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B. Tech.
(SEM I) THEORY EXAMINATION 2018-19
PHYSICS

Time: 3 Hours *Total Marks: 100*

Note: 1. Attempt all Sections. If require any missing data, then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x10 = 20

a. Write down the postulates of special theory of relativity. [CO 1]
b. How will you show that no particle can move with a velocity greater than the velocity of light in an inertial frame? [CO 1]
c. Why Maxwell proposed that Ampere's law require modification? [CO 2]
d. What do you mean by depth of penetration? [CO 2]
e. Determine the de-Broglie wavelength of a photon. [CO 3]
f. Discuss the physical significance of a wave function. [CO 3]
g. Why two independent sources cannot be coherent? [CO 4]
h. What do you mean by resolving power of an optical instrument? [CO 4]
i. Distinguish between spontaneous and stimulated emissions. Which one is required for laser? [CO 5]
j. What is the principle of operation of an optical fiber? [CO 5]

SECTION B

2. Attempt any *three* parts of the following: 10 x 3 = 30

a. Deduce the relativistic velocity addition theorem. Show that it is consistent with Einstein's second postulate. [CO 1]
b. Write the Maxwell's equations in integral as well as in differential form and explain their physical significance. Show that the velocity of plane electromagnetic wave in the free space is given by $c = 1/\sqrt{(\mu_0 \varepsilon_0)}$. [CO 2]
c. Obtain time independent and time dependent Schrodinger's wave equations. [CO 3]
d. Discuss the phenomenon of Fraunhofer diffraction at a single slit and show that the relative intensities of the successive maximum are nearly [CO 4]

$$1 : \frac{4}{9\Pi^2} : \frac{4}{25\Pi^2} : \frac{4}{49\Pi^2} \cdots\cdots$$

e. Discuss the structure of an optical fiber. What are various types of optical fibers? Explain their advantages and disadvantages. [CO 5]

SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10

(a) What do you mean by length contraction? Deduce the necessary expression for this. [CO 1]
(b) Obtain the volume of a cube, the proper length of each edge of which is l_0 when it is moving with velocity v along one edge of [CO 1]

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the cube.

(c) Deduce an expression for the variation of mass with velocity. [CO 1]

4. Attempt any *two* parts of the following: 5 x 2 = 10

(a) What is Poynting vector? Derive and explain Poynting theorem. [CO 2]

(b) Deduce Coulomb's law of electro-statistics from Maxwell's first equation. [CO 2]

(c) Calculate the magnitude of Poynting vector at the surface of the sun. Given that power radiated by sun is 5.4×10^{25} watt and radius of sun is 7×10^{8} m. [CO 2]

5. Attempt any *two* parts of the following: 5 x 2 = 10

(a) A particle is in motion along a line $x = 0$ and $x = l$, with zero potential energy. At points for which $x < 0$ and $x > l$, the potential energy is infinite. Solving Schrodinger equation, obtain energy eigen values & normalized wave function for the particle. [CO 3]

(b) What is Compton effect? Derive the necessary expression for Compton shift. [CO 3]

(c) Show that $\psi(x, y, z, t) = \psi(x, y, z)e^{-i\omega t}$ is a wave function of a stationary state. [CO 3]

6. Attempt any *two* parts of the following: 5 x 2 = 10

(a) Explain the formation of Newton's ring. Prove that in reflected light the diameter of dark rings are proportional to the square root of natural numbers. [CO 4]

(b) Light of wavelength 6000 Å falls normally on a thin wedge-shaped film of refractive index 1.4 forming fringes that are 2.0 mm apart. Find the angle of wedge in seconds. [CO 4]

(c) In a grating spectrum, which spectral line in 4th order will overlap with 3rd order line of 5461 Å. [CO 4]

7. Attempt any *two* parts of the following: 5 x 2 = 10

(a) Describe the construction and working of Ruby Laser with neat diagram. [CO 5]

(b) Calculate the population ratio of two states in He-Ne laser that produces light of wavelength 6000Å at 27°C. [CO 5]

(c) Calculate the numerical aperture, acceptance angle, and the critical angle of the optical fiber if the refractive index of the core is 1.50 and refractive index of cladding is 1.45. [CO 5]

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