

B.E./B.TECH Degree Examination, December 2020

Third Semester

EE18302- Electromagnetic Theory

(Regulation 2018)

Time: Three hours

Maximum : 80 Marks

Answer **ALL** questions**PART A - (8 X 2 = 16 marks)**

1. Given two points A ($x=2, y=3, z=-1$). The transformation of spherical coordinate is
 - (i) $r= 3.74, \theta=105.5^\circ \Phi= 56.31^\circ$
 - (ii) $r= 4.74, \theta=150.5^\circ \Phi= 60.31^\circ$
 - (iii) $r= 3.74, \theta=160.5^\circ \Phi= 56.31^\circ$
 - (iv) $r= 5.74, \theta=105.5^\circ \Phi= 76.31^\circ$
2. The relationship between D and E is
 - (i) $D = E/\epsilon$
 - (ii) $D = E.\epsilon$
 - (iii) $D = E/\rho$
 - (iv) $D = E.\rho$
3. A parallel plate capacitor has voltage of 25V across the plates. If the distance between the plates are doubled, the new voltage across the capacitor is:
 - (i) 25v
 - (ii) 30v
 - (iii) 50v
 - (iv) 75v
4. Two long parallel conductors carrying current of 40 A each, in same direction. The force per meter length is:
 - (i) 0.064N/m
 - (ii) 0.64N/m
 - (iii) 0.0064N/m
 - (iv) 6.4N/m
5. How does Stoke's theorem relate line integral with surface integral?
6. Identify the sources of electromagnetic field.
7. Relate energy in terms of E and D. Also write the expression for the energy density.
8. Determine the skin depth of copper at 60 Hz with $\sigma = 5.8 \times 10^7$ S/m. Given $\mu_r = 1$.

PART B - (4 X16 = 64 marks)

09. (a) (i) A point charge $Q_1 = 300 \mu\text{C}$ located at $(1, -1, -3)\text{m}$, experiences a force $F_1 = 8i - 8j + 4k$ (N) due to a point charge Q_2 at $(3, -3, -2)$ m. Find the charge Q_2 **(8)**
- (ii) State the Coulombs law and derive vector form of Coulomb's law **(8)**

(OR)

- (b) (i) Determine the Divergence and curl of the given field $F = 30i + 2xy j + 5xz^2 k$ (8)
at (1,1,-0.2) and hence state the nature of the field.
- (ii) Using Gauss law derive the electric field intensity of an uniformly charged (8)
long straight conductor and an uniformly charge distributed disc.
10. (a) (i) Derive the boundary conditions of the normal and tangential component of (10)
electric field at the interface of two media with different dielectrics.
- (ii) The electric field intensity in polystyrene with $\epsilon_r = 255$ filling a space (6)
between the plates of parallel plate capacitor is 10kv/m. The distance between
the plate is 1.5mm. Calculate the electric flux density and potential difference
between the plates.

(OR)

- (b) (i) The interface of dielectric free space is $3x+3y+z = 12$ m. The origin side of (8)
interface has $\epsilon_n = 3.0$ and $E_1 = 2a_x + 5a_z$. Find E_2
- (ii) For a parallel plate capacitor, the area is 110 cm^2 , $d = 5 \text{ mm}$ and $\epsilon_r = 12$. (8)
(i) Calculate capacitance (ii) After connecting the 40v battery across the
capacitor, calculate E, D, Q and total energy stored (ii) Now the source is
removed and the dielectric is withdrawn between the plates. Find the value of
E, D Q and energy.
11. (a) Derive an expression for magnetic flux density at the centre of solenoid (16)

(OR)

- (b) (i) Derive the inductance of a co-axial cable of length L of radius R (8)
- (ii) Let vector $A = (2y-z)a_x + 3xz a_y$ web/m in a certain region in free space. (8)
(a) Show that $\nabla \cdot A = 0$
(b) at point p(2,-1,3), find vectors A, B, H, and J respectively
12. (a) Derive the differential form and integral form of Maxwell's equations and also (16)
write this equation in free space and in good conductors.

(OR)

- (b) (i) Derive the electromagnetic wave equations in perfect dielectric medium (8)
- (ii) The electric field in the free space is given by $E = 100 \cos(10^8 t + \beta x) a_y$ v/m. (8)
(i) Find the direction of wave propagation
(ii) Calculate β and time it takes to travel a distance $\lambda/2$