

本試題卷共九大題，每題配分標明於題號後，合計 100 分

1. (15%)
 - (a) Find the potential V in space for an electric dipole consisting of charges $+q$ and $-q$ with a small separation d .
 - (b) Find the electric field lines equation.
 - (c) Draw the equipotential and electric field lines of an electric dipole.

2. (15%) As shown in Fig. 1, an emf V is applied across a parallel-plate capacitor of area S . The space between the conducting plates is filled with two different lossy dielectrics of thicknesses d_1 and d_2 , permittivities ϵ_1 and ϵ_2 , and conductivities σ_1 and σ_2 , respectively. Determine
 - (a) the current density J between the plates;
 - (b) the electric field intensities E in both dielectrics;
 - (c) the surface charge densities ρ_s on the plates and ρ_{si} at the interface.

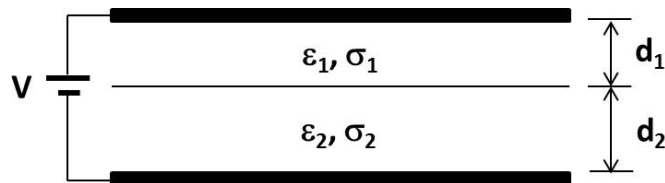


Fig. 1

3. (10 %) In what manner must the permittivity (ϵ) and electric field (E) vary in an inhomogeneous charge free space so that Laplace's equation continues to hold?

4. (10 %) Write the differential form and integral form of Maxwell's equations.

5. (10%) A sinusoidal voltage generator with $V_g = 1\angle 0^\circ$ (V) and internal impedance $Z_g = R_0$ is connected to a lossless transmission line with a characteristic impedance $R_0 = 50 \Omega$. The line is l meters long and is terminated in a load resistance $R_L = 25 \Omega$. Find
 - (a) the voltage V_L at the load and the current I_L flowing through the load;
 - (b) the average power delivered to the load.

6. (10%) Find the magnetic flux density at a distant point of a small circular loop of radius b that carries current I . Hint: use the spherical coordinate system.
7. (10%) A lossless transmission line of electrical length $l = 0.3 \lambda$ is terminated with a complex load impedance as shown in Fig. 2. Find the reflection coefficient at the load, the VSWR on the line, and the input impedance to the line.

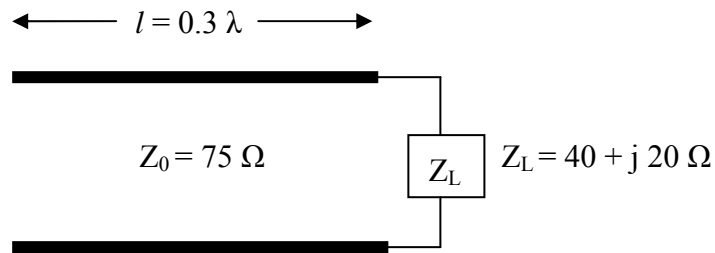


Fig. 2

8. (10%) A parallel-plate waveguide made of two perfectly conducting infinite planes spaced 3 (cm) apart in air operates at a frequency 10 (GHz). Find the maximum time-average power that can be propagated per unit width of the guide without a voltage breakdown for the TEM mode.
9. (10%) The space between a parallel-plate capacitor of area S is filled with a dielectric whose permittivity varies linearly from ϵ_1 at $y = 0$ to ϵ_2 at $y = d$. Neglecting the fringing effect, find the capacitance.