Quiz 2, ECED 3300

Instructor: Sergey A. Ponomarenko.
Place, Date & Time: B308; Tuesday, November 7, 2019, 11:35 am to 12:35 pm.
Closed Books: Formula sheets are provided; no calculators are allowed.
Hint: Make sure to justify all your answers to get full credit.

Problem 1 (15 pts)

Determine the magnetic field (magnitude and direction) at the center O of the semi-circular loop of radius b in the upper half-plane displayed in the figure below. The current I in the horizontal arms as well as in the loop flows from left to right as indicated in the figure.

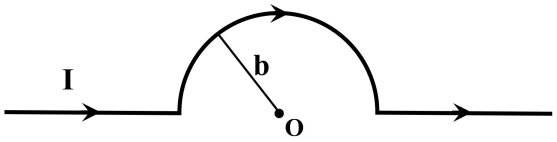

FIG. 1: Illustration to Problem 1.

Problem 2 (10 pts)

Find the flux density of the magnetic field specified by the vector potential,

$$\mathbf{A} = \tfrac{1}{2} r \sin\theta \, \mathbf{a}_\phi, \qquad \text{Wb/m}.$$

Problem 3 (15 pts)

A conducting circular cylinder of length L and radius R is placed along the z-axis of the coordinate system. Given the current density inside the cylinder,

$$\mathbf{J} = \frac{J_0 \rho}{R} \, \mathbf{a}_\rho,$$

where J_0 is a given constant, answer the following questions.

a) What is the total current through the surface of the cylinder?

b) If at time $t = 0$, the cylinder is uniformly charged with the volume charge density ρ_{v0}, what is the charge density inside the cylinder at any $t > 0$?

c) Show that the charge density inside the cylinder vanishes over a finite time t_*. What is the magnitude of t_*?