

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)**

CLASS: BE
BRANCH: EEE

SEMESTER : IV
SESSION : SP/19

SUBJECT: EE4209 ENGINEERING ELECTROMAGNETICS

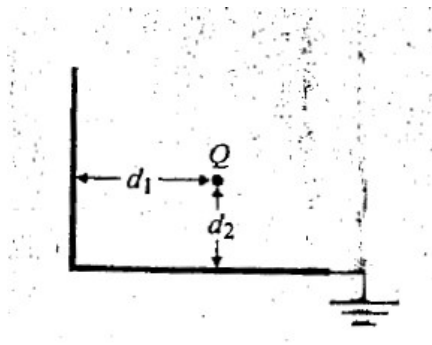
TIME: 3 Hours

FULL MARKS: 60

INSTRUCTIONS:

1. The question paper contains 7 questions each of 12 marks and total 84 marks.
 2. Candidates may attempt any 5 questions maximum of 60 marks.
 3. The missing data, if any, may be assumed suitably.
 4. Before attempting the question paper, be sure that you have got the correct question paper.
 5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) If $A = A_R a_R + A_\theta a_\theta + A_\phi a_\phi$ and write an expression to find its curl. [2]
- Q.1(b) Obtain the relation between vector magnetic potential A and magnetic flux ϕ through given area. [4]
- Q.1(c) Derive a mathematical expression for electrostatic energy in terms of E and D. [6]
- Q.2(a) Express the poissons equation in cylindrical coordinate system. [2]
- Q.2(b) What are the electrostatic boundary conditions at the interface between two dielectric media and which laws are used in obtaining boundary conditions and write their equations? [4]
- Q.2(c) Obtain the solution of two dimensional Laplace equation by method of separation of variables in Cylindrical coordinate system. [6]
- Q.3(a) What is meant by the polarization of a wave? [2]
- Q.3(b) Write non homogenous Helmholtz equations for the time varying fields and define k in the equations. [4]
- Q.3(c) The conductivity of silver is $\sigma_{ag} = 6.15 \times 10^7$ S/m. Determine the following a) attenuation constant b) intrinsic impedance c) skin depth at 1 GHz. [6]
- Q.4(a) What is Brewster angle and write its expression in case of parallel polarisation? [2]
- Q.4(b) A uniform plane wave is incident from air onto a glass normally. The intrinsic impedance of glass is 260Ω . Determine the reflection and refraction coefficients. [4]
- Q.4(c) A plane wave with electric field in y direction propagates with frequency 100MHZ in air in the + x direction and impinges normally on a perfectly conducting plane at $x = 0$. Assume the amplitude of E_i to be 6 (mV/m) write the phasor expression for a) E_i and H_i of incident wave b) E_r and H_r of relected wave and E_t and H_t of the total wave. [6]
- Q.5(a) Why TEM waves cannot exist in single conductor waveguides? [2]
- Q.5(b) An air filled rectangular wave guide has dimensions $a = 7.21$ cm and $b = 3.40$ cm calculate the cutoff frequency of TM_{12} mode? [4]
- Q.5(c) Derive wave impedance of Transverse magnetic waves propagating in a uniform waveguide [6]
- $$Z_{TM} = \frac{Y}{j\omega\epsilon}$$
- Q.6(a) Give a general definition for antenna. [2]
- Q.6(b) Write down steps to find electromagnetic field due to an assumed time harmonic current distribution on antenna structure? [4]
- Q.6(c) Determine E due to a given magnetic field H for a time harmonic current distribution in free space. [6]
- $$H = -a_\phi \frac{Idl}{4\pi} \beta^2 \sin\theta \left[\frac{1}{j\beta R} + \frac{1}{j\beta R^2} \right] e^{-j\beta R}$$
- Q.7(a) Why the Method of images is used in determining scalar potential V? [2]
- Q.7(b) Write the differential form and integral form of Maxwell's equations for time varying fields and their significance. [4]
- Q.7(c) A Positive point charge Q is located at distances d_1 and d_2 respectively from two grounded perpendicular conducting half planes as shown in the figure. Determine the force on Q caused by the charges induced on the planes? [6]



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