

KATHMANDU UNIVERSITY
End Semester Examination [C]
November/December, 2023

Marks Scored:

Level : B.E.

Year : III

Course : EEEG 309

Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date 29: NOV 2023

SECTION "A"

[20 Q. \times 0.5 = 10 marks]

Choose and encircle the most appropriate option. Symbols have their usual meaning.

- What is the cut off wavelength of 6 cm \times 3cm waveguide? Assume the dominant mode of operation.
a. 8 cm b. 10 cm c. 12 cm d. 16 cm
- For open-circuited transmission line, the reflection coefficient equals to _____
a. Zero b. Infinite c. 1 d. -1
- When uniform plane wave propagates through perfect dielectric then attenuation constant is equal to _____
a. -1 b. 1 c. 0 d. 0.5
- In free space, the Poisson equation becomes _____
a. Maxwell equation b. Ampere equation
c. Laplace equation d. Steady state equation
- Two plates of a parallel plate capacitor are separated by a distance 'd' and maintained at potential '0' and 'V' at distance $y = 0$ and $y = d$ respectively. The potential at any point between the plates is given by _____
a. $V/d a_y$ b. $-V/d a_y$ c. $(\sqrt{V/d}) a_y$ d. $d/V a_y$
- For a rectangular cavity resonator, the lowest order TM mode is _____
a. TM_{110} b. TM_{100} c. TM_{001} d. TM_{000}
- The characteristic impedance of lossless transmission is given by _____
a. L/R b. $(\sqrt{L/c})$ c. $(\sqrt{C/L})$ d. $\sqrt{1/(L/c)}$
- Divergence of current density equals to zero is referred as _____
a. Laplace equation b. Poissin's equation
c. Maxwell's equation d. Continuity equation for steady currents
- In an electromagnetic wave, the electric field of amplitude 6.2 V/m oscillates with a frequency of 2.4×10^{10} Hz. The Energy density of the wave is _____
a. $3.4 \times 10^{-10} \text{J/m}^3$ b. $4.3 \times 10^{-9} \text{J/m}^3$ c. $5 \times 10^{-7} \text{J/m}^3$ d. $4 \times 10^{-12} \text{J/m}^3$
- If the normalized load impedance of a transmission line is $0.3-j0.4$ with a characteristic impedance of 50Ω , then the load impedance is _____
a. $15-j20$ b. $15+j20$ c. $5-j2$ d. $5+j2$
- Divergence of a curl A is _____
a. 1 b. 0 c. ∞ d. $-\infty$

12. For distortion less transmission, the transmission line parameters are related as _____
 a. $R=0, G \neq 0$ b. $R/G = C/L$ c. $R=0, G = 0$ d. $R/G = L/C$
13. Which of the following represents the Poisson's equation?
 a. $\Delta^2 V=0$ b. $\Delta^2 V = \rho_v/\epsilon$ c. $\Delta^2 V = -\rho_v/\epsilon$ d. $\Delta^2 V = \epsilon/\rho_v$
14. A hollow rectangular waveguide cannot propagate TEM waves because _____
 a. Of the existence of only one conductor
 b. Of the losses caused
 c. It is dependent on the type of the material used
 d. Of the existence of two conductors
15. Which of the following is **TRUE** for time varying field?
 a. $\Delta \times \vec{E} = 0$ b. $\Delta \times \vec{E} = 1$ c. $\Delta \times \vec{E} = \partial \vec{B} / \partial t$ d. $\Delta \times \vec{E} = -\partial \vec{B} / \partial t$
16. The load is perfectly matched with the transmission line if VSWR is equal to ____
 a. 0 b. 5 c. -1 d. 1
17. In order to obtain the resonant frequency of a rectangular waveguide, the closed cavity has to satisfy _____
 a. Gaussian equation b. Helmholtz equation
 c. Ampere's law d. Maxwell's equations
18. A rectangular cavity resonator supports _____
 a. TEM mode b. TM mode c. TE mode d. TE, TM mode
19. The minimum value of the directivity of an antenna is _____
 a. 1 b. 0 c. ∞ d. 0.5
20. A lossless transmission is 80 cm long and operates at a frequency of 600 MHz. The line parameters are $L = 0.25 \mu\text{H/m}$, $C = 100 \text{pF/m}$ then the characteristic impedance is ____
 a. 60Ω b. 50Ω c. 40Ω d. 30Ω

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Semester : II
F. M. : 40

SECTION "B"

[4 Q. × 10 = 40 marks]

Attempt *ANY FOUR* questions. Symbols have their usual meaning. Smith chart will be provided

1. a. The time domain expression for the magnetic field of a uniform plane wave travelling in free space is given by the following expression: [5]
$$\vec{H}(z, t) = 2.5 \cos(1.257 \times 10^9 t - \beta z) \hat{a}_y \text{ mA/m}$$

Find

 - i. The direction of wave propagation
 - ii. The operating frequency
 - iii. The phase constant
 - iv. The time domain expression for the electric field starting from the Maxwell's equations
 - v. The phasor form of the electric field and magnetic field
- b. Inner conductor of radius 'a' of a coaxial cable held at potential V_0 while the other conductor of radius 'b' is grounded. Determine (i) potential distribution between the conductor (ii) surface charge density (ii) capacitance per unit length. [5]
2. a. What do you mean by polarization of electromagnetic waves? Explain the types of polarization in detail. [5]
- b. Derive the generalized expression for the attenuation constant and the phase constant for uniform plane wave travelling in a medium [5]
3. a. Find expression for cut-off frequency for a rectangular waveguide. [6]
- b. A lossless transmission line of length 0.434λ and characteristic impedance 100Ω is terminated in an impedance $260 + j180 (\Omega)$. Using smith chart, find (a) voltage reflection coefficient (b) standing wave ratio (c) the input impedance. [4]
4. a. Obtain the general wave equation for a transmission line and also find the expression for characteristic impedance. [4+1]
- b. What is displacement current density? Derive the Maxwell's modified equation for time varying version of Ampere's circuital law. [1+4]
5. a. What should be the size of a hollow cubic cavity made of copper in order for it to have a dominant resonant frequency of 10 GHz? Also find the Q-factor at that frequency. [4]
- b. Write the significance of the Poynting theorem with the help of suitable expressions. [3]
- c. Describe the role of antenna in wireless communication system. [3]

