國立中山大學109學年度
碩士暨碩士專班招生考試試題

科目名稱：電磁學【電波聯合碩士班】

—作答注意事項—

考試時間：100分鐘

- **考試開始鈴響前不得翻閱試題，並不得書寫、劃記、作答。**請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- **答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示**，可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。
- 答案卡請以2B鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- **試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學109學年度碩士暨碩士專班招生考試試題

科目名稱：電磁學【電波聯合碩士班】　　題號：482004

※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）　　

1. (25%) A partially filled parallel-plate capacitor with the area of the plates S and the permittivity of the dielectric ϵ is shown in Fig. 1. A constant voltage V_0 is applied to this capacitor. Please determine the force on the upper plate.

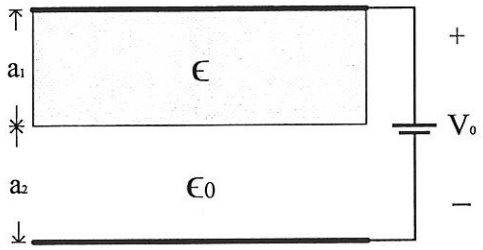

Fig. 1

2. (25%) The square and rectangular loops with parallel sides are shown in Fig. 2. The two loops are coplanar. Assume that $h >> a$ and $a > d$. Please determine the mutual inductance between these two loops.

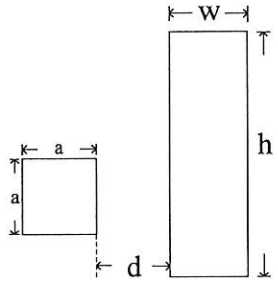

Fig. 2

3. (15%) The electric field intensity of a uniform plane wave in air is given as $\mathbf{E}_i = 100\sin(\omega t - \beta z)\mathbf{a}_x + 200\cos(\omega t - \beta z)\mathbf{a}_y$ V/m, where $\omega = 90\times10^6$ rad/s. If it strikes normally at a conducting medium ($\varepsilon_r = 81$, $\mu_r = 1$, $\sigma = 0.4$ S/m), write cosine-based phasor expressions for the incident, reflected, and transmitted fields. Show the average power density in each medium at the interface.

4. (10%) A 100 MHz generator with $V_g = 10$ V and internal resistance 50 Ω is connected to a lossless 50 Ω transmission line that is 3.6 meter long and terminated in a 25 + j*25 Ω load. Find (a) $V(z)$ at a location z from the generator, (b) V_i at the input terminal and V_L at the load, (c) voltage standing-wave ratio and the average power delivered to the load.

5. (5%) As shown in Fig. 3 with $Z_1 = \sqrt{Z_0 Z_L}$ and $l = \pi/4$, please explain how the quarter-wave transformer works to achieve impedance matching between Z_0 at Z_L, that is, $Z_{in}(\omega_0) = Z_0$ and $|\Gamma_{in}(\omega_0)| = 0$.

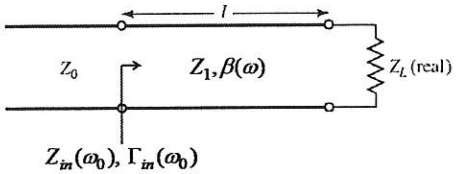

Fig. 3

6. Introduce
(10%) The differential form, integral form, and physical law of Maxwell's equations in time domain.
(5%) EM boundary conditions when medium 1 is a dielectric and medium 2 is a perfect conductor.
(5%) The wave impedance in propagating modes.