarizer），其 transmission angle 分別為 0° 及 60°，試問輸出功率為何？若在此二線極化器中間加入第三個線極化器，其 transmission angle 為 30°，則輸出功率為何？［假設三個線極化器均對雷射之波長有鍍上抗反射膜（anti-reflection coating）］（20分）

四、試畫一簡要之4階雷射之能階圖，並說明其工作原理。（20分）

五、對 homogeneously broaded 的連續光雷射，其輸出之中心波長是由 frequency pulling effect 決定，試解釋何謂 frequency pulling effect.（20分）

1. Explain the following terms:
   (a) Zeeman effect. (10%)
   (b) Wien's law. (10%)

2. Consider an electron with energy E coming from left of the potential barrier

   $V(x) = V_0, x \geq 0$

   $V(x) = 0, x < 0$

   Find the probability for the electron to transmit through the barrier.
   (a) $E > V_0$. (10%)
   (b) $E < V_0$. (10%)

3. The kinetic energy of a particle is equal to n times of its rest mass energy. Find the particle's speed and momentum. (20%)

4. A particle of mass m moves one-directionally to the right of a hard wall at x = 0 in a potential V(x), where

   $V(x) = -B$, $0 < x < b$, $B > 0$;

   $V(x) = 0$, $x > b$.

   For fixed b, there is a minimum value of B below which there are no bound states. Find this minimum, B_{min}. (20%)

5. For particle statistics, there are three distribution functions: Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac distributions.
   (a) What are the particle properties of each distribution? For each distribution, give an example of the particles. (10%)
   (b) Write down the three distribution functions. (10%)

(橫書式) 國立中山大學八十七學年度碩博士班招生考試試題

科 目：電子學 光電工程研究所 共 1 頁 第 1 頁

一. 簡答題 (共40分)

1. 何謂 common-mode rejection ratio (CMRR)？ (10分)

2. 何謂 sequential digital circuit？ (10分)

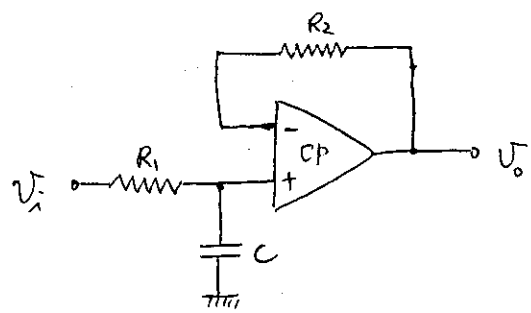
3. 何謂 multiplexer 及 demultiplexer？ (10分)

4. 為何 CMOS 電路比 pMOS 或 nMOS 電路省電？ (10分)

二. 計算及問答題 (共60分)

1. 考慮如下圖之 OP 放大器電路，試求出其 transfer function ($\frac{V_o}{V_i}$)，並大略繪出其頻率響應，此電路有何作用？ (20分)

[假設 OP 為理想之 op 放大器]



2. 对一depletion type 之 MOSFET，在固定 V_{GS} 的情況下，繪出 i_D 與 V_{DS} 之關係，並解釋此曲線。[少用算式，多用文字或圖形以說明原理] (20分)

3. 考慮如下圖之電路，i_I 為定電流源，Q_1, Q_2 為相同特性之電晶体，其小信號增益為 β，試計算 i_o 與 i_I 之關係，此電路有何作用？ (20分)