PAPER ID-411328

Subject Code: KAS101

Roll No: | | | | | | | | | | | | | |

# BTECH
## (SEM I) THEORY EXAMINATION 2021-22
## 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 x 10 = 20**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | What is inertial and non-inertial frame of references? | 2 | 1 |
| b. | Show that the massless particle can exist only if they move with the speed of light and their energy E and momentum p must have the relation E= pc. | 2 | 1 |
| c. | Write Maxwell's equations in non-conducting medium. | 2 | 2 |
| d. | Define skin depth. | 2 | 2 |
| e. | Distinguish electromagnetic waves and matter waves? | 2 | 3 |
| f. | What is de-Broglie hypothesis? | 2 | 3 |
| g. | What are coherent sources? | 2 | 4 |
| h. | State Rayleigh's criterion of resolution. | 2 | 4 |
| i. | Explain the propagation mechanism of optical fiber. | 2 | 5 |
| j. | What are the main components of laser? | 2 | 5 |

### SECTION B

**2. Attempt any *three* of the following:**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | What is length contraction? Derive the necessary expression for it. Show that $x^2+y^2+z^2- c^2t^2$ is invariant. under Lorentz transformation. | 10 | 1 |
| b. | Show that the radiation pressure exerted by an electromagnetic wave is equal to the energy density. For a medium, conductivity $\sigma = 58 \times 10^6$ seimen/m, $\epsilon_r = 1$. Find out the conduction and displacement current densities if the magnitude of electric field intensity is given by $E = 150 \sin (10^{10} t)$ Volt/m. | 10 | 2 |
| c. | Define wave function with its physical significance. Derive Schrodinger's time independent wave equation. | 10 | 3 |
| d. | Prove that reflection and transmission are complimentary in thin film interference. | 10 | 4 |
| e. | Develop the expressions for acceptance angle and numerical aperture of an optical fiber. A step index fiber has core refractive index 1.466, cladding refractive index 1.46. If the operating wavelength of the rays is 0.85 μm, calculate the cut – off parameter and the number of modes, which the fibre will support. The diameter of the core = 50 μm. | 10 | 5 |

### SECTION C

**3. Attempt any *one* part of the following:**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | By using Lorentz transformation equations, derive time dilation. Show that time dilation is a real effect. | 10 | 1 |
| b. | Derive Einstein's mass-energy relation Calculate the amount of work to be done to increase the speed of an electron from 0.6C to 0.8C. Given that the rest mass energy of electron= 0.5 MeV. | 10 | 1 |

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**4. Attempt any *one* part of the following:**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | Derive the Poynting or work-energy theorem for the flow of energy in an electromagnetic field. Also give the physical interpretation. | 10 | 2 |
| b. | With the help of Maxwell's equations for free space, derive electromagnetic wave equation in free space and prove that electromagnetic waves are transverse in nature. | 10 | 2 |

**5. Attempt any *one* part of the following:**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | Solve Schrodinger's wave equation for a particle in one dimensional infinite potential box. Compute the energy difference between the ground state & the first excited state for an electron in a one-dimensional rigid box of length 100 A°. | 10 | 3 |
| b. | Define Compton effect and apply it to find an expression for the Compton shift ($\Delta\lambda$). | 10 | 3 |

**6. Attempt any *one* part of the following:**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | Explain and describe the formation of Newton's rings in reflected light. Solve it for reflected light to prove that the diameters of dark rings are proportional to the square roots of natural numbers. Light of wavelength 6000 $A^0$ 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. | 10 | 4 |
| b. | Discuss single slit Fraunhofer's diffraction and make use to show that the relative intensities of successive maximum are nearly 1: 1/22 : 1/62 : 1/121:.... | 10 | 4 |

**7. Attempt any *one* part of the following:**

| Qno. | Question | Marks | CO |
|---|---|---|---|
| a. | With the help of diagram, classify and describe various types of optical fibers based on modes and core refractive index. | 10 | 5 |
| b. | With the help of diagram describe the process of spontaneous and stimulated emission of radiation. Also obtain an expression for Einstein's coefficients of spontaneous and stimulated emission of radiation. Analyze the value of population of two states in He-Ne laser that produces light of wavelength 6000 Å at 27°C. | 10 | 5 |

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# BTECH
## (SEM I) THEORY EXAMINATION 2021-22
## ENGINEERING PHYSICS

**Time: 3 Hours** **Total Marks: 100**

**Note:** Attempt all the sections. If require any missing data, then choose suitably.

## Section A

**1. Attempt all questions in brief:2 x 10 = 20**

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | Differentiate between inertial and non- inertial frames. | 2 | 1 |
| b. | Show that the rest mass of a photon is zero. | 2 | 1 |
| c. | Write the similarities and dissimilarities between conduction and displacement current. | 2 | 2 |
| d. | Define the Poynting vector and write its unit. | 2 | 2 |
| e. | State the Wien's displacement law. | 2 | 3 |
| f. | Distinguish between modified and unmodified x-rays. | 2 | 3 |
| g. | The light rays from two independent bulbs do not show interference. Give the reason. | 2 | 4 |
| h. | State the Rayleigh criteria of resolution. | 2 | 4 |
| i. | What is an optical fibre? How does a light signal propagate through it? | 2 | 5 |
| j. | Write the essential requirements for the laser action. | 2 | 5 |



## Section B

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

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | Show that $E^2=p^2c^2+m_0^2c^4$ | 10 | 1 |
| b. | Find the skin depth δatafrequencyof3.0x $10^6$Hzinaluminiumwhere σ=38.0 x $10^6$S/m and $\mu_r$=1. | 10 | 2 |
| c. | An electron is bound in one dimensional potential box which has width 2.5 x $10^{-10}$m. Assuming the height of the box to be infinite, calculate the lowest permitted energy values of the electron. | 10 | 3 |
| d. | White light is incident on a soap film at an angle $Sin^{-1}$ (4/5) and the reflected light is observed with a spectroscope. It is found that two consecutive dark bands correspond to wavelengths 6.1x$10^{-5}$ cm and 6.0x$10^{-5}$ cm. If the refractive index of the film is 4/3, calculate the thickness. | 10 | 4 |
| e. | A communication system uses a 10 km fiber having a loss of 2.5dB/km. Compute the output power if the input power is 500μW. | 10 | 5 |

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**ENGINEERING PHYSICS**

## Section C

**3. Attempt ant one of the following:** **1 x 10 =10**

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | State the postulates of special theory of relativity and derive the Lorentz transformation equations. When Lorentz transformation equations get reduced to Galilean transformation equations? | 10 | 1 |
| b. | State and prove the velocity addition theorem. Show that the theorem is consistent with the Einstein's second postulate. | 10 | 1 |

**4. Attempt any one of the following:** **1 x 10 =10**

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | Establish the e-m waves' equations in free space and solve them to show that they travel with the speed of light in free space and are transverse in nature. | 10 | 2 |
| b. | State and prove the Poynting theorem. Show that E/H = 377 Ohm. | 10 | 2 |

**5. Attempt any one of the following:** **1 x 10 =10**

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | What is the Planck's theory of black body radiations? Obtain an expression for the average energy of the oscillators and derive the Planck's radiation law. | 10 | 3 |
| b. | Write the Schrodinger's wave equation for a particle in one-dimensional box and solve it to obtain the eigen values and eigen functions. | 10 | 3 |

**6. Attempt any one of the following:** **1 x 10 =10**

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | What do you mean by a wedge-shaped film? Discuss the interference due to it and obtain the expression for the fringe width. | 10 | 4 |
| b. | Discuss the formation of Newton's rings. Show that the diameters of the bright rings are proportional to the square root of odd natural numbers. | 10 | 4 |

**7. Attempt any one of the following:** **1 x 10 =10**

| Q.N. | Question | Marks | CO |
|---|---|---|---|
| a. | What do you mean by acceptance angle and numerical aperture? Derive the expressions for acceptance angle and numerical aperture. | 10 | 5 |
| b. | What do you understand by the stimulated emission? Discuss the He-Ne laser by giving its construction and working. How He-Ne laser is superior to the Ruby laser? | 10 | 5 |

**Physical Constants:**
Rest mass of electron $m_o$= 9.1 x $10^{-31}$kg, Speed of light c = 3 x $10^8$ m/s
Planck 's Constant h = 6.63 x $10^{-34}$ J-s, Charge on electron e = 1.6 x $10^{-19}$Coulomb