SSR DEGREE COLLEGE (AUTONOMOUS) NIZAMAMABAD
SEM –I INTERNAL – II
M.SC. PHYSICS SUB: EMT (PAPER-3)
QUESTION BANK

I. Fill in the Blanks (with Answers)

1. The interaction of EM radiation with matter mainly occurs through **electric dipole** interaction.
   Answer: electric dipole
2. The probability of absorption or emission of radiation is given by **Einstein coefficients**.
   Answer: Einstein coefficients
3. The interaction Hamiltonian for EM waves with matter is proportional to **– μ · E**.
   Answer: dipole moment, electric field
4. When the frequency of incident radiation matches the natural frequency of an atom, **resonance** occurs.
   Answer: resonance
5. The absorption of photons raises an electron to a **higher energy level**.
   Answer: excited state / higher energy level
6. Spontaneous emission does not depend on the **radiation field density**.
   Answer: radiation field density
7. The refractive index of a medium depends on the **polarizability** of atoms or molecules.
   Answer: polarizability
8. In Raman scattering, the scattered photon has **different energy** from the incident photon.
   Answer: different
9. The process in which photons are emitted in phase is called **stimulated emission**.
   Answer: stimulated emission
10. Plasma frequency depends on the **electron density** of the medium.
    Answer: electron density
11. Maxwell's equations in free space predict the existence of **electromagnetic waves**.
    Answer: electromagnetic waves
12. The speed of electromagnetic waves in vacuum is given by **c=1μ0ε0c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}c=μ0 ε0 1** .
    Answer: 1μ0ε0\frac{1}{\sqrt{\mu_0 \varepsilon_0}}μ0 ε0 1
13. The displacement current term was introduced by **Maxwell**.
    Answer: Maxwell
14. The Poynting vector represents the **energy flow per unit area** of an EM wave.
    Answer: energy flow per unit area
15. The radiation field varies inversely as **1/r**.
    Answer: 1/r

16. In the far-field region, electric and magnetic fields are **mutually perpendicular**.
    Answer: mutually perpendicular
17. The scalar potential satisfies the **Poisson equation** in electrostatics.
    Answer: Poisson equation
18. The gauge condition commonly used in radiation problems is the **Lorentz gauge**.
    Answer: Lorentz gauge
19. An oscillating electric dipole emits **electromagnetic radiation**.
    Answer: electromagnetic radiation
20. The total power radiated by an accelerating charge is given by **Larmor's formula**.
    Answer: Larmor's formula

II. Multiple Choice Questions (MCQs)

1. The dominant interaction between EM waves and atoms in optical frequencies is:

A) Magnetic dipole
B) Electric quadrupole
C) Electric dipole
D) Nuclear interaction

✓ **Answer:** C) Electric dipole

2. Which process is responsible for laser action?

A) Absorption
B) Spontaneous emission
C) Stimulated emission
D) Raman scattering

✓ **Answer:** C) Stimulated emission

3. The Einstein coefficient A represents:

A) Absorption probability
B) Stimulated emission probability
C) Spontaneous emission probability
D) Scattering probability

✓ **Answer:** C) Spontaneous emission probability

4. When EM waves propagate through plasma, propagation is possible only if:

A) ω < ωp
B) ω = ωp
C) ω > ωp
D) ω = 0

✓ **Answer:** C) ω > ωp
(ωp = plasma frequency)

5. Which scattering involves no change in photon energy?

A) Raman scattering
B) Compton scattering
C) Rayleigh scattering
D) Brillouin scattering

✓ **Answer:** C) Rayleigh scattering

6. Polarization of a dielectric medium is defined as:

A) Dipole moment per unit volume
B) Charge per unit volume
C) Energy per unit volume
D) Electric field per unit charge

✓ **Answer:** A) Dipole moment per unit volume

7. The complex refractive index is associated with:

A) Reflection only
B) Absorption only
C) Dispersion and absorption
D) Scattering

✓ **Answer:** C) Dispersion and absorption

8. The selection rule for electric dipole transitions is:

A) Δl = 0
B) Δl = ±1
C) Δm = 0 only
D) Δn = 0

✓ **Answer:** B) Δl = ±1

9. Raman effect is due to:

A) Electronic transitions
B) Nuclear transitions
C) Rotational and vibrational transitions
D) Ionization

✓ **Answer:** C) Rotational and vibrational transitions

10. In matter–radiation interaction, dispersion arises due to:

A) Free electrons
B) Bound electrons
C) Neutrons
D) Nuclei

✓ **Answer:** B) Bound electrons

1. Which Maxwell equation introduces the concept of displacement current?

A) Gauss's law
B) Faraday's law
C) Ampere–Maxwell law
D) Gauss's law for magnetism

✓ **Answer:** C) Ampere–Maxwell law

2. The Poynting vector is defined as:

A) $\vec{E} \cdot \vec{B}$\vec{E} \cdot \vec{B}E·B
B) $\vec{E} \times \vec{B}$\vec{E} \times \vec{B}E×B
C) $\vec{B} \times \vec{H}$\vec{B} \times \vec{H}B×H
D) $\vec{E} \times \vec{D}$\vec{E} \times \vec{D}E×D

✓ **Answer:** B) $\vec{E} \times \vec{B}$\vec{E} \times \vec{B}E×B

3. In the radiation zone, the ratio of electric to magnetic field is:

A) ε_o
B) μ_o
C) c
D) μ0/ε0\sqrt{\mu_0/\varepsilon_0}μ0 /ε0

✓ **Answer:** D) μ0/ε0\sqrt{\mu_0/\varepsilon_0}μ0 /ε0

4. The vector potential A is related to magnetic field B by:

A) $\vec{B} = -\nabla \vec{A}$B=−∇A
B) $\vec{B} = \nabla \times \vec{A}$B=∇×A
C) $\vec{B} = \nabla \cdot \vec{A}$B=∇·A
D) $\vec{B} = \partial \vec{A} / \partial t$B=∂A/∂t

✓ **Answer:** B) $\vec{B} = \nabla \times \vec{A}$B=∇×A

5. The condition satisfied by scalar and vector potentials in Lorentz gauge is:

A) $\nabla \cdot \vec{A} = 0$∇·A=0
B) $\nabla \cdot \vec{A} + \mu_0 \varepsilon_0 \frac{\partial \phi}{\partial t} = 0$∇·A+μ0 ε0 ∂t∂φ =0
C) $\nabla \times \vec{A} = 0$∇×A=0
D) $\phi = 0$φ=0

✓ **Answer:** B)

6. Radiation from an accelerating charge is due to:

A) Uniform motion
B) Constant velocity
C) Acceleration
D) Rest mass

✓ **Answer:** C) Acceleration

7. The angular distribution of radiation from an oscillating dipole is proportional to:

A) $\cos \theta$cosθ
B) $\sin \theta$sinθ
C) $\sin^2 \theta$sin2θ
D) $\cos^2 \theta$cos2θ

✓ **Answer:** C) $\sin^2 \theta$sin2θ

8. Which of the following quantities is conserved in electromagnetic radiation?

A) Electric field
B) Magnetic field
C) Energy
D) Vector potential

✓ **Answer:** C) Energy

9. The near field of an antenna is also called:

A) Radiation zone
B) Induction zone
C) Far field
D) Wave zone

✓ **Answer:** B) Induction zone

10. Retarded potentials arise because:

A) Fields propagate instantaneously
B) Fields propagate with finite velocity
C) Charges are stationary
D) Fields are static

✓ **Answer:** B) Fields propagate with finite velocity

III. DESCRIPTIVE QUESTIONS

1. Obtain the boundary conditions for E.D.B and H.
2. How does reflection and refraction of EM waves occur at a plane interface dielectrics
3. Explain about Multiple expansion of EM radiations for harmonically oscillator
4. Get the expressions for Lienard Wiechart potentials
5. Obtain the expression for transmission and reflections coefficients of EM wave