PhD Preliminary Written Exam   **Problem Number 8**   **page 1 of 2**
Fall 2015 Semester   **Transmission Lines and Fields**
Part A

[A] A Si-Ge heterojunction bipolar transistor is used in an amplifier circuit at 2GHz. The equivalent circuit of the input base for a grounded emitter configuration is estimated to have an input resistance of 5Ω in parallel with a capacitance of 1pF. Design a single stub matching circuit to a 50Ω line. Use a Smith chart to design your matching circuit. Determine:

1. The 50Ω line length to shunt stub from the load. (1 point)
2. Determine the length of the 50Ω open circuit stub (1 point).

[B] A coaxial line operates at 2 GHz and is designed to have an impedance of 50Ω. Assume that the coaxial line is filled with dielectric material whose relative permittivity ϵ_r is 2.25, has an inner copper conductor diameter is 2mm.

1. Derive the expression for capacitance per unit length using Gaus's Law. (0.5 points)
2. Derive the expression for the inductance using Ampere's Law. (0.5 points)
3. What is inner diameter of the outer conductor to ensure the impedance is 50Ω. (0.5 points)
4. What is the phase velocity of this coaxial line? (0.5 points)