Reg. No. | | | | | | | | | |

M.E. / M.TECH. DEGREE EXAMINATIONS, MAY/JUNE 2017

FIRST SEMESTER

POWER ELECTRONICS AND DRIVES

PD16003 – ELECTROMAGNETIC FIELD COMPUTATION AND MODELLING

(Regulation 2016)

Q. Code: 407029

Time: Three Hours **Maximum : 100 Marks**

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

1. What is the magnetic force in a charge, moving with velocity v, in a magnetic field?
2. What is the importance of Poisson's equations?
3. Compare analytical and numerical methods used for solving EM problems.
4. What are the limitations of analytical methods?
5. Compare Finite difference and Finite Element Methods.
6. What is stiffness matrix?
7. Write the expression for force with the local value of flux density *B* and current density J. Why this expression is important for Electrical machines?
8. Find the magnetization in a material for which there are $3X10^{28}$ atoms/m^3 and each atom has equal dipole moment of $1.7 X 10^{-33}$ A/m^2.
9. How FEM may be used for transformer design?
10. What is the advantage of using Park's transformation?

PART B - (5 X16 = 80 Marks)

11. (a) (i) Find the electric field a distance z above the midpoint of a straight line segment of length 2L, which carries a uniform line charge λ. **(10)**

(ii) Three point charges 2μC, 4μC and 8μC are located at (0,0,0), (0,0,1) and (1,0,0) respectively. Find energy in the system. **(6)**

(OR)

(b) Determine whether the following pair of fields satisfy Maxwell's equations in the region where σ =0, ε =2.5ε_0, μ= 10μ_0 **(16)**

$$\vec{E} = 3y\hat{a}_y, \quad \vec{H} = 4x\hat{a}_x$$

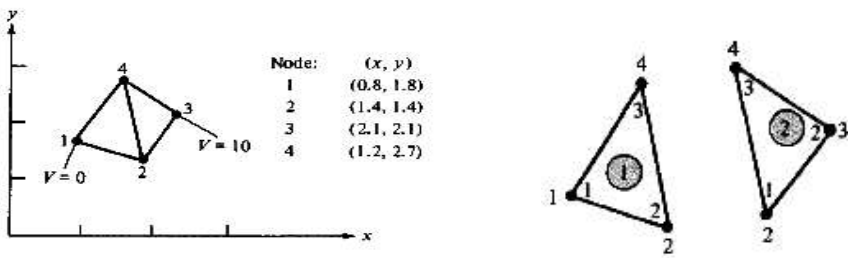
12. (a) (i) An electric field strength of 1000 V/m in a medium of $\varepsilon_r = 6$ passes into air ($\varepsilon_r = 1$) at an angle of 45° to the normal of the boundary. Find the magnitude of $\overline{E}$ in air. **(8)**

(ii) A plane surface S separates two linear, homogeneous and isotropic conducting media. Show that, if a time invariant current crosses from one medium into the other, a surface charge will appear on S, whose density is $Q = \left(\frac{\varepsilon_2}{\sigma_2} - \frac{\varepsilon_1}{\sigma_1}\right) J_{1N}$. **(8)**

(OR)

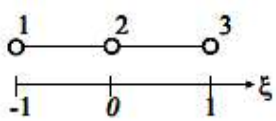
(b) Determine the steps involved to find a solution to Poisson's equation by finite difference method. **(16)**

13. (a) Using the finite element method, determine the potentials within the two-element mesh shown in fig. **(16)**



(OR)

(b) Obtain shape functions for the one-dimensional quadratic element with three nodes. Use local coordinate system $-1 \le \xi \le 1$. **(16)**



14. (a) How the computation of dc resistance in machine windings is done? Discuss about the computation of ac winding resistance. **(16)**

(OR)

(b) Derive energy stored in the magnetic field by using vector identity. Find the flux linkage in two dimensions. **(16)**

15. (a) Obtain the time dependent magnetic diffusion equation of an induction motor by applying FEM. **(16)**

(OR)

(b) (i) Find the insulation resistance of a co-axial cable per unit length whose radii are R_1 and R_2, ε is the permittivity of the medium between the cylinders. **(10)**

(ii) What is the effect of electric field stress on insulator? **(6)**