Field and Waves (ECPC-204) **Test-II (MM: 20)** **Dated 23.10.2024**

Note: Attempt all questions.

1. A current I flows in the inner conductor of an infinitely long coaxial line and returns via the outer conductor. The radius of the inner conductor is a, and the inner and outer radii of the outer conductor are b and c, respectively. Find the magnetic flux density B for all regions and plot |B| versus r.

OR

A thin conducting wire is bent into the shape of a regular polygon of N sides. A current I flows in the wire. Show that the magnetic flux density at the center is $B = a_n \frac{\mu_0 NI}{2\pi b} \tan\frac{\pi}{N}$ where b is the radius of the circle circumscribing the polygon and a_n is a unit vector normal to the plane of the polygon. Show also that, as N becomes very large, this result reduces to that given by $B = a_z \frac{\mu_0 I b^2}{2(z^2+b^2)^{3/2}}$ with $z = 0$.

2. Calculations concerning the electromagnetic effect of currents in a good conductor usually neglect the displacement current even at microwave frequencies.
   a. Assuming $\epsilon_r = 1$ and $\sigma = 5.70 \times 10^7$ (S/m) for copper, compare the magnitude of the displacement current density with that of the conduction current density at 100 GHz. J_d
   b. Write the governing differential equation for magnetic field intensity H in a source free good conductor.

3. Find the resistance between two concentric spherical surfaces of radii R_1 and R_2 ($R_1 < R_2$) if the space between the surfaces is filled with a homogeneous and isotropic material having a conductivity σ.

4. It is known that the electric field intensity of a spherical wave in free space is $\mathbf{E} = \mathbf{a}_\theta \frac{E_0}{R} \sin\theta \cos(\omega t - kR)$. Determine the magnetic field intensity $\mathbf{H}$ and the value of k

$J = \sigma E$