UE21EC351B - MCQs/Gate Questions
Unit 1

1	At microwave frequencies, we prefer waveguides to transmission lines for transporting EM energy because of all the following *except* that (a) Losses in transmission lines are prohibitively large. (b) Waveguides have larger bandwidths and lower signal attenuation. (c) Transmission lines are larger in size than waveguides. (d) Transmission lines support only TEM mode.
2	An evanscent mode occurs when (a) A wave is attenuated rather than propagated. (b) The propagation constant is purely imaginary. (c) $m = 0 = n$ so that all field components vanish. (d) The wave frequency is the same as the cutoff frequency.
3	The dominant mode for rectangular waveguides is (a) TE_{11} (b) TM_{11} (c) TE_{101} (d) TE_{10}
4	The TM_{10} mode can exist in a rectangular waveguide. (a) True (b) False
5	For TE_{30} mode, which of the following field components exist? (a) E_x (b) E_y (c) E_z (d) H_x (e) H_y

6	If in a rectangular waveguide for which $a = 2b$, the cutoff frequency for TE_{02} mode is 12 GHz, the cutoff frequency for TM_{11} mode is (a) 3 GHz (b) $3\sqrt{5}$ GHz (c) 12 GHz (d) $6\sqrt{5}$ GHz (e) None of the above
7	If a tunnel is 4 by 7 m in cross section, a car in the tunnel will not receive an AM radio signal (e.g., $f = 10$ MHz). (a) True (b) False
8	When the electric field is at its maximum value, the magnetic energy of a cavity is (a) At its maximum value (b) At $\sqrt{2}$ of its maximum value (c) At $\frac{1}{\sqrt{2}}$ of its maximum value (d) At 1/2 of its maximum value (e) Zero
9	Which of these modes does not exist in a rectangular resonant cavity? (a) TE_{110} (b) TE_{011} (c) TM_{110} (d) TM_{111}
10	How many degenerate dominant modes exist in a rectangular resonant cavity for which $a = b = c$? (a) 0 (b) 2 (c) 3 (d) 5 (e) ∞

11	The interior of a $\frac{20}{3} cm \times \frac{20}{4} cm$ rectangular waveguide is completely filled with a dielectric of $\in_r = 4$. Waves of free space wave – length shorter than……….can be propagated in the TE_{11} mode. **[GATE: 1994: 1 Mark]**
12	A rectangular air – filled waveguide has a cross section of $4\ cm \times 10\ cm$ The minimum frequency which can propagation in the waveguide is (a) 1.5 GHz (b) 2.0 GHz (c) 2.5 GHz (d) 3.0 GHz **[GATE 1997: 1 Mark]**
13	Indicate which one of the following modes do NOT exist in a rectangular resonant cavity (a) TE_{110} (b) TE_{011} (c) TM_{110} (d) MT_{111} **[GATE 1999: 1 Mark]**
14	The phase velocity of waves propagation in hollow metal waveguide is (a) Greater than velocity of light in free space (b) Less than velocity of light in free space (c) Equal to velocity of light in free space (d) Equal to group velocity **[GATE 2001: 1 Mark]**
15	The dominant mode in a rectangular waveguide is TE_{10} because this mode has (a) No attenuation (b) No cut off (c) No magnetic field component (d) The highest cut off wavelength **[GATE 2001: 1 Mark]**

16	The phase velocity for the TE_{10} mode in an air filled rectangular waveguide is (a) Less than c (b) Equal to c (c) Greater than c (d) None of the above **[GATE 2002: 1 Mark]**
17	The phase velocity of an electrometric wave propagating in a hollow metallic rectangular waveguide in the TE_{10} mode is (a) Equal to its group velocity (b) Less than velocity of light in free space (c) Equal to the velocity of light in free space (d) Greater than the velocity of light in free space **[GATE 2004: 1 Mark]**
18	Refractive index of glass is 1.5 Find the wavelength of a beam of light with a frequency of 10^{14} Hz in glass. Assume velocity of light $3 \times 10^8\ m/s$ is vacuum. (a) 3 μm (b) 3 μm (c) 2 μm (d) 1 μm **[GATE 2005: 1 Mark]**
19	. The modes of rectangular waveguide are denoted by TE_{mn} / TM_{mn} when m and n are Eigen numbers along the larger and smaller dimensions of the waveguide respectively. Which one of the following statement is true. (a) The TM_{10} mode of waveguide does not exist. (b) The TE_{10} mode of waveguide does not exist. (c) The TM_{10} and TE_{10} modes both exist and have same cut off frequency. (d) The TM_{10} and TE_{10} modes both exist and have same cut off frequency **[GATE 2011: 1 Mark]**
20	Consider an air filled rectangular waveguide with a cross – section of 5 cm × 3 cm. For this waveguide, the cut off frequency (in MHz) of TE_{21} mode is ________ **[GATE 2014: 1 Mark]**

21	The cut off frequency of waveguide depends upon (a) The dimensions of the waveguide. (b) The dielectric property of the medium in the waveguide. (c) The characteristic impedance of the waveguide (d) The transverse and axial components of the fields **[GATE 1987: 2 Marks]**
22	For normal mode EM wave propagation in a hollow rectangular waveguide (a) The phase velocity is greater than group velocity. (b) The phase velocity is greater than velocity of light in free space. (c) The phase velocity is less than the velocity of light in free space. (d) The phase velocity may be either greater than or less than group velocity. **[GATE 1988: 2 Marks]**
23	Choose the correct statements for a wave propagating in an air filled rectangular waveguide (a) Guided wavelength is never less than free space wavelength. (b) Wave impedance is never less than free space impedance. (c) Phase velocity is never less than the free space velocity. (d) TEM mode is possible if the dimensions of the waveguide are properly chosen. **[GATE 1990: 2 Marks]**
24	A rectangular waveguide has dimensions $1cm \times 0.5\ cm$. Its cut off frequency is (a) 5 GHz (c) 15 GHz (b) 10 GHz (d) 20 GHz **[GATE 2000: 2 Marks]**

25

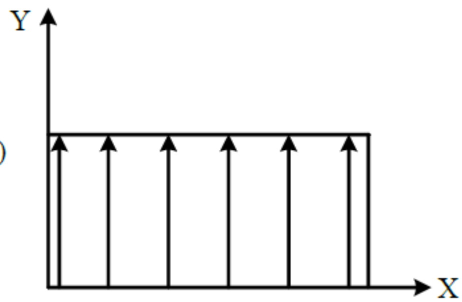
A rectangular metal wave guide filled with a dielectric material of relative permittivity $\varepsilon_r = 4$ has the inside dimensions $3.0\ cm \times 1.2\ cm$. The cut off frequency for the dominant mode is

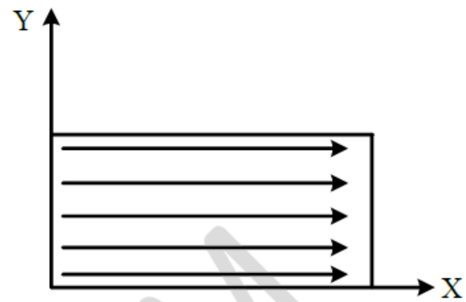
(a) 2.5 GHz
(b) 5.0 GHz
(c) 10.0 GHz
(d) 12.5 GHz

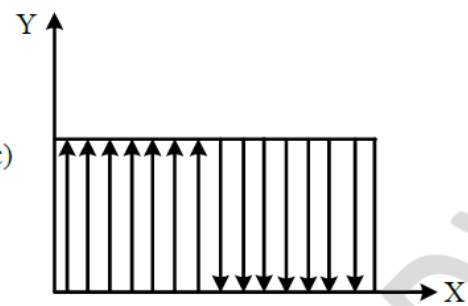
[GATE 2003: 2 Marks]

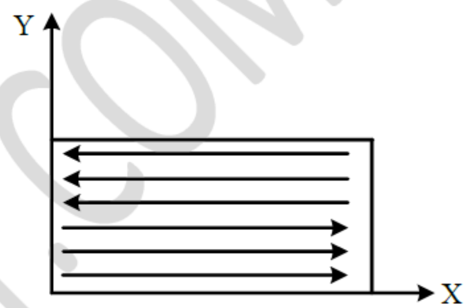
26

Which one of the following does represent the electric field lines for the TE_{02} mode in the cross – section of a hollow rectangular metallic waveguide?

(a)


(b)


(c)


(d)


[GATE 2005: 2 Marks]

27

A rectangular waveguide having TE_{10} mode as dominant mode is having a cut off frequency of 18 GHz for the TE_{30} mode. The inner broad – wall dimension of the rectangular waveguide is

(a) 5/3 cm
(b) 5 cm
(c) 5/2 cm
(d) 10 cm

[GATE 2006: 2 Marks]

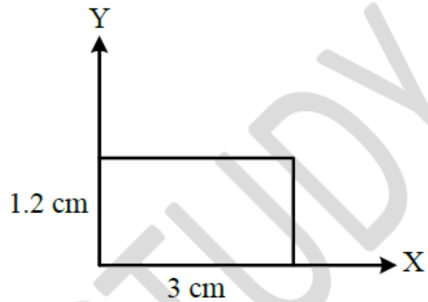
28	An air – filled rectangular waveguide has inner dimensions of $3\ cm \times 2\ cm$. The wave impedance of the TE_{20} mode of propagation in the waveguide at a frequency of 30 GHz is (free space impedance $\eta_0 = 377\ \Omega$). (a) 308 Ω (c) 400 Ω (b) 355 Ω (d) 461 Ω **[GATE 2007: 2 Marks]**
29	The $\vec{E}$ field in a rectangular waveguide of inner dimensions $a \times b$ is given by $\vec{E} = \frac{\omega\ \mu}{h^2}\left(\frac{\pi}{a}\right)\ H_0 \sin\left(\frac{2\pi x}{a}\right) \sin(\omega t - \beta z)\ \hat{y},$ Where H_0 is a constant, a and b are the dimensions along the x – axis and the y – axis respectively. The mode of propagation in the waveguide is (a) TE_{20} (c) TM_{20} (b) TM_{11} (d) TM_{10} **[GATE 2007: 2 Marks]**
30	A rectangular waveguide of internal dimensions (a = 4 cm and b = 3 cm) is to be operated in TE_{11} mode. The minimum operating frequency is (a) 6.25 GHz (c) 5.0 GHz (b) 6.0 GHz (d) 3.75 GHz **[GATE 2008: 2 Marks]**

31

The magnetic field along the propagation direction inside a rectangular waveguide with the cross section shown in the figure is

$$H_z = 3\cos(2.094 \times 10^2 x)\cos(2.618 \times 10^2 y)\cos(6.283 \times 10^{10}\, t - \beta\, z)$$

The phase velocity v_P of the wave inside the waveguide satisfies



(a) $v_P > c$
(b) $v_P = c$
(c) $0 < v_p < c$
(d) $v_P = c$

[GATE 2012: 2 Marks]

32

For a rectangular waveguide of internal dimensions $a \times b (a > b)$, the cut – off frequency for the TE_{11} mode is the arithmetic mean of the cut – off frequencies for TE_{10} mode and TE_{20} mode. If $a = \sqrt{5}$ cm. the value of b (in cm) is --------.

[GATE 2014: 2 Marks]

33

The longitudinal component of the magnetic field inside an air – filled rectangular waveguide made of a perfect electric conductor is given by the following expression

$$H_z(x, y, z, t) = 0.1\cos(25\pi x)\cos(30.3\,\pi y)\cos(12\pi \times 10^9 t - \beta z)\ (A/m)$$

The cross – sectional dimensions of the waveguide are given as a = 0.08 m and b = 0.033 m. The mode of propagation inside the waveguide is

(a) TM_{12}
(b) TM_{21}
(c) TE_{21}
(d) TE_{12}

[GATE 2015: 2 Marks]

34	An air – filled rectangular waveguide of internal dimension a $cm \times b\ cm\ (a > b)$ has a cut off frequency of 6 GHz for the dominant TE_{10} mode. For the same waveguide, if the cutoff frequency of the TM_{11} mode is 15 GHz, the frequency of the TE_{01} mode GHz is ____________ **[GATE 2015: 2 Marks]**
35	Consider an air – filled rectangular waveguide with dimensions a = 2.286 cm and b = 1.016 cm. At 10 GHz operating frequency, the value of the propagation constant (per meter) of the corresponding propagation mode is __________ **[GATE 2016: Marks]**
36	Consider an air – filled rectangular waveguide with dimensions a = 2.286 cm and b = 1.016 cm. The increasing order of the cut – off frequency for different modes is (a) $TE_{01} < TE_{10} < TE_{11} < TE_{20}$ (b) $TE_{20} < TE_{11} < TE_{10} < TE_{01}$ (c) $TE_{10} < TE_{20} < TE_{01} < TE_{11}$ (d) $TE_{10} < TE_{11} < TE_{20} < TE_{01}$ **[GATE 2016: 2 Marks]**