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**MANIPAL INSTITUTE OF TECHNOLOGY, MANIPAL**  
(A Constituent Institute of MAHE, Deemed University)

**THIRD SEMESTER B.E. DEGREE MAKE-UP EXAMINATION**  
(REVISED CREDIT SYSTEM)

**13 January 2007**

**ELECTRO MAGNETIC THEORY (ELE 207)**

Time: 3 hours

Max.Marks: 50

**Note:** Answer any **FIVE** full questions.

- 1A) A square sheet defined by  $-2m \leq x \leq 2m$ ,  $-2m \leq y \leq 2m$  lies in the  $z = -3m$  plane. The charge density on the sheet is  $\rho_s = 2(x^2 + y^2 + 9)^{3/2}$  nano coulomb/m<sup>2</sup>. Calculate the electrical field intensity at the origin. (04)
- 1B) Charge is distributed uniformly along a straight line of finite length  $2L$ . Show that for two external points near the mid point, such that  $r_1$  and  $r_2$  are small compared to the length, the potential  $V_{12}$  is the same as for an infinite line charge. (06)
- 2A) Given  $V = 8x^2y^2 - 6xz^2$  volts. Find i)  $\vec{E}$  at  $p(3,4,5)$   
ii) Unit vector in the direction of  $\vec{E}$       iii)  $\vec{D}$  assuming free space. (03)
- 2B) Derive expression for the capacitance of a two wire transmission line (04)
- 2C) Explain boundary conditions between two dielectric media. (03)
- 3A) State and explain Biot-savart's law for static magnetic field (03)
- 3B) Develop expressions for the magnetic field intensity, both inside and outside a solid cylindrical conductor of radius 2cm, carrying a current of 100Amp with uniform current density (04)
- 3C) A conductor of length 2.5cm located at  $Z=0$   $X=4cm$  carries a current of 12Amp in the  $-ay$  direction find the uniform  $B$  in the region if the force on the conductor is  $1.20 \times 10^{-2}N$  in the direction  $(-ax + ay)/\sqrt{2}$  (03)
- 4A) Write a short notes on  
a) Stoke's Theorem as applied to magnetic field  
b) Magnetic vector potential (04)
- 4B) Determine the loop inductance of two wire transmission line with solid wires of radii  $a$  and  $b$  (06)
- 5A) Show that  $J_{total} = J + J_d$  with the usual notations. Explain the current density terms. (03)
- 5B) A circular loop of radius 10 cm is located in  $x-y$  plane in a magnetic field of flux density  $B = 0.5 \cos 377t (3 ay + 4 az)$  Tesla. Using Faraday's law find the induced emf in the loop, if there are 10 turns in the loop. (03)
- 5C) Write short note on 1) transformer emf 2) skin depth (04)
- 6A) Derive expressions for propagation constant and intrinsic impedance of the medium when a uniform plane wave propagates through a perfect dielectric medium. (06)
- 6B) A plane wave is travelling in the  $x$ -direction in a lossless medium having permeability same as free space and permittivity 9 times that of free space. Find the phase velocity of the wave. If the electric field intensity has only  $y$ -component with an amplitude of 10 v/m, find the amplitude and direction of the magnetic field intensity. (04)