**18ECC350T COMPREHENSION**

**ELECTROMAGNETICS AND TRANSMISSION LINES**

**QUESTION BANK**

1. Vector Analysis and Applications, Coordinate System
2. Vector Calculus
3. Electrostatic Fields
4. Maxwell Equations
5. Transmission Lines and Waveguides
6. **Vector Analysis and Applications,** **Coordinate System**

**Q.1** Lorentz force is based on,

(A) Dot product **(B) Cross product** (C) Both dot and cross product

(D) Independent of both

**Q.2** Which of the following is not true?

(A) A. (B. C) = scalar value (B) A. (B x C) = scalar value

**(C) A x (B. C) = scalar value**  (D) A x (B x C) = vector value

**Q.3** A vector is said to be solenoidal when its

**(A) Divergence is zero**  (B) Divergence is unity

(C) Curl is zero (D) Curl is unity

**Q.4** When a vector is irrotational, which condition holds good?

(A) Stoke’s theorem gives non-zero value **(B) Stoke’s theorem gives zero value**

(C) Divergence theorem is invalid (D) Divergence theorem is valid

**Q.5** The relation between vector potential and field strength is given by

**(A) Gradient** (B) Divergence (C) Curl (D) Del operator

**Q.6** The work-electric field relation is given by

(A) Volume integral (B) Surface integral **(C) Line integral**

(D) Relation impossible

1. **Vector Calculus**

**Q.11** The gradient can be replaced by which of the following?

(a) Maxwell equation (B) Volume integral **(C) Differential equation**

(D) Surface integral

**Q.12** Identify the nature of the field, if the divergence is zero and curl is also zero.

(A) Solenoidal, irrotational (B) Divergent, rotational

**(C) Solenoidal, irrotational** (D) Divergent, rotational

**Q.13** Which of the following theorem use the curl operation?

(A) Green’s theorem (B) Gauss Divergence theorem

**(C) Stoke’s theorem**  (D) Maxwell equation

**Q.14** Line integral is used to calculate

(A) Force (B) Area (C) Volume (D**) Length**

**Q.15** The ultimate result of the divergence theorem evaluates which one of the following?

(A) Field intensity (B) Field density (C) Potential **(D) Charge and flux**

**Q.16** The divergence theorem converts

(A) Line to surface integral **(B) Surface to volume integral**

(C) Volume to line integral (D) Surface to line integral

1. **Electrostatic Fields**

**Q.21** Coulomb law is employed in

(A) **Electrostatics**  (B) Magnetostatics (C) Electromagnetics

(D) Maxwell theory

**Q.22** Electric field intensity due to infinite sheet of charge σ is

(A) Zero (B) Unity (C) σ/ε **(D) σ/2ε**

**Q.23** Electric flux density in electric field is referred to as

(A) Number of flux lines

**(B) Ratio of flux lines crossing a surface and the surface area**

(C) Direction of flux at a point

(D) Flux lines per unit area

**Q.24** A circular disc of radius 5m with a surface charge density ρs = 10sinφ is enclosed by surface. What is the net flux crossing the surface?

(A) 3 (B) 2 (C) 1 **(D) 0**

**Q.25** With Gauss law as reference which of the following law can be derived?

a) Ampere law (B) Faraday’s law (C**) Coulomb’s law** (D) Ohm’s law

**Q.26** Find the electric potential for an electric field 3units at 2m.

(A) 9 (B) 4 **(C) 6** (D) 3/2

1. **Maxwell Equations**

**Q.31** The first Maxwell law is based on which law?

(A) Ampere law (B) Faraday law (C) Lenz law

**(D) Gauss law of electrostatic**

**Q.32** In a medium other than air, the electric flux density will be

**(A) Solenoidal** (B) Curl free (C) Irrotational (D) Divergent

**Q.33** In a medium other than air, the electric flux density will be

(A) Solenoidal (B) Curl free (C) Irrotational **(D) Divergent**

**Q.34** An implication of the continuity equation of conductors is given by

(A) **J = σ E** (B) J = E/σ (C) J = σ/E (D) J = jwEσ

**Q.35** Find the equation of displacement current density in frequency domain.

(A) **Jd = jwεE** (B) Jd = jwεH (C) Jd = wεE/j (D) Jd = jεE/w

**Q.36** The loss tangent refers to the

**(A) Power due to propagation in conductor to that in dielectric**

(B) Power loss (C) Current loss (D) Charge loss

1. **Transmission Lines and Waveguides**

**Q.41** The condition which will satisfy the dimensions of the waveguide is

(A) a = b **(B) a > b** (C) a < b (D) ab = 0

**Q.42** The cut off wavelength of the TE10 mode having a broad wall dimension of 5 cm is **(A) 0.1** (B) 1 (C) 10 (D) 0.01

**Q.43** In a waveguide, always which condition holds good?

(A) phase velocity = c **(B) phase velocity greater than c**

(C) phase velocity lesser than c (D) group velocity = c

**Q.44** The dominant mode in rectangular waveguide is

(A) TE01 **(B) TE10** (C) TM01 (D) TM10

**Q.45** In a transverse electric magnetic wave, which of the following will be true?

(A) E is transverse to H

(B) E is transverse to wave direction

(C) H is transverse to wave direction

**(D) E and H are transverse to wave direction**

**Q.46** Standing waves occurs due to

(A) Impedance match **(B) Impedance mismatch** (C) Reflection

(D) Transmission

**Detailed Explanation:**

Ans.1. (B) Lorentz force is given by F = q (E + v x B). Thus, cross product is the answer.

Ans.2. (C) Cross product of dot product of two vectors is a vector value.

Ans.3. (A) When the divergence of a vector is zero, it is said to be solenoidal /divergent-free.

Ans.4. (B) Stoke’ theorem is given by, ∫ A. dl = ∫ (Curl A). ds, when curl is zero(irrotational), the theorem gives zero value.

Ans.5. (A) The relation between vector potential and field is given by E = -Del (V).

Ans.6. (C) The work done is given by W = -Q ∫E dl. Thus, it is line integral.

Ans.11. (C) Since gradient is the maximum space rate of change of flux, it can be replaced by differential equations.

Ans.12. (C) Since the vector field does not diverge (moves in a straight path), the divergence is zero. Also, the path does not possess any curls, so the field is irrotational.

Ans.13. (C) The Stoke’s theorem is given by ∫ A.dl = ∫Curl(A).ds, which uses the curl operation. There can be confusion with Maxwell equation also, but it uses curl in electromagnetics specifically, whereas the Stoke’s theorem uses it in a generalised manner. Thus, the best option is Stoke’s theorem.

Ans.14. (D) Length is a linear quantity, whereas area is two dimensional and volume is three dimensional. Thus, single or line integral can be used to find length in general.

Ans.15 (D) Gauss law states that the electric flux passing through any closed surface is equal to the total charge enclosed by the surface. Thus, it is given by, ψ = ∫∫ D.ds= Q, where the divergence theorem computes the charge and flux, which are both the same.

Ans.16. (B) The divergence theorem is given by, ∫∫ D.ds = ∫∫∫ Div (D) dv. It is clear that it converts surface (double) integral to volume(triple) integral.

Ans.21 (A) Coulomb law is applied to static charges. It states that force between any two-point charges is proportional to the product of the charges and inversely proportional to square of the distance between them. Thus, it is employed in electrostatics.

Ans.22. (D) E = σ/2ε. (1- cos α), where α = h/(√(h2+a2)) Here, h is the distance of the sheet from point P and a is the radius of the sheet. For infinite sheet, α = 90. Thus E = σ/2ε.

Ans.23. (B) Electric flux density is given by the ratio between number of flux lines crossing a surface normal to the lines and the surface area. The direction of D at a point is the direction of the flux lines at that point.

Ans.25. (C) From Gauss law, we can compute the electric flux density. This in turn can be used to find electric field intensity. We know that F = qE. Hence force can be computed. This gives the Coulomb’s law.

Ans.26. (C) The electric field intensity is the ratio of electric potential to the distance. E = V/d. To get V = E X d = 3 X 2 = 6units.

Ans.33. In any medium other than the air, the conduction is possible, due to the charge carriers. Thus, charge density is also non-zero. We can write from Gauss law that Div(D) is non-zero. When the divergence is said to be non-zero, the field is not solenoidal or called as divergent field.

Ans.34. The continuity equation indicates the current density in conductors. This is the product of the conductivity of the conductor and the electric field subjected to it. Thus J = σE is the implication of the continuity equation for conductors.

Ans.35. (A) The displacement current density is Jd = dD/dt. Since D = εE and in frequency domain d/dt = jw, thus we get Jd = jwεE.

Ans.36. (A) The loss tangent is the tangent angle formed by the plot of conduction current density vs displacement current density. It is the ratio of Jc by Jd. It represents the loss of power due to propagation in a dielectric, when compared to that in a conductor.

Ans.41. (B) The dimensions a and b represent the broad wall and the side wall dimensions respectively. The broad wall will be greater than the side wall. Thus, the condition a>b is true.

Ans.42. (A) The cut off wavelength of the waveguide is given by λc = 2a/m. on substituting for a = 0.05 and m = 1, we get λc = 2 x 0.05/1 = 0.1 units.

Ans.43. (B) In air medium, the phase velocity is assumed to be the speed of light. For waveguides, the phase velocity is always greater than the speed of the light.

Ans.44. (B) TE10 is the dominant mode in the rectangular waveguide. This is because it gives the minimum cut off frequency required for transmission.

Ans.46. (B) Impedance mismatches result in standing waves along the transmission line. It shows the variation of the wave amplitudes due to mismatching.