

# 國立中正大學

## 111 學年度碩士班招生考試

# 試題

[第 2 節]

|      |               |
|------|---------------|
| 科目名稱 | 電磁學           |
| 系所組別 | 機械工程學系光機電整合工程 |

### —作答注意事項—

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

國立中正大學 111 學年度碩士班招生考試試題

科目名稱：電磁學

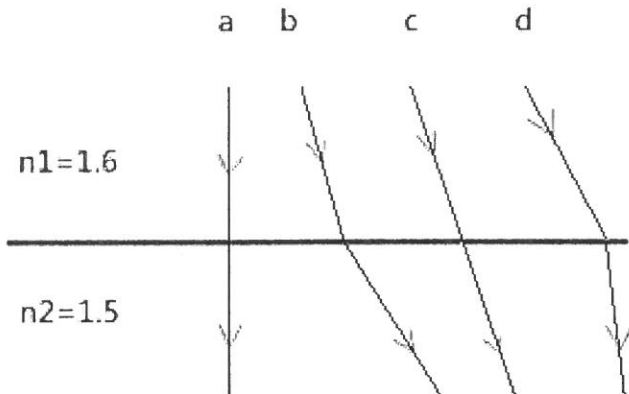
本科目共 2 頁 第 1 頁

系所組別：機械工程學系光機電整合工程

1. (10%) How many photons per second are emitted from a 100 W yellow lightbulb (average wavelength,  $\lambda = 550 \text{ nm}$ ) if 2.5% of the applied energy is emitted as light? (10%)

(a)  $0.69 \times 10^{18}$ , (b)  $6.9 \times 10^{18}$ , (c)  $0.59 \times 10^{18}$ , (d)  $5.9 \times 10^{18} \text{ photons s}^{-1}$ .

2. (10%) Which of the following is a possible path followed by a ray of light incident from  $n_1$  into  $n_2$ ? (10%)



- (a) a only
- (b) b only
- (c) a and b only
- (d) a, b and d only
- (e) d only

3. (10%) Write the formula of total internal reflection and how to find the angle of total internal reflection (5%), then write down the conditions for total reflection (5%).

4. (20%) A ray of light incident in water strikes the surface (assumed flat) separating water from air making an angle of  $10^\circ$  with the normal to the surface. (refractive index of air = 1 and refractive index of water = 1.3)

- (a) What is the angle of refraction? (8%)
- (b) What should be the angle of incidence if we want an angle of refraction not greater than  $45^\circ$ ? (8%)
- (c) What is the critical angle? (4%)

5. (25%) The following set of electromagnetic fields satisfies the Maxwell's equation in free space. and

$$\begin{cases} \vec{E} = \hat{x}E_0 e^{-ikz+i\omega t} \\ \vec{H} = \hat{y}H_0 e^{-ikz+i\omega t} \end{cases}$$

- (a) Express  $H_0$  in terms of  $E_0$ . (5%)
- (b) Do the fields in this problem represent a uniform plane wave? (5%)
- (c) In what direction does the wave travel? (5%)
- (d) Find the velocity of the wave. (5%)
- (e) Find the time-average Poynting vector  $\langle \vec{s} \rangle$ . (5%)
6. (10%) A plane e.m. wave is given as  $\vec{E} = \vec{E}_0 e^{-j\vec{k}\cdot\vec{r}+j\omega t}$ , which is propagating from medium 1 ( $\epsilon_1, \mu_1$ ) across a plane interface at  $z = 0$  into medium 2 ( $\epsilon_2, \mu_2$ )
- (a) Write down the proper boundary conditions. (5%)
- (b) Derive the law of reflection. (5%)
7. (15%) Consider the distributed parameters R, L, G, C of a two-conductor transmission line.
- (a) What are the (MKSA) units for R, L, G and C? (5%)
- (b) What are the physical effects characterized by R and G, respectively? (5%)
- (c) What is the reason that we do not use two-conductor lines in the microwave range? (5%)