1. **Course number and name**
   EE 331: Electromagnetic Fields and Waves

2. **Credits and contact hours**
   3.0 (three lecture hours per week)

3. **Instructor's or course coordinator's name**
   John B. Schneider

4. **Text book, title, author, and year**
   M.N.O. Sadiku. 2018. *Elements of Electromagnetics* (7th ed.). Oxford University Press.
   Other supplemental materials
   M.R. Spiegel and J. Liu. *Schaum's Outlines: Mathematical Handbook of Formulas and Tables*, McGraw-Hill.

5. **Specific course information**
   a. *Catalog description:* Fundamentals of transmission lines, electrostatics, magnetostatics, and Maxwell's Equations for static fields.
   b. *Prerequisites or co-requisites:* E E 261 with a C or better; E E 262 with a C or better or concurrent enrollment; MATH 315 with a C or better; PHYSICS 202 with a C or better. Certification not required. Students will be required to pass a math skills test.

6. **Specific goals for the course**
   At the end of this course, students must be able to:
   - Formulate the solution to the wave equation for transmission lines for a given set of transmission line parameters, characteristic and load impedances, and operating frequencies. (1)
   - Design a single shorted-stub, shunt-stub tuner to match a complex load to a transmission line using a Smith Chart. (1)
   - Create a bounce diagram to analyze the transient behavior of a signal on a transmission line. (1)
   - Calculate the electric field or potential for a given charge distribution and the magnetic field or vector potential for a given current distribution. (1)
   - Calculate the energy stored in an electric or magnetic field. (1)
   - Analyze and solve boundary condition problems. (1)
   - Solve Poisson's and Laplace's equations for canonical 1-D problems in Cartesian, cylindrical, and spherical coordinates and Laplace's equation for 2-D problems in Cartesian coordinates. (1)
   - Calculate the torque and magnetic moment and forces due to magnetic fields. (1)
   - Set-up and analyze the Lorentz force equation for charged moving particles to determine location, velocity, and kinetic energy as a function of time. (1)
   - Know and understand Maxwell's equations for static fields. (1)

7. **Brief list of topics to be covered**
   - Introductory material, wave equations, propagating waves.
   - Transmission lines: lumped element model; transmission line parameters; transmission line equations; characteristic, input, and load impedances; reflection coefficient; VSWR; power; quarter-wave transformer.
   - Smith chart; shunt-stub tuning; bounce diagrams; transients.
   - Review of vectors; position and distance vectors; vector fields; scalar and vector projections; vector algebra; vector calculus; coordinate systems; coordinate transformations.
   - Electrostatics: Coulomb's law; electric field; electric flux density; Gauss's law; Maxwell's equations for electrostatic fields; electric potential; work; electric dipole; energy density; Joule's law.
   - Convection and conduction currents; properties of materials; dielectrics; permittivity; polarization; dielectric constant; conductors; resistance; capacitance; continuity equation; relaxation time; boundary conditions.
   - Poisson's and Laplace's equations; uniqueness theorem.
   - Magnetostatics: Biot-Savart law, Ampere's law; magnetic flux density; Maxwell's equations for magnetostatic fields; magnetic scalar and vector potentials.
   - Forces due to magnetic fields; magnetic torque and moment; magnetic dipole; classification of materials; boundary conditions; inductance; energy density.