BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION)

CLASS: BE **SEMESTER: IV**
BRANCH: EEE **SESSION : SP/2019**

SUBJECT : EE4209 ENGINEERING ELECTROMAGNETICS

TIME: 1.5 HOURS **FULL MARKS: 25**

INSTRUCTIONS:
1. The total marks of the questions are 30.
2. Candidates may attempt for all 30 marks.
3. In those cases where the marks obtained exceed 25 marks, the excess will be ignored.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. The missing data, if any, may be assumed suitably.

Q1 (a) Electrostatic field is conservative field. Justify? [2]
(b) Two point charges Q_1 and Q_2 are located at (1,2,0) and (2,0,0) respectively. Find the relation between Q_1 and Q_2 such that the total force on a test charge at the point P(-1,1,0) will have no x component ? [3]

Q2 (a) Define Ampere's circuital law and write its equation in both differential and integral form for a static magnetic field? [2]
(b) For a continuous charge distribution ρ derive the equation of electrostatic energy density $w_e = \frac{1}{2} D.E$? [3]

Q3 (a) Define uniqueness theorem? [2]
(b) Derive Poisson's equation in electrostatics and express the equation in spherical coordinate system? [3]

Q4 (a) Express the Laplace equation in three dimensional cylindrical coordinate system? [2]
(b) Write the differential form and integral form of Maxwell's equations for time varying fields and their significance? [3]

Q5 (a) Calculate the skin depth of a Aluminium conductor at 1 MHz frequency if its conductivity is 3.54×10^7 ? [2]
(b) The instantaneous expression for magnetic field intensity of a uniform plane wave propagating in the positive y direction in air is given by [3]

$$H = a_z \, 4 \times 10^{-6} \cos\left(10^7 \pi t - k_0 y + \frac{\pi}{4}\right)$$

Determine k_0 and the location where H_z vanishes at t = 3 ms and write the instantaneous expression for E ?

Q6 (a) Write the Helmholtz homogenous and Non homogenous equations for time varying fields? [2]
(b) A plane wave with $E = a_x E_x$ propogates in a lossless simple medium ($\varepsilon_r = 4$, $\mu_r = 1$, $\sigma = 0$) in the positive Z direction. Assume E_x is sinusoidal with a frequency 100 MHz and has maximum value of 10^{-4} V/m at t = 0 and $Z = \frac{1}{8}$. Write the instantaneous expression for H? [3]

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