1. A conducting material of uniform thickness $h$ and conductivity $\sigma$ has the shape of a quarter of a flat circular washer, with inner radius $a$ and outer radius $b$, as illustrated in Fig. 1. Determine the resistance between the end faces. (10%)

2. A coaxial cable with inner radius $a$ and outer radius $b$, the dielectric between these two conductor has conductivity $\sigma$ and relative permittivity $\varepsilon$. Determine the resistance ($R$) and capacitance ($C$) per unit length in Fig. 2. (12%)

3. Find the magnetic vector potential $\mathbf{A}$ at a distance point of a small circular loop of radius $b$ that carries current $I$ (magnetic dipole) as shown in Fig. 3. Based on the derived $\mathbf{A}$, please also find the corresponding magnetic field $\mathbf{B}$. (16%)
4. Please find the magnetic flux density at the center of a rectangular loop carrying a current $I$, with side width $U$ and $V$, respectively as shown in Fig.4. (12%)

![Fig.4](image)

5. (a) Please write Maxwell’s Equations in differential form and phasor form, and explain each equation’s physical significance. (12%)

(b) Please write the time-harmonic transmission-line equations. (4%)

(c) If a transmission line characterized by $(Z_0, \gamma)$ with length $l$ is connected to a load $Z_L$, please find the expression for the input impedance $Z_i$. (4%)

6. Determine the mutual inductance between a very long, straight wire and a conducting triangular loop, as shown in Fig. 6. (8%)

![Fig. 6](image)

7. The standing-wave ratio on a lossless 75 ($\Omega$) transmission line terminated in an unknown load impedance is found to be 4. The distance between successive voltage minima is 30 (cm) and the first minimum is located at 6 (cm) from the load. Determine (a) the reflection coefficient $\Gamma$ and the load impedance $Z_L$. (6%)

(b) the equivalent length and terminating resistance of a line such that the input impedance is equal to $Z_L$. (4%)
8. The electric field intensity of a linearly polarized uniform plane wave propagating in the
+z-direction in seawater is \( E = \hat{a}_x 100 \cos \left( 2\pi \times 10^6 t \right) \) (V/m) at \( z = 0 \). The constitutive
parameters of seawater are \( \varepsilon_r = 72 \), \( \mu_r = 1 \), and \( \sigma = 4 \) (S/m).
(a) Determine the attenuation constant, phase constant, intrinsic impedance, phase
velocity, wavelength, and skin depth. (6%)
(b) Find the distance at which the amplitude of \( E \) is 1% of its value at \( z = 0 \). (2%)
(c) Write the expressions for \( E(z, t) \) and \( H(z, t) \) at \( z = 0.8 \) (m) as functions of \( t \). (4%)