

PONDICHERRY UNIVERSITY-4623028

B.Tech. DEGREE EXAMINATION, APRIL/MAY 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. State Stokes's theorem.

Ans 1. For answer refer: Page 28, topic 1.6.1 greyed box.

2. What is an electric dipole? Write down the potential due to an electric dipole.

Ans 2. For answer refer: Page 63, 1<sup>st</sup> greyed box and 2<sup>nd</sup> greyed box. Fig 2.17 and Fig. 2.18.

For answer refer: Page 65, formula  $V_p = \frac{m \cdot \cos \theta}{4\pi\epsilon_0 r^2}$  (Dipole moment,  $m = Ql$ ).

3. What is meant by magnetic field intensity?

Ans 3. For answer refer: Page 105, last paragraph (ie) Topic 3.2.....;  $\Rightarrow H = \left(\frac{B}{\mu}\right)$ .

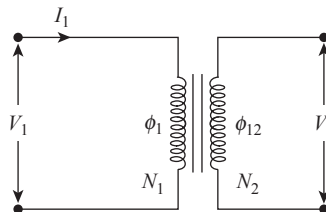
4. Define Helmholtz's theorem.

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

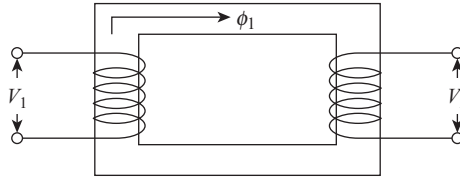
5. Differentiate self inductance and mutual inductance.

Let a voltage source  $V_1$  set up a flux  $\phi_1$  per turn in the primary of the transformed 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  $\phi_{12}$  per turn, then mutual inductance is given by,  $M = \left(\frac{N_2\phi_{12}}{I_1}\right)$ .



6. Write the expression for energy stored in an inductor.

**Ans 6.** For answer refer: **Page 139, topic 3.14** till ending at eq. “ $E = \frac{1}{2} LI^2$ ”.

7. Write down instantaneous, average and complex Poynting vectors.

**Ans 7.** For answer refer: **Page 205, topic 5.8.1.**

$$\text{Instantaneous power} - P_{\text{inst}} = \frac{|V||I|}{2} [\cos(\theta_v - \theta_i) + \cos(2\omega t + \theta_v + \theta_i)]$$

$$\text{Average power } P_{\text{av}} = \frac{|V||I|}{2} \cos(\theta_v - \theta_i) = \frac{|V||I|}{2} \cos \theta$$

Where  $\theta = \theta_v - \theta_i$

$$\text{Reactive Power, } P_{\text{rea}} = \frac{|V||I|}{2} \sin \theta.$$

$$\text{Complex Power, } P = \frac{|V||I|}{2} \cos \theta + j \frac{|V||I|}{2} \sin \theta.$$

8. What do you mean by a wave?

**Ans 8.** For answer refer: **Page 171, topic 5.1.**

9. Determine the intrinsic impedance of free space.

**Ans 9.** For answer refer: **Page 193, Q-6**,  $\eta_0 = \sqrt{\left(\frac{\mu_0}{\epsilon_0}\right)} = 120\pi$ .

10. What is Brewster angle?

**Ans 10.** The incident angle at which no reflection takes place is called the Brewster angle  $\theta_B$  or the polarizing angle.

$$\eta_2 \cos \theta_t = \eta_1 \cos \theta_{B\parallel}$$

$$\text{Brewster angle, } \theta_B = \cos^{-1} \left[ \left( \frac{\eta_2}{\eta_1} \right) \cdot \cos \theta_t \right]$$

**PART B – (5 × 11 = 55 marks)****Answer ALL question, One from each Unit. All questions carry equal marks.****UNIT I**

11. State and prove divergence theorem. (11)

**Ans 11.** For answer refer: **Page 30, topic 1.6.3** till page 31.

Or

12. Derive the expression for electric field intensity due to point charge and an infinite long charge. (11)

**Ans 12.** For answer refer: **Page 32, topic 1.8** till “ $E = \frac{Q(1)}{4\pi\epsilon_0 r^2} \hat{a}_r = \frac{Q}{4\pi\epsilon_0 r^2} \hat{a}_r$ .”

For answer refer: Page 37, Gauss’s Law statement only from greyed box and page 39, topic 1.9.3 only.

**UNIT II**

13. Derive an expression for the force between two long straight parallel current carrying conductors. (11)

**Ans 13.** For answer refer: **page 118, topic 3.7.1.1.**

Or

14. State and explain Biot-savart’s Law. (11)

**Ans 14.** For answer refer: **Page 107, topic 3.4** till figure 3.6 in page 108 and topic 3.7.1 till page 117 end.**UNIT III**

15. Derive the expression for inductance of a toroidal coil carrying current. (11)

**Ans 15.** For answer refer: **Page 115, topic 3.6.1.4** and **page 134, topic 3.13.2.**

Or

16. Derive the boundary conditions at an interface between two magnetic medias. (11)

**Ans 16.** For answer refer: **Page 132, topic 3.12 fully.****UNIT IV**

17. Derive and explain Maxwell’s equation in point and integral form using Ampere’s circuital Law. (11)

**Ans 17.** For answer refer: **Page 112, topic 3.6** greyed box.For answer refer: **Page 163, Topic 4.5.2** Maxwell’s Equation I fully.

Or

18. Derive the electromagnetic wave equation in phasor form. (11)

**Ans 18.** For answer refer: **Page 176, topic 5.3 and topic 5.3.1** fully.For answer refer: **Page 179, Topic 5.3.3** till equation (4).

**UNIT V**

19. Briefly explain the types of polarization of uniform plane wave. (11)

**Ans 19.** For answer refer: **Page 176, topic 5.2.2.**

Or

20. Explain the reflection of plane waves by a perfect dielectric. (11)

**Ans 20.** For answer refer: **Page 206, topic 5.9** till Page 210-Special case I till conclusion: The Wave is totally reflected.