所別：電機工程學系碩士班 電波組(一般生)　科目：電磁學　共 ／ 頁 第 ／ 頁

1. The electric- and magnetic- field intensities of the radiation field from an antenna placed at the origin are given in spherical coordinates by

$$\mathbf{E} = E_0 \frac{\cos\theta}{r} \sin\omega(t - r\sqrt{\mu_0\varepsilon_0})\mathbf{a}_\theta \ \text{V/m}$$

$$\mathbf{H} = \frac{E_0}{\sqrt{\mu_0/\varepsilon_0}} \frac{\cos\theta}{r} \sin\omega(t - r\sqrt{\mu_0\varepsilon_0})\mathbf{a}_\phi \ \text{A/m}$$

Find: (a) the polarization of the wave radiated from the antenna (3%); (b) the phase velocity of the wave (2%); (c) the instantaneous power radiated by the antenna by evaluating the surface integral of the instantaneous Poynting vector over a spherical surface of radius r centered at the antenna and enclosing the antenna (10%); and (d) the time-average power radiated by the antenna. (10%)

2. (a) State the boundary conditions on the surface of a perfect conductor. (5%) (b) Why are low-frequency waves more suitable than high-frequency waves for communication with underwater objects? (5%) (c) State the differences between the conduction current and polarization current. (5%) (d)Are static electric and magnetic fields interdependent? Explain. (5%) (e) State two different ways in which an emf is induced around a loop. (5%)

3. A load of $\lambda_g/8$ short stub (Z_0 = 50 Ω) is connected to a 50-Ω transmission line. Determine the following: (a) Γ_L (5%), (b) Z_{in} at 0.25 λ_g away from the load (5%), (c) Y_L (3 %), (d) the VSWR (5%), (e) d_{max} and d_{min} (5%), and (f) is it possible to match this load to a 50-Ω system using lossless network? Why? (2%).

4. Standard air-filled waveguides have been designed for the microwave and millimeter-wave bands. One type, designated WR-05, is suitable for G-band applications. Its dimensions are a = 1300 μm and b = 648 μm. If it is desired that a WR-05 waveguide operates only in the dominant mode and that the operating frequency must be at least 25% above the cutoff frequency of the dominant mode and no higher than 95% of the next higher cutoff frequency, find the allowable operating-frequency range. (15%) Can we use the WR-05 air-filled waveguide for dc transmission? Why? (4 %) If a section of the WR-05 air-filled waveguide with a length of 1000 μm is adopted for a rectangular cavity resonator of a Gunn source, determine the resonant frequency for the dominant mode. (6 %)