

PONDICHERY UNIVERSITY-4623028

B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014

Third Semester-Electronics and Communication Engineering

ENGINEERING ELECTROMAGNETICS AND WAVES (2009-2012 Batches)

Time: Three hours

Maximum : 75 marks

PART A — (10 × 2 = 20 marks)

Answer ALL questions. All questions carry equal marks.

1. Define Coulomb's law.

Ans 1. For answer refer: **Page 32, topic 1.7**, till formula $F = \frac{Q_1 Q_2}{4\pi\epsilon_0 r_{12}^2}$.

2. Write note on Divergence theorem.

Ans 2. For answer refer: **Page 30, topic 1.6.3** upto formula.

3. Define Ampere's law.

Ans 3. For answer refer: **Page 112, topic 3.6** greyed box.

4. Write short note on Helmholtz's theorem.

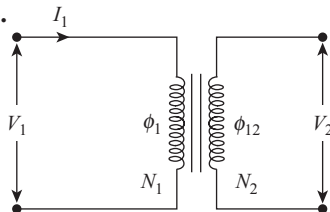
Ans 4. Helmholtz' theorem is stated as: A vector function is determined uniquely if the values of its curl and divergence are known at all points.

5. State Faraday's law of electromagnetism.

Ans 5. For answer refer: **Page 154, topic 4.2** till before Lenz's law.

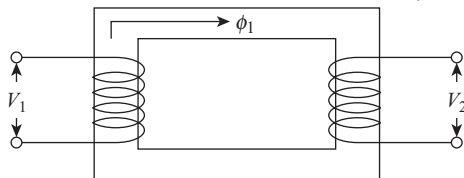
6. What is mutual inductance?

Ans 6.



Let a voltage source V_1 set up a flux ϕ_1 per turn in the primary of the transformer taking current I_1 .

Then self Inductance is given by $L = \left(\frac{N\phi_1}{I_1} \right)$



Let the flux linking the secondary be ϕ_{12} per turn, then mutual inductance is given by,

$$M = \left(\frac{N_2 \phi_{12}}{I_1} \right).$$

7. Write the wave equation for free space.

Ans 7. For answer refer: **Page 178, topic 5.3.2**; Equation III and IV.

8. Define Poynting's Theorem.

Ans 8. For answer refer: **Page 204**, Poynting theorem 2nd greyed box.

9. What is intrinsic impedance?

Ans 9. For answer refer: **Page 210**, $\eta = \sqrt{\frac{j\omega\mu}{\sigma + j\omega\epsilon}}$.

10. Write short note on surface waves.

Ans 10. Surface wave is an electromagnetic wave that travels along a surface or an interface between two medium that have different refraction indexes (or different Intrinsic Impedances) and keeps being trapped between the two mediums.

PART B – (5 × 11 = 55 marks)

Answer ALL question, One from each Unit. All questions carry equal marks.

UNIT I

11. Explain the applications of Gauss's Law in electric field.

Ans 11. For answer refer: **Page 37, topic 1.9**; greyed box. **Topic 1.9.3 in Page 39. Topic 1.9.4 and 1.9.5 in page 40 & 41.**

Or

12. Obtain the expression for Electric field intensity in surface charge distribution

Ans 12. For answer refer: **Page 36, Topic 1.8.3** Fully.

UNIT II

13. Derive the expression for Torque on closed conductors.

Ans 13. For answer refer: **Page 124, Topic 3.8** Fully.

Or

14. State Biot-savart's Law and Obtain its applications.

Ans 14. For answer refer: **Page 107, Topic 3.4** till fig 3.6
Application: topic 3.7.1 Fully.

UNIT III

15. Derive the expression for energy stored in magnetic field.

Ans 15. For answer refer: **Page 138, Topic 3.14 and 3.14.1.**

Or

16. Obtain the expression for Boundary conditions at the surface of dielectric.

Ans 16. For answer refer: **Page 132, Topic 3.12** Fully.

UNIT IV

17. Derive the expression for Maxwell's equation in point form.

Ans 17. For answer refer: **Page 163, Topic 4.5.2** till page 166 upto $\nabla \cdot B = 0$ and greyed box.

Or

18. Obtain the wave equations for conducting medium.

Ans 18. For answer refer: **Topic 5.3** upto eq (I) in Page 176 & 177; Page 179 and Topic 5.3.3, till Page 180.

UNIT V

19. Discuss with relevant equations about the wave propagation in a lossless medium.

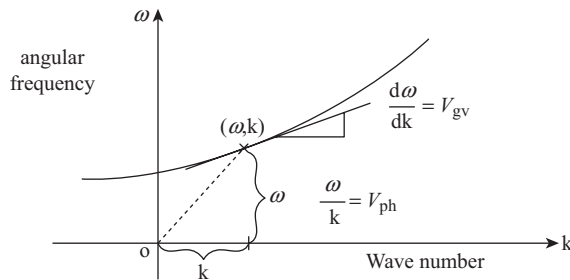
Ans 19. For answer refer: **Page 176, Topic. 5.3** till eq(I) in Page 177. Refer Page 181, topic 5.4 till $E = C_1 e^{-j\beta x} + C_2 e^{j\beta x}$.

Or

20. Explain in detail about the phase velocity and group velocity with relevant equations.

Ans 20. Phase Velocity and Group Velocity.

1. Phase velocity " V_{ph} " is the velocity of propagation of equiphase surfaces along the wave guide.
2. Group velocity " V_{GR} " is the velocity of energy propagation in the direction of the axis of the waveguide.
3. Phase velocity " V_{ph} " and velocity of propagation " V_0 " of the wave fronts will be identical only for non-dispersive wave.
4. For a waveguide propagation, the phase velocity " V_{ph} " is always greater than velocity of propagation v_0 , whereas the group velocity is always less than v_0 .
5. The geometrical significance of "Phase velocity", "group velocity" can be shown in angular frequency ω . wave number plot.



- (a) The slope of the line joining the point (ω, k) and the origin is the phase velocity.
- (b) The tangent of the $\omega - k$ curve at the point (ω, k) is the group velocity.