Full Length Test - 1 [ECE/EE]

EMFT

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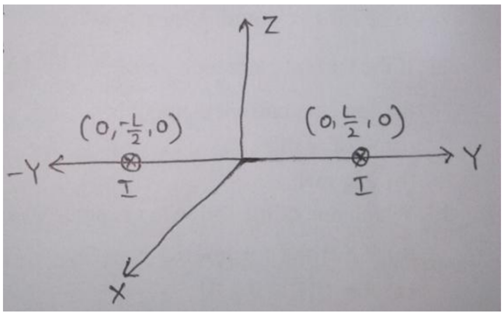
1. A field $\vec{A} = 3x^2yz\hat{a}_x + x^3z\hat{a}_y + (x^3y - 2z)\hat{a}_z$ can be termed as
   (a) Harmonic
   (b) Divergence less
   (c) Solenoidal
   (d) Rotational
2. Given $\vec{F} = z\hat{a}_x + x\hat{a}_y + y\hat{a}_z$, represents the portion of the sphere $x^2 + y^2 + z^2 = 1$ for $z \geq 0$. Then $\int_s (\vec{\nabla} X \vec{F}).ds$ is ……………………..?
3. The following four fields are given in Cartesian co-ordinate system. The vector field which does not satisfy the property of magnetic flux density is
   (a) $y^2\hat{a}_x + z^2\hat{a}_y + x^2\hat{a}_z$
   (b) $x^2\hat{a}_x + z^2\hat{a}_y + y^2\hat{a}_z$
   (c) $z^2\hat{a}_x + x^2\hat{a}_y + y^2\hat{a}_z$
   (d) $y^2z^2\hat{a}_x + x^2z^2\hat{a}_y + x^2y^2\hat{a}_z$
4. A steady current I is flowing in the x-direction through of two infinitely long wires at $y = \pm\frac{1}{2}$ as shown in figure. The permibility of medium is μ_0. The $\vec{B}$ field at (0, L, 0) is



   (a) $-\frac{4\mu_0 I}{3\pi L}\hat{a}_z$
   (b) $+\frac{4\mu_0 I}{3\pi L}\hat{a}_z$
   (c) 0
   (d) $-\frac{3\mu_0 I}{4\pi L}\hat{a}_z$
5. Let $\vec{\nabla}.(f.\vec{v}) = x^2y + y^2z + z^2x$, where f is scalar and v is vector. If $\vec{v} = y\hat{i} + j\hat{j} + x\hat{k}$. Then $\vec{v}.\left(\vec{\nabla}(f)\right)$ is
   (a) $x^2y + y^2z + z^2x$
   (b) $2xy + 2yz + 2zx$
   (c) 0
   (d) None of the above
6. Two semi-infinite dielectric regions are separated by a plane boundary at y = 0. The $\epsilon_{r_1} = 2, (y < 0)$ and $\epsilon_{r_2} = 5, (y > 0)$. The $(y < 0)$ region 1 has uniform electric field $\vec{E} = 3\hat{a}_x + 4\hat{a}_y + 2\hat{a}_z$. The electric field in region 2 (y > 0) is
   (a) $\vec{E}_2 = 3\hat{a}_x + 10\hat{a}_y + 0.8\hat{a}_z$
   (b) $\vec{E}_2 = 3\hat{a}_x + 1.6\hat{a}_y + 2\hat{a}_z$
   (c) $\vec{E}_2 = 1.2\hat{a}_x + 4\hat{a}_y + 0.8\hat{a}_z$
   (d) $\vec{E}_2 = 1.2\hat{a}_x + 4\hat{a}_y + 2\hat{a}_z$
7. If the electric field intensity is given by $\vec{E} = \left(x\hat{a}_x + y\hat{a}_y + z\hat{a}_z\right) V/m$. The potential difference between point P (2,0,0) and Q (1,2,3) is
   (a) +1 Volt
   (b) -1 Volt
   (c) +5 Volt
   (d) +6 Volt
8. Let the radial component for the spherical co-ordinate system is given by the equation $|A| = \frac{5}{4}r^2$, where $\sqrt{x^2 + y^2 + z^2} = 1$. Then the value of the integral $-\oiint \vec{A}.d\vec{s} = ?$

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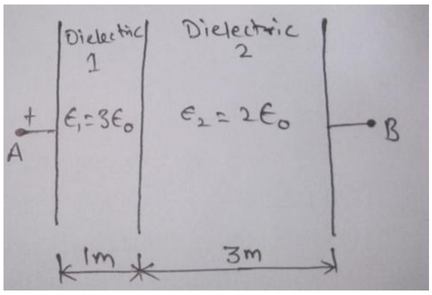
9. A parallel plate capacitor has two layers of dielectrics with permitivities $\epsilon_1 = 3\epsilon_0$ and $\epsilon_2 = 2\epsilon_0$ as shown in figure. Then the capacitance without dielectric is C_0. Then the new capacitance across AB is



(a) $2C_0$
(b) $3C_0$
(c) $\frac{C_0}{2}$
(d) $\frac{C_0}{3}$

10. The magnetic field at a distance r from the center of the wire is proportional to
(a) r for $r < a$ *and* $\frac{1}{r^2}$ for $r > a$
(b) 0 for $r < a$ *and* $\frac{1}{r}$ for $r > a$
(c) r for $r < a$ *and* $\frac{1}{r}$ for $r > a$
(d) 0 for $r < a$ *and* $\frac{1}{r^2}$ for $r > a$

11. If the current element represented by $4 \text{ X } 10^{-4}\hat{a}_y$ Amp-m is placed in a magnetic field $\vec{H} = \frac{5}{\mu}\hat{a}_x$ A/m, the force on current element is
(a) $-2\hat{a}_z$ mN
(b) $2\hat{a}_z$ mN
(c) $-2\hat{a}_z$ N
(d) $2\hat{a}_z$ N

12. Which one of the following is not a Maxwell's equation?
(a) $\nabla \text{ X } \vec{H} = (\sigma + j\omega\epsilon)\vec{E}$
(b) $\vec{F} = Q[\vec{E} + \vec{v} \text{ X } \vec{B}]$
(c) $\oint \vec{H}.d\vec{l} = \oint \vec{J}.\partial\vec{s} + \oint \frac{\partial\vec{D}}{\partial t}.d\vec{s}$
(d) $\oint \vec{B}.\partial\vec{s} = 0$

13. If $\vec{E} = (\hat{a}_x + j\hat{a}_y)e^{j(\omega t - Bz)}$ and $\vec{H} = \frac{k}{\omega\mu}(\hat{a}_y + j\hat{a}_x)e^{j(\omega t - Bz)}$, the average pointing vector is
(a) Null vector
(b) $\frac{k}{\omega\mu}\hat{a}_z$
(c) $\frac{2k}{\omega\mu}\hat{a}_z$
(d) $\frac{k}{2\omega\mu}\hat{a}_z$

14. If the electric field intensity associated with a uniform EM plane wave traveling in a perfect dielectric medium is given by $E(z,t) = 10\cos(2\pi \text{ X } 10^7 t - 0.1\pi z)$ V/m. Then the phase velocity v_p of the wave is
(a) $3 \text{ X } 10^8$ m/sec
(b) $2 \text{ X } 10^8$ m/sec
(c) $6.28 \text{ X } 10^7$ m/sec
(d) $2 \text{ X } 10^7$ m/sec

15. In free space $\vec{H}$ field is given as $\vec{H}(z,t) = -\frac{1}{6\pi}\cos(\omega t + Bz)\hat{a}_y$, then $E(z,t)$ =?
(a) $20\cos(\omega t + Bz)\hat{a}_x$
(b) $20\cos(\omega t + Bz)\hat{a}_z$
(c) $20\sin(\omega t + Bz)\hat{a}_y$
(d) $20\sin(\omega t + Bz)\hat{a}_x$

16. A uniform plane wave in air incident at 45^0 angle on a lossless materials with dielectric constant ϵ_r. The transmitted wave propagating with angle 30^0 with respect to normal. The value of ϵ_r is
(a) 1.5
(b) $\sqrt{1.5}$
(c) 2
(d) $\sqrt{2}$

17. Which one of the following is not boundary condition at an interface between two media?

(a) $\hat{n}.(\vec{D}_1 - \vec{D}_2) = P_s$
(b) $\hat{n} \, X \, (\vec{H}_1 - \vec{H}_2) = \hat{k}$
(c) $\hat{n}.(\vec{B}_1 - \vec{B}_2) = 0$
(d) $\hat{n} \, X \, (\vec{D}_1 - \vec{D}_2) = P_s$

18. Consider a vector field $\vec{A}(r)$. The closed loop line integral $\oint \vec{A}.d\vec{l}$ can be expressed as

(a) $\oiint_s (\vec{\nabla} X \vec{A}).d\vec{s}$
(b) $\oiiint_V (\vec{\nabla}.\vec{A}) \, dV$
(c) $\iiint_V (\vec{\nabla}.\vec{A}).dV$
(d) $\iint_S (\vec{\nabla} X \vec{A}) \, ds$

19. The longitudinal component of the magnetic field inside an air-field rectangular wave-guide made of a perfect electric conductor is given by the following expression.

$$H_z = 0.1\cos(2\pi x)\cos(30.3\,\pi y)\cos(12\pi \, X \, 10^9 t - \beta z) \, A/m$$

The cross-sectional dimensions of W.G. are a = 0.08 m, b = 0.0033 m. The mode of propagation inside the guide is

(a) Tm_{12}
(b) TE_{21}
(c) Tm_{21}
(d) TE_{12}

20. The type of polarization and the frequency of wave for electric field wave are

$$\vec{E} = 10(\hat{y} + j\hat{z})e^{-j2\pi x}$$

(a) 1.2 GHz, RCP
(b) 1.2 GHz, LCP
(c) 4 GHz, RCP
(d) 4 GHz, LCP

21. Inductance and capacitance per unit length of a lossless transmission line are 250 nH/m and 0.1 nF/m respectively. The velocity of the wave propagation and characteristic impedance of the transmission line are respectively.

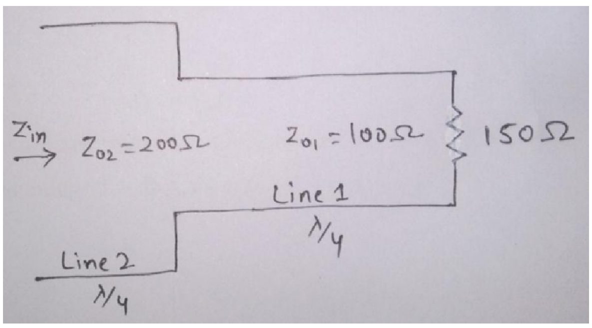
(a) $2 \, X \, 10^8 \, m/s, 100\Omega$
(b) $3 \, X \, 10^8 \, m/s, 50\Omega$
(c) $2 \, X \, 10^8 \, m/s, 50\Omega$
(d) $3 \, X \, 10^8 \, m/s, 100\Omega$

22. A transmission line has the characteristic impedance Z_0 and the voltage standing wave ratio is S. The line impedance on the transmission line at voltage maximum and minimum are respectively.

(a) $Z_0 S, \frac{Z_0}{S}$
(b) $\frac{Z_0}{S}, Z_0 S$
(c) $Z_0 S, Z_0 S$
(d) $\frac{Z_0}{S}, \frac{Z_0}{S}$

23. A lossless transmission line of characteristic impedance $Z_0 = 25\Omega$ is connected to a load impedance $Z_L = (15 - j25)\Omega$. What will be the standing wave ratio on the line?

24. A $\lambda/4$ section of a 100Ω lossless transmission line terminated in a 150 Ω resistive load is preceded by another $\lambda/4$ section of a 200 Ω lossless line as shown in figure. What is the input impedance, Z_{in} (in Ω)?



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25. A coaxial-cable with an inner diameter of 1 mm and outer diameter of 2.4 mm is filled with a dielectric of relative permittivity 10.89. Given $\mu_0 = 4\pi \, X \, 10^{-7} \, H/m, \varepsilon_0 = \frac{10^{-9}}{36\pi} F/m$, the characteristic impedance of the cable is
    (a) 330 Ω
    (b) 100 Ω
    (c) 143.3 Ω
    (d) 43.4 Ω
26. A ideal lossless transmission line of $Z_0 = 60\Omega$ is connected to unknown Z_L. If SWR = 4, find Z_L.
    (a) 240 Ω
    (b) 480 Ω
    (c) 120 Ω
    (d) 100 Ω
27. $Z_L = 200\Omega$ and it is desired that $Z_{in} = 50\Omega$. The quarter wave transformer should have a characteristic impedance of
    (a) 100 Ω
    (b) 40 Ω
    (c) 10000 Ω
    (d) 4 Ω
28. What is the attenuation constant α for distortion less transmission line?
    (a) $\alpha = 0$
    (b) $\alpha = R\sqrt{\frac{C}{L}}$
    (c) $\alpha = R\sqrt{\frac{L}{C}}$
    (d) $\alpha = \sqrt{\frac{RL}{C}}$