KATHMANDU UNIVERSITY
End Semester Examination
August, 2018

Marks scored:

Level : B.E.
Year : III

Course : EEEG 309
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date AUG 0 8 2018

SECTION "A"
[20 Q × 1 = 20 marks]

Choose the most appropriate option. **Symbols** have their usual meaning.

1. The side lengths of the cross section of an air filled rectangular waveguide are 7.5 cm and 5 cm respectively. The cutoff frequency for TE_{10} mode is _____
   a. 6 GHz b. 4 GHz c. 3 GHz d. 2 GHz

2. If ρ_v and V denote volume charge density and potential respectively, which of the following expression 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. $\nabla^2 V = -\varepsilon_0/\rho_v$

3. For a wave propagating through the sea water with frequency of 1 MHz, conductivity equal to 4 s/m and permittivity of medium equal to permittivity of air, what is the value of skin depth?
   a. 0.1 m b. 0.35 m c. 0.5 m d. 0.25 m

4. The div **D** at the origin if $\mathbf{D} = e^{-x}\sin y\,\mathbf{a}_x - e^{-x}\cos y\,\mathbf{a}_y + 2z\,\mathbf{a}_z$ is equal to _____
   a. 1 b. 2 c. 3 d. 4

5. 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. Then potential at any point between the plates is given by
   a. $V/d\,\mathbf{a}_y$ b. $-V/d\,\mathbf{a}_y$ c. $(\sqrt{V/d})\,\mathbf{a}_y$ d. $\mathbf{a}_y$

6. Electromagnetic waves can travel _____
   a. Without medium b. With medium
   c. With medium and without medium d. In a disturbed Path

7. A dielectric medium has losses but no free charges. The propagation constant of the medium is given by _____
   a. $\sqrt{j\omega\mu(\sigma + j\omega\epsilon)}$ b. $\sqrt{\omega\mu(\sigma + j\omega\epsilon)}$ c. $j\omega\mu(\sigma + j\omega\epsilon)$ d. $\omega\mu(\sigma + j\omega\epsilon)$

8. Which of the following represents Maxwell's divergence equation for static field?
   a. $\nabla.B = 0$ b. $\nabla.H = 0$ c. $\nabla.B = \mu$ d. $\nabla.H = \mu$

9. A uniform plane wave with an intensity of electric field 1V/m is travelling in free space. The magnitude of associated magnetic field is _____
   a. 2.65 mA/m b. 4.35 mA/m c. 6.55 mA/m d. 8.75 mA/m

10. If reflection coefficient is zero then transmission coefficient is equal to_____
a. -1 b. 1 c. 0 d. Infinite

11. 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. . $E_z \neq 0,\ H_z \neq 0$

12. The area of the following surface using differential surface area in square unit is equal to_____
$\rho = 2, \quad 0 < z < 5, \quad \pi/3 < \phi < \pi/2$
a. 1.73 b. 2.59 c. 4.13 d. 5.23

13. An ideal loss less transmission line of characteristic impedance 60 Ω is connected unknown load of impedance Z_L. If SWR is equal to 4, what is the value of Z_L?
a. 130 Ω b. 200 Ω c. 240 Ω d. 300 Ω

14. If voltage standing wave ratio is 4, which of the following is the magnitude of reflection coefficient of a transmission line?
a. 0.1 b. 0.4 c. 0.6 d. 0.8

15. If b is the separation between the parallel plates then the cut off frequency of the parallel plate wave guide in TM_0 mode is given by
a. $1/(b\sqrt{\mu\varepsilon})$ b. $1/(2b\sqrt{\mu\varepsilon})$ c. $2/(b\sqrt{\mu\varepsilon})$ d. 0

16. For a lossless transmission line with inductance equal to 0.35μH/m, capacitance equal to 90 pF/m and frequency equal to 500 MHz, the magnitude of propagation constant is ___
a. 14.48 b. 17.63 c. 19.59 d. 21.20

17. According to Poynting theorem, the vector $\vec{E} \times \vec{H}$ is a measure of which one of the following?
a. Stored energy density of the electric field
b. Stored energy density of the magnetic field
c. Power dissipated per unit volume.
d. Rate of energy flow per unit area

18. In an ideal dipole along the z-axis, the incident electric field is that of a plane wave travelling such that its k-vector makes an angle θ with the z-axis, and E-field is contained in the yz-plane and points towards the +z axis. The open circuit voltage (Induced voltage) in the received antenna will be maximum if_____
a. $\theta = 0$ degree b. $\theta = 45$ degree c. $\theta = 60$ degree d. $\theta = 90$ degree

19. Among following electromagnetic waves, which has lowest frequency ?
a. Radio waves b. Infrared c. Ultraviolet d. Gamma rays

20. Radiation pattern of an antenna is _____dimensional quantity.
a. One b. Two c. Three d. Four

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SECTION "B"

Attempt *ANY FIVE* questions. Symbols have their usual meaning. Students are required to write answer in their own words as far as practicable. **Smith chart will be provided.**

1. (a) With the help of suitable diagram, obtain spherical co-ordinates and cylindrical co-ordinates from Cartesian co-ordinates. [4]
   (b) Two point charges 5 nC and -3 nC are located at p (-1, 0.8, 2) and Q(2,1,-1) respectively in free space. Find the electric field intensity at R(0.5, -0.7, 1). [3]
   (c) The magnetic field intensity in free space is given by $\vec{H} = H_0 \text{Sin}\theta \overrightarrow{a_y}$ A/m Where $\theta = \omega t - Bz$, B is constant. Determine displacement current density and electric field intensity. [4]

2. (a) A two conductor transmission line is excited by a 50 MHz source. The inductance and the capacitance per meter length of the line are 300 nH and 120 pF respectively. Calculate the characteristic impedance of the transmission line, phase constant, phase velocity and wavelength of the wave. [4]
   (b) Derive an expression for magnetic field due to straight current carrying conductor. [4]
   (c) Write the importance of Maxwell's equation with examples. [3]

3. (a) Obtain the second order differential equation for a two-wire transmission line and also find the transmission line parameters for distortion less transmission line. [6]
   (b) The outside radius of the inner conductor and the inside radius of the outer conductor of a coaxial transmission are 15 mm and 25 mm respectively. The electric potential of inner conductor is 1100 V whereas the outer conductor is grounded. Find the potential and the electric field intensity at a radial distance 22.5 mm. [5]

4. (a) Write the expression for x circles and r circles in smith chart. A 50 ohm transmission line is terminated to a load of 100 +j100, the length of transmission line is 0.2λ. Using Smith Chart, plot for normalized load impedance and find VSWR, reflection coefficient, input impedance, input admittance. [1+5]
   (b) Find the expression for skin depth if uniform plane wave is travelling through a good conductor. The depth of penetration of electromagnetic wave in a medium having conductivity σ at a frequency 1 KHz is 25 cm. Find the depth of penetration of the wave at a frequency of 4 KHz. [2+3]

5. (a) The height and the width of a hollow rectangular waveguide with perfect conducting walls are 5 cm and 3 cm respectively. Find the operating frequency if its value is midway between the cut-off frequencies of TM_{11} mode and TM_{21} mode. [5]
   (b) Derive the general equation for a uniform plane wave propagating through any medium and obtain the expression for attenuation constant and phase constant if the wave is propagating through the good conductor. [6]

6. (a) What are the basic antenna parameters? How does Yagi antenna work? Explain with suitable figure. [2+3]
   (b) Write short notes on: [3+3]
   (i) Cavity resonators (ii) Voltage standing wave ratio (VSWR)