

PhysicsByAaryan

CSIR NET . GATE . JEST . BARC - Physics

Waveguides - CSIR NET Physics PYQs

Electromagnetism . All PYQs (2015-2025) with answer key

7 questions . Answer key included

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Q1. [June 2015] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET	2015 June	5 M
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Consider a rectangular wave guide with transverse dimensions $2\text{ m} \times 1\text{ m}$ driven with an angular frequency $\omega = 10^9\text{ rad/s}$. Which transverse electric (TE) modes will propagate in this wave guide?

1. TE_{10} , TE_{01} and TE_{20}
2. TE_{10} , TE_{11} and TE_{20}
3. TE_{01} , TE_{10} and TE_{11}
4. TE_{01} , TE_{10} and TE_{22}

Q2. [June 2016] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET	2016 June	5M
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A waveguide has a square cross-section of side $2a$. For the TM modes of wavevector k , the transverse electromagnetic modes are obtained in terms of a function $\psi(x, y)$ which obeys the equation

$$\left[\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \left(\frac{\omega^2}{c^2} - k^2 \right) \right] \psi(x, y) = 0$$

with the boundary condition

$\psi(\pm a, y) = \psi(x, \pm a) = 0$. The frequency ω of the lowest mode is given by

1. $\omega^2 = c^2 \left(k^2 + \frac{4\pi^2}{a^2} \right)$

2. $\omega^2 = c^2 \left(k^2 + \frac{\pi^2}{a^2} \right)$

3. $\omega^2 = c^2 \left(k^2 + \frac{\pi^2}{2a^2} \right)$

4. $\omega^2 = c^2 \left(k^2 + \frac{\pi^2}{4a^2} \right)$

Q3. [June 2018] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET

2018 June

5M

A hollow waveguide supports transverse electric (TE) modes with the dispersion relation $k = \frac{1}{c} \sqrt{\omega^2 - \omega_{mn}^2}$, where ω_{mn} is the mode frequency. The speed of flow of electromagnetic energy at the mode frequency is

1. c
2. ω_{mn}/k
3. 0
4. ∞

Q4. [Dec 2019] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET	2019 Dec	5M
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A metallic wave guide of square cross-section of side L is excited by an electromagnetic wave of wave-number k . The group velocity of the TE_{11} mode is

1.
$$\frac{ckL}{\sqrt{k^2L^2 + \pi^2}}$$

2.
$$\frac{c}{kL} \sqrt{k^2L^2 - 2\pi^2}$$

3.
$$\frac{c}{kL} \sqrt{k^2L^2 - \pi^2}$$

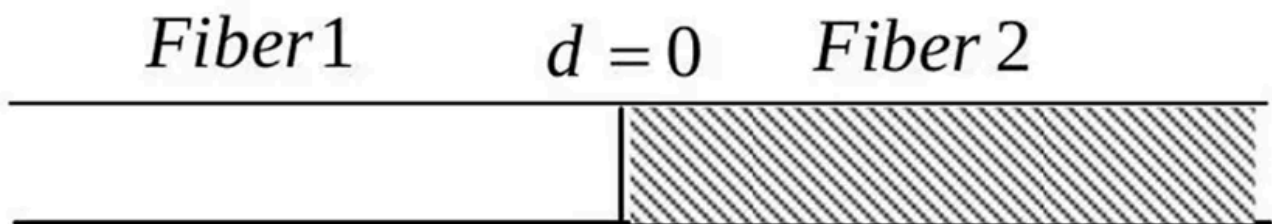
4.
$$\frac{ckL}{\sqrt{k^2L^2 + 2\pi^2}}$$

Q5. [June 2021] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET	2021 June	5M
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A laser beam propagates from fiber 1 to fiber 2 in a cavity made up of two optical fibers (as shown in the figure). The loss factor of fiber 2 is 10 dB/km.



If $E_2(d)$ denotes the magnitude of the electric field in fiber 2 at a distance d from the interface, the ratio $E_2(0)/E_2(d)$ for $d = 10\text{km}$, is

1. 10^2
2. 10^3
3. 10^5
4. 10^7

Q6. [Dec 2023] . 5.0 marks

Electromagnetism > Waveguides

CSIR NET	2023 Dec	5 M
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A transmission line has the characteristic impedance of $(50 + 1j)\Omega$ and is terminated in a load resistance of $(70 - 7j)\Omega$ (where $j^2 = -1$). The magnitude of the reflection coefficient will be closest to

1. $\frac{5}{7}$
2. $\frac{1}{2}$
3. $\frac{1}{6}$
4. $\frac{1}{7}$

Q7. [Dec 2023] . 5.0 marks

Electromagnetism > Waveguides

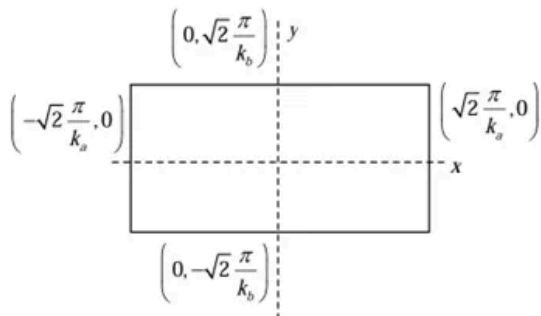
CSIR NET	2023 Dec	5 M
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A 2-dimensiona~~nl~~ resonant cavity supports a TM mode built from a function

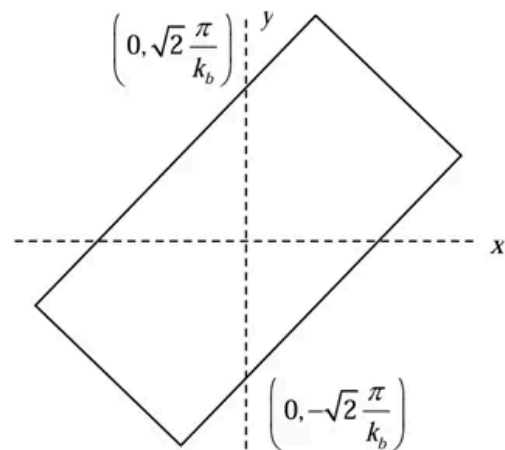
$$\psi(x, y, t) = \sin(\vec{k}_a \cdot \vec{r} - \omega t) + \sin(\vec{k}_b \cdot \vec{r} - \omega t) + \sin(\vec{k}_a \cdot \vec{r} + \omega t) + \sin(\vec{k}_b \cdot \vec{r} + \omega t)$$

where \vec{k}_a and \vec{k}_b lie in the xy -plane and make angles $\frac{\pi}{4}$ and $\frac{3\pi}{4}$ with the x -axis, respectively. If $0 < |\vec{k}_a| < |\vec{k}_b|$, then which of the following closely describes the outline of the cavity?

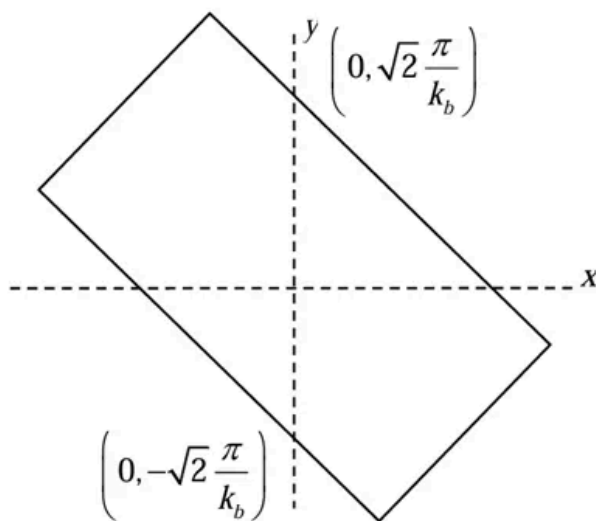
1.



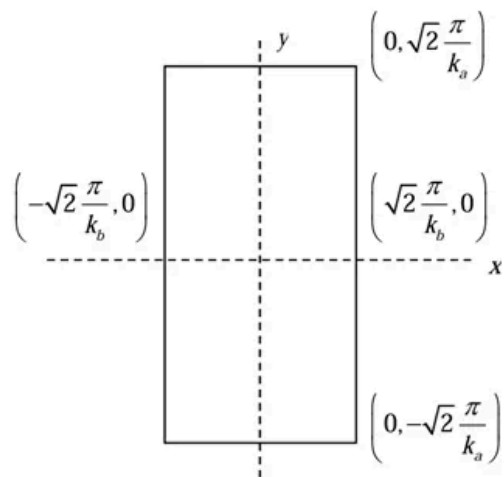
2.



3.



4.



Answer Key

7 questions . Subject and topic for quick revision

Q. No	Subject	Topic	Answer
Q1	Electromagnetism	Waveguides	1
Q2	Electromagnetism	Waveguides	3
Q3	Electromagnetism	Waveguides	3
Q4	Electromagnetism	Waveguides	4
Q5	Electromagnetism	Waveguides	3
Q6	Electromagnetism	Waveguides	3
Q7	Electromagnetism	Waveguides	2

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