KATHMANDU UNIVERSITY
End Semester Examination
May/June, 2022

Marks scored:

Level : B.E.
Year : III

Course : EEEG 309
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date :

SECTION "A"

[20Q × 0.5 = 10 marks]

Encircle the most appropriate option. Symbols have their usual meaning.

1. The Laplacian operation of a scalar function V is given by
   a. $\nabla . V$ b. $\nabla^2 V$ c. $-\nabla^2 V$ d. $\nabla^2 \times V$

2. The Maxwell's divergence equation in case of static electric field $\vec{E}$ is expressed as_____
   a. $\nabla . \vec{E} = 0$ b. $\nabla^2 . \vec{E} = 0$ c. $\nabla \times \vec{E} = 0$ d. $\nabla . \vec{E} = 1$

3. The divergence of a curl is always_____
   a. 0 b. 1 c. -1 d. ∞

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

5. Poynting vector is _____
   a. The current density vector producing electrostatic field
   b. The current density vector producing electromagnetic field
   c. The power density vector producing electrostatic field
   d. The power density vector producing electromagnetic field

6. A uniform plane wave has a wavelength of 2 cm in free space and 1 cm in a perfect dielectric. What is the relative permittivity of the dielectric?
   a. 2 b. 1 c. 3 d. 4

7. For a conducting medium with conductivity σ, permeability μ and permittivity ε, the skin depth at an angular frequency ω is proportional to _____
   a. σ b. $\frac{1}{\omega}$ c. $\frac{1}{\mu}$ d. $\frac{1}{\sqrt{\sigma}}$

8. 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. $\Delta \times \vec{E} = -\partial \vec{B}/\partial t$

9. The propagation constant for a wave propagating through a perfect dielectric is given by
   a. $\sqrt{0.5 + j\omega\sqrt{\mu\varepsilon}}$ b. $\sqrt{0.9 + j\omega\sqrt{\mu\varepsilon}}$
   c. $\sqrt{-j\omega\sqrt{\mu\varepsilon}}$ d. $\sqrt{j\omega\sqrt{\mu\varepsilon}}$

10. Conversion of point P(r, θ, z) = (4, 5π/6, 3) into rectangular co-ordinate yields
a. P (x, y, z) = P (-2 $\sqrt{3}$, 2, 3)
b. P (x, y, z) = P (2 $\sqrt{3}$, 3, 3)
c. P (x, y, z) = P ($\sqrt{3}$, 1, 3)
d. P (x, y, z) = P (- $\sqrt{3}$, 3, 3)

11. 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

12. A transmission line having 50 Ω impedance is terminated with a load of (40+j30) Ω. The VSWR is _____
a. 1.33 b. 3 c. 0.8 d. 2

13. For loss less transmission, the transmission line parameters are related as
a. R=0, G ≠ 0 b. R/G = C/L c. R=0, G = 0 d. R/G = L/C

14. The mode(s) supported by waveguide is given by
a. TM b. TM and TE c. TEM d. TE

15. A transmission line has characteristic impedance of 50 Ω and a resistance of 0.1 Ω/cm. If the line is distortion less, the value of attenuation constant is _____
a. 0.1 N_p/m b. 0.2 N_p/m c. 0.001 N_p/m d. 0.002 N_p/m

16. A lossless transmission is 80 cm long and operates at a frequency of 600 MHz. The line parameters are L= 0.25μH/m, C= 100pF/m then the characteristic impedance is ____
a. 60 Ω b. 50 Ω c. 40 Ω d. 30 Ω

17. In a wave guide if TM 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. $E_z \neq 0$, $H_z \neq 0$

18. Let ω be the angular frequency. What is the characteristic impedance of a transmission line having resistance R, inductance L, capacitance C and conductance of dielectric G?
a. $\sqrt{((G + J\omega l)/(R + J\omega C))}$
b. $\sqrt{((C + J\omega l)/(G + J\omega R))}$
c. $\sqrt{((R + J\omega l)/(C + J\omega G))}$
d. $\sqrt{((R + J\omega l)/(G + J\omega C))}$

19. The dominant mode in a waveguide is characterized by
a. Modes having zero cut off frequency
b. Modes having same cut off frequency
c. Mode having lowest cut off frequency
d. Modes having no phase shift

20. For $\vec{H}(z,t) = 10\cos(2x10^6\ t + 20z)\ \check{a}_y$ A/m, the value of wave length is _____
a. 3.1m b. 0.31 m c. 0.21m d. 2.2m

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Course : EEEG 309
Semester : II
F.M. : 40

SECTON "B"
[4Q × 10 = 40 marks]

Attempt *ANY FOUR* questions. Symbols have their usual meaning. Students are required to write answer in their own words as far as practicable. The figure in the margin indicates full marks. **Smith chart will be provided.**

1.

a. Determine the primary constants (R, L, G and C) and the phase velocity of the transmission line. The measurement on transmission line at 1 kH_z provided the following results:
$Z_0 = 710 \angle -16^0\ \Omega$, $\alpha = 0.01\ N_P/m$, $\beta = 0.035$ rad/m [5]

b. How does the cut off frequency in rectangular waveguide depend on the dimension of the waveguide? Explain with the help of derived expression. [5]

2.

a. Consider a wave propagating through seawater whose conductivity is 5 S/m and $\mu = \mu 0$. If frequency of propagating wave is 2 MHz, find the skin depth and wave velocity. [2]

b. A lossless transmission line of length 0.434λ and characteristic impedance 100 (Ω) is terminated in an impedance 260 + j180 (Ω). Using Smith Chart, find (a) the reflection coefficient (b) the Standing-wave ratio (c) input impedance [5]

c. Why TEM wave doesn't exist in a waveguide? Explain relevant examples [3]

3.

a. Find the expression for propagation constant, attenuation constant (α) and phase constant (β) for an electromagnetic wave travelling through a medium characterized by μ, ε and σ. Make suitable assumptions if necessary. [5]

b. Write the Maxwell's equations in phasor and differential form. [2]

c. Inner conductor of radius 'a' of a coaxial cable held at potential V_0 while the other conductor of radius 'b' is grounded. Determine [3]
(i) potential distribution between the conductor
(ii) surface charge density
(iii) capacitance per unit length.

4.

a. Given Electric potential, $V = [5x^3y^2 z]$ and $\varepsilon = 2.25\ \varepsilon_0$. Calculate the electric field intensity and the volume charge density at P (-3, 1, 2). [4]

b. 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)? [3]

c. Briefly explain the possible effects of electromagnetic fields exposure on human health. [3]

5.

a. What is the significance of VSWR? Find the expression that relates VSWR and reflection coefficient. [2 + 3]

b. Write short notes on: [2 × 2.5 = 5]
(i) Wave polarization
(ii) Cavity resonator