14. a) Calculate the characteristic impedance of free space.

[**OR**]

b) Obtain the wave equation of electromagnetic wave in one dimesion.

15. a) Distinguish Coulomb Gauge and Lorentz Gauge.

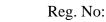
[**OR**]

b) Give Jefimenko's equation.

SECTION - C [3 X 10 = 30]

Answer Any THREE Questions.

- 16. Explain the polarization of a dielectric material and derive the expression for field inside and outside the dielectrics.
- 17. Derive the expressions for magnetic flux intensity due to solenoid of the coil.
- 18. With necessary explanation, derive the Maxwell's equation in differential and integral form.
- 19. Show that in a good conductor the magnetic field lags the electric filed and find there ratio of their amplitudes.
- 20. An infinite straight wire carries the current $f(x) = \begin{cases} -0, t \le 0 \\ I_0, t \ge 0 \end{cases}$ that is a constant current I_0 is turned on abruptly at t = 0. Find the resulting electric and magnetic fields.



G.T.N. ARTS COLLEGE (AUTONOMOUS)

(Affiliated to Madurai Kamaraj University) (Accredited by NAAC with 'B' Grade)

END SEMESTER EXAMINATION – APRIL 2021

Programme: M.Sc. Physics	Date: 17.6.2021
Course Code:19PPHC42	Time: 10 am. to 1 pm.
Course Title : Electromagnetic Theory	Max. Marks :75

SECTION – A

[10 X 1 = 10]

Answer ALL the Questions.

Choose the Correct Answer.

1. The device which work based on electrostatics principle is _____.

[a] GM Counter	
----------------	--

[b] Michelson Interferometer

[c] Ion drive rocket engine [d] Automobile Engines

2. Consider four equal charges placed at the corners of square. What is the value of electric field where potential is non-zero?

[a] definite maximum	[b] definite minimum
[c] Infinity	[d] zero

3. In the presence of both electric and magnetic fields, the net force on any point charge Q is _____.

[a]
$$F = Q(v \times B)$$

[b] $F = Q\{E + (v \times B)\}$
[c] $F = Q\{E - (v \times B)\}$
[d] $F = -Q(v \times B)$
4. $\oint B. dI =$ _____
[a] $\mu_0 \int J. da$
[b] $E + \mu_0 \int J. da$
[c] Zero
[d] $\mu_0/4\pi$

5. The bound current is _____.

$[a] J_b = \nabla \times M$	$[b] J_b = \nabla \times B$
$[c] J_b = \nabla . D$	$[\mathbf{d}] J_b = \nabla . B$

6. Integral form of Maxwell's third equation is _____.

$[a] \oint E.dI = -\frac{d}{dt} \int J.da$	$[b] \oint E.dI = -\frac{d}{dt} \int H.da$
$[c] \oint H.dI = -\frac{d}{dt} \int B.da$	$[d] \oint E. dI = -\frac{d}{dt} \int B. da$

 A wave whose amplitude is the same at any point in a plane perpendicular to specified direction is called _____.

- [a] Sinusoidal wave[b] Square wave[c] Plane wave[d] Rectangular Wave
- 8. Fresnel's equation for the reflection amplitude for the case of polarization in the plane of incidence is _____.

[a]
$$\tilde{E}_{0R} = \left(\frac{\alpha+\beta}{\alpha-\beta}\right) \tilde{E}_{0I}$$
 [b] $\tilde{E}_{0R} = \left(\frac{\alpha-\beta}{\alpha+\beta}\right) \tilde{E}_{0I}$
[c] $\tilde{E}_{0R} = \left(\frac{\alpha-\beta}{\alpha-\beta}\right) \tilde{E}_{0I}$ [d] $\tilde{E}_{0R} = \left(\frac{\alpha+\beta}{\alpha+\beta}\right) \tilde{E}_{0I}$

9. Consider magnetic vector potential A and scalar potential Φ which define the magnetic field B and electric field E. If one adds -∇λ to A for a welldefined λ, then what should be added to Φ so, that E remains unchanged up to an arbitrary function of time f(t), _____

[a]
$$\frac{\partial \lambda}{\partial t}$$
[b] $-\frac{\partial \lambda}{\partial t}$ [c] $\frac{1}{2} \frac{\partial \lambda}{\partial t}$ [d] $-\frac{1}{2} \frac{\partial \lambda}{\partial t}$

10. If the vector potential $\vec{A} = \alpha x \hat{x} + 2y \hat{y} - 3z \hat{z}$, satisfies the Coulomb		
gauge, the value of the constant α is		
[a] 0	[b] 2	
[c] -3	[d] 1	

SECTION – B [5 X 7 = 35] Answer ALL the Questions.

11. a) Obtain the relationship between the net electric flux through a closed surface and the charge enclosed by the surface.

[OR]

b) Explain Poisson and Laplace's equations in electrostatics.

12. a) State Ampere circuital law. Derive the relation between relative permeability and susceptibility.

[OR]

- b) Discuss about magnetostatic boundary conditions.
- 13. a) Prove that energy stored in the magnetic field in the amount of $(B^2/2\mu_0)$ per unit volume.

[**OR**]

b) Sea water at frequency $v = 4 \times 10^8$ Hz has permittivity $\epsilon = 81\epsilon_0$, permeability $\mu = \mu_0$, and resistivity $\rho = 0.23 \ \Omega$.m. What is the ratio of conduction current to displacement current?