Electromagnetic Field Theory
(EC-208, Dec-2005)

Note: Section A is compulsory. Attempt any four questions from Section-B and any two from Section-C.

Section-A

1. a) Define magnetic potential vector.
   b) What do you mean by elliptically polarized wave?
   c) Give the physical significance of Maxwell's first and second equations in integral form.
   d) What are equipotential surfaces?
   e) Explain the forms "Poynting Vector" and "Average Poynting Vector".
   f) Define the depth of penetration.
   g) Explain the meaning of terms 'reflected wave' and 'standing wave ratio'.
   h) What is the skin depth of current penetration in copper at a frequency of 10^4 MHz, if the resistivity is 1.7×10^{-6} ohm cm.
   i) What is the dominant mode in rectangular waveguide?
   j) What is the physical significance of divergence of a vector field 'A'?

Section-B

2. State Gauss's law and explain its usefulness in analyzing problems related to the electric field intensity.
3. Explain the principle of double stub matching. Explain two methods of impedance matching using transmission lines.
4. The electric field intensity associated with a plane wave traveling in a perfect dielectric medium having $\mu = \mu_0$ is given by

   $\overline{E} = 10 \cos (6\pi \times 10^7 t - 0.4\pi z)\overline{ix}$ V/m

   Find the phase velocity, the permittivity of medium and associated magnetic vector $\overline{H}$. Velocity in free space = 3×10^8 m/s
5. When the dominant H-mode is propagated in an air filled rectangular waveguide, the guide wavelength for a frequency of 9 GHz is 4.0 cm. Calculate the breadth of the guide.
6. Develop the concept of displacement current using Maxwell's equations.

Section-C

7. Derive Poynting theorem from Maxwell's equations and explain its physical significance and also show that the Poynting vector represents surface power density at a point.
8. (a) An open wire r.f. transmission line, which may be regarded as loss-free has a characteristic impedance Z_0 of 600 Ω and is connected to a resistive load of 25 Ω. Find the position and length of a short circuited stub of the same constriction as the line, which would enable the main length of the line to be correctly terminated at a frequency of 150 MHz.
   (b) State and prove Green's theorem. How Gauss's theorem of divergence is derived from it?
9. (a) A uniform plane electromagnetic wave traveling in free space enters into a loss less medium at normal incidence. In the medium its velocity reduces by 50% and in free space sets up a standing wave having a reflection coefficient of -0.125. Calculate the permissibility and the permittivity of the medium.
   (b) Derive the wave equations for magnetic field in free space.