Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–IV (New) • EXAMINATION – WINTER 2016

Subject Code: 2140909 Date: 23/11/2016

Subject Name: Field Theory

Time:02:30 PM to 05:00 PM Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 Short Questions (14)

1) The proportionality constant in Coulomb's law has a unit of

(a) Farad (b) Farad/metre (c) Newton/metre (d) metre/Farad

2) If a pair of (+)ve and (-ve) charges of 1C are separated by a distance of 1 μm, the magnitude of dipole moment is

(a) 1C- μm (b) 1C/ μm (c) zero (d) 2C- μm

3) Point form of Gauss' law is

(a) $\nabla \cdot D = \rho s$ (b) $\nabla \cdot D = \rho v$ (c) $\nabla \cdot D = \rho v/\epsilon_0$ (d) $\nabla \cdot D = Q$

4) If the voltage applied across the capacitor is increased, its capacitance value

(a) increases (b) decreases (c) remains constant (d) becomes infinity

5) Unit of electric flux is

(a) Coulomb (b) Weber (c) Tesla (d) Weber/m

6) If a current of 1A is flowing in an inductor with L = 2H, the energy stored in the inductor is

(a) 2.0 J (b) 1.0 J (c) 4.0 J (d) 0.5 J

7) $\oint B \cdot dS$ is

(a) zero (b) Q (c) H (d) J

8) If a charge of 1C is moving with a velocity of $2a_x$ in a magnetic field B = $1a_y$, the force experienced by the charge is

(a) $2a_z$ (b) $1a_y$ (c) $2a_x$ (d) $1a_z$

9) Curl of the gradient of scalar magnetic potential is

(a) zero (b) 1 (c) -1 (d) undefined

10) Electric field in free space is

(a) D/μ_0 (b) D/ϵ_0 (c) $D\,\epsilon_0$ (d) σ/ϵ_0

11) Write the equation for curl of magnetic field intensity for conservative and non-conservative fields

12) Write the equation for point form of Ohm's law

13) At the conductor-dielectric boundary $D_t = 0$ (True or False)

14) In a spherical co-ordinate system θ = constant is a plane (True or False)

Q.2

(a) Explain how dot product and cross product of vectors is carried out (3)

(b) Explain cylindrical co-ordinate system of vectors in brief (4)

(c) Points A($r = 100, \theta = 90^0, \Phi = 0$) and B = ($r = 100, \theta = 90^0, \Phi = 5^0$) are located on the surface of a 100m radius sphere (i) What is their separation using a path on the spherical surface? (ii) What is separation using a straight line path? Give the answer upto four decimal places after the decimal point. (7)

OR

(c) A point charge $Q_1 = 2\mu C$ is located at $P_1(3,7,-4)$ and $Q_2 = -5\mu C$ is at $P_2(2,4,-1)$ At a point (12,15,18) find (i) E (ii) |E| (iii) a_E (7)

Q.3

(a) State and explain Coulomb's law (3)

(b) Derive the point form of continuity equation (4)

(c) Derive the expression for electric field intensity due to line charge (7)

OR

Q.3

(a) State and explain Gauss' law (3)

(b) What net flux crosses the closed surface which contains charge distribution in the form of a plane disc of radius 4m in z=0 plane with $\rho s = \sin^2\Phi/2\rho$ (4)

(c) A co-axial conducting cylinder has charge density of ρs on the outer surface of the inner cylinder. Use Gauss' law to find 'D' in all the regions. Assume that inner cylinder has radius of 'a' metres and outer cylinder has radius of 'b' metres (7)

Q.4

(a) If $E = 2xa_x - 4ya_y$ V/m find the work done in moving a point charge of +2C from (2,0,0) to (0,0,0) to (0,2,0) (3)

(b) Explain electric dipole. Derive the expression for E and V at any distant point from dipole (4)

(c) For steady magnetic fields, prove that $\nabla \times H = J$ (7)

OR

Q.4

(a) Derive Poisson's and Laplace's equations (3)

(b) Assuming that V satisfies Laplace's equation in cylindrical co-ordinate system, find the expression for V and E as a function of Φ. (4)

(c) Explain scalar and vector magnetic potentials. With the help of an example prove that the value of scalar magnetic potential can be non-unique (7)

Q.5

(a) State and explain Stoke's theorem (3)

(b) Write Maxwell's equations in integral form and point form (4)

(c) Derive the expression for force on a current carrying element placed in a magnetic field (7)

OR

Q.5

(a) Explain the concept of wave propagation on transmission line. Assume line to be lossless (3)

(b) State and explain in brief, various sources of EMI (4)

(c) Discuss the methods adopted to eliminate EMI (7)