KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.
Year : III

Course : EEEG 309
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 01 AUG 2024

SECTION "A"

[20 Q. × 0.5 = 10 marks]

Choose and encircle in the most appropriate option from each set of choices

1. If 'f' is the operating frequency, which of the following is true for the skin depth (δ)?
   a. $\delta \propto \frac{1}{\sqrt{f}}$ b. $\delta \propto \frac{1}{f^2}$ c. $\delta \propto \frac{1}{\sqrt{f3}}$ d. $\delta \propto \frac{1}{f}$

2. If the reflection coefficient is -1, then VSWR equals to_____
   a. 0.1 b. 0 c. 0.5 d. Infinite

3. Which of the following is the correct option for propagation mode supported by waveguide_____?
   a. TM and TE b. TEM and TE c. TEM and TM d. TEM only

4. For open-circuited transmission line, the reflection coefficient equals to _____
   a. Zero b. Infinite c. 1 d. -1

5. If reflection coefficient is -1 then transmission coefficient is equal to _____
   a. -1 b. 1 c. 0 d. 2

6. In a wave guide if TE mode exists for z-direction propagation then _____
   a. $E_z=0,\ H_z \neq 0$ b. $E_z \neq 0, H_z=0$ c. $H_z=0, E_z=0$ d. $E_z \neq 0, H_z \neq 0$

7. Which of the following is the expression for the intrinsic impedance?
   a. Zero b. Infinite c. 1 d. -1

8. The range of millimeter wave is given by
   a. 10 GHz -200 GHz
   b. 30GHz -300GHz
   c. 30 GHz -400 GHz
   d. 20 GHz -350 GHz

9. Which of the following represents the Poisson's equation?
   a. $\nabla^2 V = 0$ b. $\nabla^2 V = \rho_v/\varepsilon_0$ c. $\nabla^2 V = -\rho_v/\varepsilon_0$ d. $\nabla^2 V = -\varepsilon_0/\rho_v$

10. Conversion of point $P(r,\theta,z) = (5, \pi/6, 4)$ into rectangular co-ordinate yields _____
    a. $P(x,y,z) = P(\frac{\sqrt{3}}{2}, \frac{5}{3}, 4)$
    b. $P(x,y,z) = P(2\frac{\sqrt{3}}{2}, 6, 4)$
    c. $P(x,y,z) = P(5\frac{\sqrt{3}}{2}, \frac{5}{2}, 4)$
    d. $P(x,y,z) = P(3\frac{\sqrt{3}}{2}, \frac{7}{2}, 4)$

11. For TE mode of propagation in a rectangular waveguide, which of the following are the dominant mode of propagation?
    a. TE_{01} and TE_{10} b. TE_{01} and TE_{11} c. TE_{10} and TE_{11} d. TE_{00} and TE_{11}

12. What is the characteristic impedance of a transmission line having resistance R, inductance L, capacitance C and conductance of dielectric G for loss less transmission?

a. $\sqrt{\frac{L}{C}}$ b. $\sqrt{LC}$ c. $\sqrt{\frac{R}{C}}$ d. $\sqrt{\frac{G}{C}}$

13. If a plane electromagnetic wave satisfies the equation $(\partial^2 E_x/\partial y^2) = \varepsilon_0\mu_0(\partial^2 E_x/\partial t^2)$, the wave propagates in the _____

a. X-direction
b. Y-direction
c. Z direction
d. XY plane at angle of 45 degrees between X and Z direction

14. The dominant modes in a waveguide is characterized by

a. Modes having zero cut off frequency b. Modes having same cut off frequency
c. Modes having lowest cut off frequency d. Modes having no phase shift

15. The Smith chart consists of _____

a. Constant r and variable x circles b. Variable r and constant x circles
c. Variable r and variable x circles d. Constant r and constant x circles

16. Which of the following represents the Maxwell's equation?

a. $\nabla x\vec{E} = \partial\vec{B}/\partial t$ b. $\nabla x\vec{E} = \partial\vec{D}/\partial t$ c. $\nabla x\vec{E} = -\partial\vec{B}/\partial t$ d. $\nabla x\vec{E} = \partial\vec{D}/\partial t$

17. A rectangular waveguide of dimension a = 4 cm and b = 3 cm is to be operated in TE_{11} mode. The minimum operating frequency is_____

a. 1.52 GHz b. 6.25 GHz c. 9.32 GHz d. 12.5 GHz

18. For EM wave expressed as $\vec{E}(z,t) = 7\ \mathrm{Cos}(4x10^7\ t + 6z)\ \breve{a}_y$ v/m, the value of phase constant is _____

a. 5 rad/m b. 2 rad/m c. 10 rad/m d. 6 rad/m

19. The phase constant for a wave propagating through a perfect dielectric medium is equal to_____

a. $\omega\sqrt{\mu\varepsilon}$ b. $\sqrt{\omega\mu\varepsilon}$ c. $\mu\sqrt{\omega\varepsilon}$ d. $\varepsilon\sqrt{\mu\omega}$

20. Let λ, d are the wavelength, round trip distance and N∈ {1,2, 3,}. For a rectangular cavity resonator, which of the following is the condition for resonance?

a. $Nd = 2\lambda$ b. $2d = N^2\lambda$ c. $d = N\lambda$ d. $2d = N\lambda$

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Semester : II
F. M. : 40

SECTION "B"
[4 Q. × 10 = 40 marks]

Attempt *ANY FOUR* questions. *Symbols have their usual meanings. Urgent appropriate assumptions are permissible. Marks are indicated inside brackets.*

1.
   a. Write the basic characteristic of uniform plane wave and obtain the generalized expression for the attenuation constant and the phase constant for a uniform plane wave travelling through a medium. [2+4]
   b. Starting from the Ampere's law, derive the expression for the Ampere-Maxwell equation for free space in differential form and integral form. [4]

2.
   a. A 50 Ω lossless transmission line is connected to a load impedance $Z_L = 60+80j\ \Omega$. Using Smith chart, find the position and length of a short-circuit stub required to match the load at a frequency of 250 MHz. [5]
   b. Calculate the numerical values for electric potential (V) and volume charge density at point P if $V = 5\rho^2 \cos 2\theta$ at $P(\rho = 3, \theta = \frac{\pi}{3}, z = 2)$ [5]

3.
   a. A rectangular waveguide made of copper has 7cm x 4cm cross-section. The waveguide is filled with a material having dielectric constant 3 and relative permeability equal to 1. Determine all the modes which will propagate at 3 GHz. [5]
   b. Draw a two wire transmission line model and obtain the transmission line equations in terms of current and voltage. [5]

4.
   a. How does skin effect occur in a good conductor? Derive an expression for the skin depth. [2+3]
   b. List the exposure sources and briefly describe the effects of electromagnetic field exposure. [3]
   c. (c) Find the depth of penetration of an electromagnetic wave at frequency of 60 GHz and 100 MHz. For copper, conductivity = 5.8×10^7 mho/m, $\varepsilon_r = 1$, $\mu_r = 1$ [2]

5.
   a. How does a rectangular cavity resonator work? Explain with the help of suitable diagram and also find the expression for the cutoff frequency of the rectangular cavity resonator. [5]
   b. Write short notes on: [2.5×2=5]
      i. Wave Polarization
      ii. Dielectric waveguide

EEEG-309

The Complete Smith Chart

Black Magic Design

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