

KATHMANDU UNIVERSITY
End Semester Examination
December 2024/January 2025

Marks Scored:

Level : B.E.

Year : IV

Exam Roll No. :

Time: 30 mins.

Course : ETEG 402

Semester : I

F. M. : 10

Registration No.:

Date 09 JAN 2025

SECTION "A"

[20Q. \times 0.5 = 10 marks]

Choose the most appropriate answer and **encircle**.

1. Terrestrial television transmission usually is done in _____ frequency bands.
a. C and Ka band b. Ka band c. SHF band d. VHF and UHF bands
2. The term axial ratio is related to _____ of antenna.
a. impedance matching b. polarization
c. gain d. bandwidth
3. The efficiency parameter of antenna is calculated as the ratio of _____.
a. radiated power to input power
b. power in main lobe to total radiated power
c. power in front lobe to that in back lobe
d. directivity to gain
4. The radiation resistance of a half wave dipole antenna is approximately _____.
a. 73Ω b. 120Ω c. 36.5Ω d. $73 + j42.5 \Omega$
5. An antenna has an input impedance of $Z_a = 50 + j30 \Omega$. The feed line has an impedance of $Z_f = 50 \Omega$. Calculate the reflection coefficient.
a. $1 - j3.33$ b. $1 + j0.6$ c. $\frac{j30}{100+j30}$ d. $\frac{100-j30}{j30}$
6. Which of the following is NOT TRUE about radiation pattern of dipole antennas?
a. Radiation pattern changes with length
b. They radiate equally in all direction
c. They have omnidirectional radiation pattern
d. Radiation pattern is doughnut shaped
7. An antenna has a gain of 20 dBi at a frequency of 300 MHz. Calculate the effective aperture A_e of the antenna in square meters.
a. $\frac{\pi}{5}$ b. 10π c. 5π d. $\frac{5}{\pi}$
8. What is the main advantage offered by parabolic reflector antennas?
a. They offer high bandwidth b. They provide high gain
c. They always have circular polarization d. They have very small loss
9. By using MIMO technology in antennas, we can achieve _____.
a. enhanced signal strength and capacity b. wider frequency range
c. simplified antenna design d. smaller antenna sizes

10. Directivity of an antenna is measure of _____.
- its efficiency and loss
 - matching of antenna with its feed line
 - capacity to focus energy in one direction
 - range of frequencies that it can radiate
11. Yagi Uda array antenna differs from log periodic dipole array (LPDA) in the sense that ____
- Yagi does not consists of dipoles.
 - LPDA does not contain elements of different lengths.
 - Yagi is wideband while LPDA is a narrow band antenna.
 - LPDA has all elements connected to feed line.
12. Helical antennas work in axial mode when _____.
- its circumference is comparable to wavelength.
 - its circumference is very small compared to wavelength.
 - axis of helix is parallel to the ground.
 - a conducting plate simulating the ground plane is used.
13. Impedance of antennas are _____ while that of popular transmission lines are _____.
- real.....complex
 - complex.....real
 - inductive.....real
 - inductive....capacitive
14. In an array, the presence of multiple unintended lobes of maximum radiation are known as.....
- minor lobes
 - grating lobes
 - back lobes
 - harmonic lobes
15. Which of the following is not a frequency independent antenna?
- LPDA
 - Spiral planar antenna
 - Spiral conical antenna
 - Helical antenna
16. Which of the following is not a common name for type of horn antenna?
- sectoral horn
 - exponential horn
 - logarithmic horn
 - conical
17. Which is NOT a common characteristic of travelling wave antennas?
- unidirectional radiation pattern
 - high gain
 - use of termination resistance
 - travelling wave pattern of current or voltage
18. Wave propagation through ionosphere is unique due to _____.
- absence of absorbing materials
 - multipath possibility
 - path deviation due to presence of charges
 - high attenuation
19. A surface wave propagating along a coastal area with initial intensity 150 dB suffers loss with loss coefficient $L = 0.05 \text{ dB/m}$. What is the intensity of the wave after it travels 2 km?
- 100 dB
 - 10 dB
 - 50 dB
 - 1.5 dB
20. The phase angle of the reflection coefficient for wave reflection from a lossy medium (such as the Earth), with horizontal polarization and an incidence angle ψ equal to zero, is:
- 90°
 - -90°
 - 180°
 - -180°

KATHMANDU UNIVERSITY
End Semester Examination
December 2024/ January 2025

Level : B.E.
Year : IV
Time : 2 hrs. 30mins.

Course : ETEG 402
Semester : I
F. M. : 40

09 JAN 2025

SECTION "B"

[5 Q. × 8 = 40 marks]

Attempt ANY FIVE questions. Candidates are instructed to be specific while writing answers. Assume suitable values for any missing parameters.

1. a. Define the term 'antenna' as used in the fields of communication engineering. Explain different field regions around an antenna. [1+2]
- b. A finite length dipole is assumed to have a sinusoidal current distribution. Derive the expression for far field electric field intensity due to a half wave dipole. Consider that the vector magnetic potential is given as:
$$dA_z = \frac{\mu}{4\pi} \frac{I_0 dz \cos\omega\left(t - \frac{R}{v}\right)}{R}$$
2. a. Explain the concept of antenna bandwidth and its significance in communication systems. [2]
- b. An antenna with a radiation resistance of 48Ω , a loss resistance of 2Ω and a reactance of 50Ω is connected to a generator with open circuit voltage of 10 v and internal impedance of 50Ω via a $\lambda/4$ long transmission line with characteristic impedance of 100Ω . Draw the equivalent circuit of the system. Determine the power supplied by the generator. Determine the power radiated by the antenna. [3]
- c. Explain the concept of impedance matching in antennas and why it is important. Introduce in short some popular impedance matching techniques used for dipole antennas. [3]
3. a. A linear array consists of 5 isotropic antennas spaced $\lambda/2$ apart. Derive the expression for the array factor and calculate the maximum directivity of this array. [3]
- b. Explain how the term 'antenna gain' differs from the traditional definition of gain. How are directive gain and directivity related? [2]
- c. A communication link operates at a frequency of 2.4 GHz with a transmitted power $P_t = 10 \text{ W}$. The gains of the transmitting and receiving antennas are $G_t = 5 \text{ dBi}$ and $G_r = 7 \text{ dBi}$, respectively. The distance between the antennas is 500 m . Calculate the received power in watts using the Friis transmission equation assuming free-space conditions. What will be received power in dB if a rain attenuation of 0.5 dB is considered? [3]

P.T.O.

4. a. You are assigned a task by an upcoming television company to select a proper antenna for terrestrial transmission of its TV program in a city. It plans to keep antenna in the center of the city. Present your analysis about the properties of the antenna to be used (regarding bandwidth, radiation pattern, gain, polarization etc). Based on your analysis, suggest few proper antenna to the company. [3]
- b. Compute the radiation resistance of a $3\lambda/4$ wavelength dipole antenna. Use the table for sine and cosine integrals required. [3]
- c. Describe the construction and important properties of the helical antenna. [2]
5. a. Explain the basic concept of frequency independent antennas. How does the spiral antenna scales itself to work as frequency independent antennas. [3]
- b. Show that the directivity of a half wave dipole is 1.64. [2]
- c. For an E-plane horn with $\rho_1 = 6\lambda$, $b_1 = 6\lambda$, and $a = 0.5\lambda$, compute (in dB) its directivity. [3]
6. a. Ion density in different regions of ionosphere is different, leading to varying refractive index. Derive the expression for refractive index of a particular ionospheric layer as function of its ion/electron density. [3]
- b. Explain the construction, working principle and application of reflector based antennas. [3]
- c. Calculate the maximum usable frequency if electron density of ionosphere is 1.2×10^{12} electrons/ m^3 and the angle of incident is 40° . [2]