

D 30901

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Name.....

Reg. No.....

**THIRD SEMESTER B.TECH. (ENGINEERING) DEGREE EXAMINATION  
OCTOBER 2012**

Electrical and Electronics Engineering

EE 09 304/PTEE 09 303—ELECTROMAGNETIC FIELD THEORY

(2009 Admissions)

Time : Three Hours

Maximum : 70 Marks

**Part A**

Answer all questions.

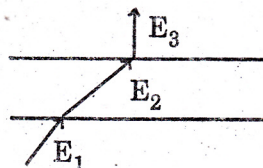
1. State Gauss's law.
2. Define Inductance.
3. What is meant by displacement current ?
4. Define uniform plane electromagnetic wave.
5. Define phase velocity.

(5 × 2 = 10 marks)

**Part B**

Answer any four questions.

6. Express the vector field  $G = 8 \sin \phi \bar{a}_\theta$  in :
  - (a) Rectangular components.
  - (b) Cylindrical components.
7. Two infinite plane sheets are separated by a distance 'd'. The first has a charge of  $+\sigma$  C per unit area, the second has a charge of  $-\sigma$  C per unit area. Find the electric field intensity at any point between them.
8. Fig. 1 shows a planar dielectric slab with free space on either side. Assuming a constant field  $E_2$  within the slab, Express  $E_3$  in terms of  $E_1$ . Prove your answer.



**Fig. 1.**

9. A parallel plate capacitor with area  $0.3 \text{ m}^2$  and separation  $5.5 \text{ mm}$  contains three dielectrics with interfaces normal to  $E$  and  $D$  as follows :

$\epsilon_1 = 3.0, d_1 = 1.0 \text{ mm} ; \epsilon_2 = 3.0, d_2 = 2.0 \text{ mm} ; \epsilon_3 = 6.0, d_3 = 2.5 \text{ mm}$ . Find the capacitance.

Turn over

10. Discuss Pointing Theorem.  
 11. Derive Maxwell's equation from Ampere's law.

(4 × 5 = 20 marks)

**Part C***Answer all questions.*

12. (a) Three point charges in free space are located as follows :  
 $+ 5 \times 10^{-8} \text{c}$  at (0, 0) m,  $- 6 \times 10^{-8} \text{c}$  at (0, 4) m and  $+ 4 \times 10^{-8} \text{c}$  at (0, 4) m  
 (i) Find the electric field intensity and electric flux density at (3, 4) m.  
 (ii) What is the total electric flux over a sphere of 5 m radius with centre at (0, 0).
- Or*
- (b) Let a point charge  $Q_1 = 25 \text{ nC}$  be located at  $P_1 (4, -2, 7)$  and a charge  $Q_2 = 60 \text{ nC}$  be at  $P_2 (-3, 4, -2)$ . Assume both the charges are in free space.  
 (i) Find  $E$  at  $P_3 (1, 2, 3)$   
 (ii) At what point on the  $y$ -axis is  $E_x = 0$  ?
13. (a) Two circular coils are located in free space at the  $z = 0 \text{ m}$  plane and  $z = 5 \text{ m}$  plane, centered about the axis. The first coil having a radius of 1 m carries a current of 10 A. The second coil having a radius of 0.5 m carries a current 20 A. (both the coil currents one in anti clockwise direction) Calculate the magnetic field intensity at (0, 0, 2.5). Derive the formula used.

*Or*

- (b) A shielded power cable has a polyethylene insulation for which  $\epsilon_r = 2.26$  and the dielectric strength is 18.1 MV/m. What is the upper limit of voltage on the inner conductor with respect to the shield when the inner conductor has a radius of 1 cm and the inner side of the concentric shield is at radius of 8 cm ?
14. (a) Derive the wave equation for a conducting medium.
- Or*
- (b) Explain various types of wave polarization.
15. (a) Write short notes on :  
 (i) Standing wave ratio.  
 (ii) Impedance matching.

*Or*

- (b) State and explain law of reflection and law of refraction.

(4 × 10 = 40 marks)