Prof. Yen-Chieh Huang
Dept of Electrical Engineering
National Tsing-Hua University
office: Delta 856
ext: 62340
email:ychuang@ee.nthu.edu.tw

Your name: ________________ ID: __________________ Dec. 7th, 2020

EE214000 Electromagnetics, Fall, 2020
Quiz #13-1, Open books, notes (20 points), due 11 pm, Wednesday, Dec. 9th, 2020
(submission through iLMS)

Late submission won't be accepted!

1. What are the two fundamental postulates for magnetostatics in vacuum? Define all the symbols in the mathematic expressions. (6 points) State the important physical consequences of the two postulates. (4 points)

2. Show that the magnetic flux density in a very-large-radius toroid approaches that of a long solenoid. (5 points)

3. Use the magnetic field derived from the Biot-Savart law for a finite-length current element to solve the magnetic field everywhere generated by an infinite long wire carrying a current of I along +z. The wire is in vacuum and its diameter is negligible. Compare the result with that derived from the Ampere's law. (5 points)

4. The name and definition of the magnetic vector potential A in $\nabla \cdot \vec{B} = 0 \Rightarrow \vec{B} = \nabla \times \vec{A}$ is somewhat mysterious. The analogy in electrostatics is the scalar potential, V, defined in $\nabla \times \vec{E} = 0 \Rightarrow \vec{E} = -\nabla V$. We now know V is the potential energy per unit charge in an electric field, manifested by the electrostatic energy of charges stored in a volume $W_e = \frac{1}{2}\int_{V'} \rho V dv$. Later, we will also derive an expression for the magnetostatic energy of current stored in a volume $W_m = \frac{1}{2}\int_V \vec{A} \cdot \vec{J} dv$. Based on this analogy, what can you say about the magnetic vector potential? (5 points)