

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2018
B. Tech. in Electronics & Communication Engineering, Semester IV

Roll No.....

ECE403: Electromagnetic Field Theory

Time: 3 hours

Max. Marks: 100

Instructions to students:

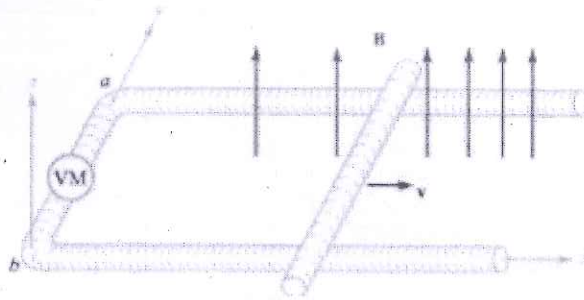
1. Do not write anything other than your roll number on question paper.
 2. Assume suitable data wherever required and mention it clearly.
 3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
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- Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10
- i. Which of the following parameters is not a primary parameter?
 - a) Resistance
 - b) Attenuation constant
 - c) Capacitance
 - d) Conductance
 - ii. When a transmission line has a load impedance same as that of the characteristic impedance, the line is said to be
 - a) Parallel
 - b) Perpendicular
 - c) Polarized
 - d) Matched
 - iii. The electric field strength at a far-off point P due to a point charge, $+q$ located at the origin O is 100 milliVolt/meter. The point charge is now enclosed by a perfectly conducting hollow metal sphere with its centre and the origin O. The electric field strength at the point, P is
 - a) Remains unchanged in its magnitude and direction
 - b) Remains unchanged in its magnitude but reverse in direction
 - c) Would be that due to a dipole formed by the charge, $+q$, at O and $-q$ induced
 - d) Would be zero
 - iv. The cable transmission line consists of
 - a) Conductors
 - b) Insulators
 - c) Insulated conductors
 - d) Insulated conductors with dielectric
 - v. Calculate the wavelength of the wave with phase constant of 3.14 units.
 - a) 1
 - b) 2
 - c) 0.5
 - d) 4

- vi. The product of the phase and the group velocities is given by the
 - a) Speed of light
 - b) Speed of light/2
 - c) 2 x Speed of light
 - d) (speed of light)/4
- vii. Which of the following are not vector functions in Electromagnetics?
 - a) Gradient
 - b) Divergence
 - c) Curl
 - d) There is no non- vector functions in Electromagnetics
- viii. Electromagnetic forces are defined by
 - a) Fleming's right hand rule
 - b) Fleming's left hand rule
 - c) Faraday's law
 - d) Ampere law
- ix. The del operator is called as
 - a) Gradient
 - b) Curl
 - c) Divergence
 - d) Vector differential operator
- x. The Snell law is applicable for perpendicular polarization and the Brewster law is applicable for parallel polarization. State True/False.

- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- a) What do you understand with loss tangent? Give the value of loss tangent for lossy dielectric.
 - b) State and explain Divergence theorem using mathematical equation.
 - c) State and explain Biot Savart's Law using mathematical equation.
 - d) Two field equations are given by
 $P = 2a_x - a_z$
 $Q = 2a_x - a_y + 2a_z$
 Calculate P.Q and $P \times Q$.
- Q.3A Determine D at (4,0,3) if there is a point charge -5π mC at (4,0,0) and a line charge 3π mC/m along the y axis. 05
- Q.3B Calculate the Electric Field Intensity due to infinite line charge at point P. 05
- Q.4A Assume that dry soil has $\sigma = 10^{-4}$ S/m, $\epsilon = 3\epsilon_0$ and $\mu = \mu_0$. Determine the frequency at which the ratio of the magnitudes of the conduction current density and the displacement current density is unity. 05
- Q.4B State Ampere's Circuit Law and calculate the H for Infinitely long coaxial transmission line. 05
- Q.5A A distortion less line has $Z_0 = 60$ ohm, $\alpha = 20$ mNp/m, $u = 0.6c$, where c is the speed of light in vacuum. Find R,L,G and C at 100 MHz. 05
- Q.5B For silver, $\sigma = 6.1 \times 10^7$ S/m. $\mu_r = 1$, $\epsilon_r = 1$, determine the frequency at which the penetration depth is 2 mm. 05

- Q.6A Discuss the causes and sources of electromagnetic interference. 05
- Q.6B A lossless transmission line with $Z_0 = 50 \text{ ohm}$ is 30 meter long and operates at 2MHz. The line is terminated with a load $Z_L = 60 + j40 \text{ ohm}$. If $\Gamma = 0.6$ on the line, find 05
- The reflection coefficient.
 - The standing wave ratio.
- Q.7A What do understand with Ohmic losses? 03
- Q.7B A magnetic field strength of 5 micro Amp/meter is required at a point on $\theta = \pi/2$, which is 2 Km from an antenna in air. Neglecting Ohmic losses, how much power must the antenna transmitted if it is 07
- A half-wave dipole?
 - A quarter-wave monopole?
- Q.8A Discuss different control techniques to suppress electromagnetic interference 03
- Q.8B The electric field intensity of a uniform plane wave in a medium ($\sigma = 0, \mu = \mu_0, \epsilon = \epsilon_0 \epsilon_r$) is $E = 12 \sin(2\pi \times 10^7 t - 3y) a_z \text{ V/meter}$. Determine the polarization of wave. 07
- Calculate ϵ_r .
 - Find the frequency.
 - Obtain the magnetic field intensity H.
- OR
- Q.8B Determine the Brewster angle for an air-seawater ($\epsilon = 81\epsilon_0$) interface for the following cases: 07
- EM plane wave passing from air to seawater.
 - EM wave passing from seawater to air.
- Q.9 The location of the sliding bar in figure is given by $x = 5t + 2t^3$, and the separation of the two rails is 20cm. Let $B = 0.8 x^2 a_z \text{ Tesla}$. Find the voltmeter reading at 10
- $t = 0.4 \text{ s}$
 - $x = 0.6 \text{ m}$



OR

- Q.9 In free space ($z \leq 0$), a plane wave with $H_i = 10\cos(10^8t - \beta z) \mathbf{a}_x$ mA/meter is incident normally on a lossless medium ($\mu = 8\mu_0$, $\epsilon = 2\epsilon_0$) in region $z \geq 0$. Determine the received wave H_r , E_r and the transmitted wave H_t , E_t . 10

- Q.10 Explain transformer and motional electromotive forces in detail 10

OR

- Q.10 Show that a linearly polarized plane wave of the form $E_s = E_0 e^{-j\beta z} \mathbf{a}_x$ can be expressed as the sum of the two circularly polarized waves. 10