**ANTENNAS & WAVE PROPAGATION**

**SHORT ANSWER QUESTIONS**

**STEP MATERIAL**

**UNIT 1:**

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1. Define an antenna.  
Transducer between a guided wave and a free space wave or vice versa. Antenna is also said to be an impedance transforming device.  
  
2. What is meant by radiation pattern?  
Antenna is a transition device or a Radiation pattern is the relative distribution of radiated power as a function of distance in space .It is a graph which shows the variation in actual field strength of the EM wave at all points which are at equal distance from the antenna. The energy radiated in a particular direction by an antenna is measured in terms of FIELD STRENGTH.(E Volts/m)  
  
3. Define Radiation intensity?  
The power radiated from an antenna per unit solid angle is called the radiation intensity U (watts per  
steradian or per square degree). The radiation intensity is independent of distance.  
  
4. Define Beam efficiency?  
The total beam area ( ΩA) consists of the main beam area ( ΩM ) plus the minor lobe area ( Ωm) .  
Thus ΩA = ΩM+ Ωm . beam area is called beam efficiency.  
The ratio of the main beam area to the total  
Beam efficiency = ΣM = ΩM / ΩA.  
  
5.Define Directivity?  
The directivity of an antenna is equal to the ratio of the maximum power density P(θ,φ)max to its  
average value over a sphere as observed in the far field of an antenna. D = P(θ,φ)max / P(θ,φ)av. Directivity from Pattern. D = 4π / ΩA. Directivity from beam area(ΩA ).  
  
6.What are the different types of aperture.?  
i) Effective aperture.  
ii). Scattering aperture.  
iii) Loss aperture.  
iv) collecting aperture.  
v). Physical aperture.  
  
7.Define different types of aperture.?  
Effective aperture(Ae). It is the area over which the power is extrated from the incident wave and delivered to the load is called effective aperture. Scattering aperture(As.)  
It is the ratio of the reradiated power to the power density of the incident wave. Loss aperture. (Ae).  
It is the area of the antenna which dissipates power as heat. Collecting aperture. (Ae).It is the addition of above three apertures.  
Physical aperture. (Ap). This aperture is a measure of the physical size of the antenna.  
  
8. Define Aperture efficiency?  
The ratio of the effective aperture to the physical aperture is the aperture efficiency. i.e Aperture efficiency = ηap = Ae / Ap (dimensionless).  
  
9. What is meant by effective height?  
The effective height h of an antenna is the parameter related to the aperture.It may be defined as  
the ratio of the induced voltage to the incident field.i.e H= V / E.  
  
10. What are the field zone?  
The fields around an antenna ay be divided into two principal regions.  
i. Near field zone (Fresnel zone)  
ii. Far field zone (Fraunhofer zone)  
  
11.What is meant by Polarization.?  
The polarization of the radio wave can be defined by direction in which the electric vector E is aligned during the passage of atleast one full cycle.Also polarization can also be defined the physical orientation of the radiated electromagnetic waves in space.  
The polarization are three types. They are Elliptical polarization ,circular polarization and linear  
polarization.  
  
12. What is meant by front to back ratio.?  
It is defined as the ratio of the power radiated in desired direction to the power radiated in the opposite  
direction. i.e FBR = Power radiated in desired direction / power radiated in the opposite direction.  
  
13. Define antenna efficiency.?  
The efficiency of an antenna is defined as the ratio of power radiated to the total input power supplied to the antenna. Antenna efficiency = Power radiated / Total input power  
  
14. What is radiation resistance ?  
The antenna is a radiating device in which power is radiated into space in the form of electromagnetic  
wave. W‟= I  
Rr = W‟/ I2 R2  
Where Rr is a fictitious resistance called called as radiation resistance.  
  
15 What is meant by antenna beam width?

Antenna beamwidth is a measure of directivity of an antenna. Antenna beam width is an angular width in degrees, measured on the radiation pattern (major lobe) between points where the radiated power has fallen to half its maximum value .This is called as “beam width” between half power points or half power beam width.(HPBW).  
  
16. What is meant by reciprocity Theorem.?  
If an e.m.f is applied to the terminals of an antenna no.1 and the current measured at the terminals of the another antenna no.2, then an equal current both in amplitude and phase will be obtained at the terminal of the antenna no.1 if the same emf is applied to the terminals of antenna no.2.  
  
17.What is meant by isotropic radiator?  
A isotropic radiator is a fictitious radiator and is defined as a radiator which radiates fields uniformly in all directions. It is also called as isotropic source or omni directional radiator or simply unipole.  
  
18. Define gain  
The ratio of maximum radiation intensity in given direction to the maximum radiation intensity from a  
reference antenna produced in the same direction with same input power. i.e Maximum radiation intensity from test antenna  
Gain (G) = --------------------------------------------------------  
  
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Maximum radiation intensity from the reference antenna  
with same input power  
  
19. Define self impedance  
Self impedance of an antenna is defined as its input impedance with all other antennas are completely removed i.e away from it.  
  
20 . Define mutual impedance  
The presence of near by antenna no.2 induces a current in the antenna no.1 indicates that presence of  
antenna no.2 changes the impedance of the antenna no.1.This effect is called mutual coupling and results in mutual impedance.  
  
21. What is meant by cross field.?  
Normally the electric field E is perpendicular to the direction of wave propagation. In some situation the  
electric field E is parallel to the wave propagation that condition is called Cross field.  
  
22.Define axial ratio  
The ratio of the major to the minor axes of the polarization ellipse is called the Axial Ratio. (AR).  
  
23. What is meant by Beam Area.?  
The beam area or beam solid angle or ΩA of an antenna is given by the normalized power pattern over a sphere.  
ΩA = ∫ ∫4π Pn ( θ,φ ) dΩ  
Where dΩ = Sin θ d θ .dφ  
  
24. What is duality of antenna.?  
It is defined as an antenna is a circuit device with a resistance and temperature on the one hand and the  
space device on the other with radiation patterns, beam angle ,directivity gain and aperture.  
  
25.State Poynting theorem.  
intensity vector E and the magnetic filed intensity vector H at any point is a measure of the rate of energy flow per unit area at that point.The direction of power flow is perpendicular to both the electric field and magnetic field components. It states that the vector product of electric field  
  
26.What is point source?  
emitter source at the center „O‟ of the observation circle. It is the waves originate at a fictitious volumeless  
  
27.What is meant by array.?  
An antenna is a system of similar antennas oriented similarly to get greater directivity in a desired direction.  
  
28.What is meant by uniform linear array.?  
An array is linear when the elements of the array are spaced equally along the straight line. If the elements are fed with currents of equal magnitude and having a uniform progressive phase shift along the line, then it is called uniform linear array .  
  
29.What are the types of array.?  
a. Broad side array.  
b. End fire array  
c. Collinear array.  
d. Parasitic array.  
  
30.What is Broad side array.?  
which the principal direction of radiation is perpendicular to the array axis and also the plane containing the array element. For Broad side array the phase difference  
  
31.Define End fire array.?  
which the principal direction of radiation is coincides with the array axis.  
  
32. What is collinear array.?  
Broad side array is defined as an arrangement in  
End fire array is defined as an arrangement in

In this array the antenna elements are arranged coaxially by mounting the elements end to end in straight line or stacking them one over the other with radiation pattern circular symmetry. Eg. Omnidirectional antenna.  
  
33. What is Parasitic array.?  
In this array the elements are fed parasitically to reduce the problem of feed line. The power is given to one element from that other elements get by electro magnetic coupling.  
Eg. Yagi uda antenna.  
  
34. What is the condition on phase for the end fire array with increased directivity.?

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 = 0 but does not give the maximum directivity. It has been shown by Hansen and woodyard that a large  
directivity is obtained by increasing the phase change  
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This condition will be referred to as the condition for increased directivity.  
  
35.Define array factor.  
---- referred to as array factor.  
The normalized value of the total field is given by, The field is given by the expression E will be-----  
  
36. Define beam width of major lobe?  
is defined as twice the angle between the first null and the major lobe maximum direction.  
It is defined the angle between the first nulls (or) it  
  
37. List out the expression of beam width for broad side  
array and end fire array. between the first nulls is given by, For broad side array the expression for beam width BWFN = ((+/ - Q G  
For End fire array the expression for beam width between the first nulls is given by,  
BWFN = ((+/ - Q G1/ 2.

38. Differentiate broad side and End fire array.?  
Broad side array  
1. Antennas fed in Phase  
2. Maximum Radiation is perpendicular to the direction of array axis.  
3. Beam width of major lobe is twice the array  
Antenna elements are fed of out of Phase  - G  
Maximum Radiation is directed along the array axis. Beam width is greater than that for a broad side array of same length.  
BW = -------  
reciprocal of the array length. BW = ----  
  
39.What is the need for the Binomial array.?  
The need for a binomial array is

i). In uniform linear array as the array length is increased to increase the directivity, the secondary lobes  
also occurs. that secondary lobes should be eliminated completely or reduced to minimum desirable level compared to main lobes.  
ii) For certain applications, it is highly desirable  
  
40. Define power pattern.?  
component of the pointing vector Sr at a constant radius as a function of angle is called power density pattern or power pattern.  
  
41. What is meant by similar Point sources.?  
phase of the field with respect to the absolute angle for any two sources are same then they are called similar point sources. sources may be unequal.  
Graphical representation of the radial Whenever the variation of the amplitude and the  
The maximum amplitudes of the individual  
  
42. What is meant by identical Point sources.?  
amplitudes are called identical point sources.  
  
43. What is the principle of the pattern multiplication?  
isotropic but similar sources is the product of the  
i) individual source pattern and  
ii) The array pattern of isotropic point sources each  
Similar point sources with equal maximum The total field pattern of an array of non  
located at the phase center of the individual source having the same amplitude and phase.  
While the total phase pattern is the sum of the phase patterns of the individual source pattern and array pattern.0  
  
44.What is the advantage of pattern multiplication?  
TMUseful tool in designing antenna  
TMIt approximates the pattern of a complicated array without making lengthy computations  
  
45.What is tapering of arrays?  
of unwanted side lobes .The amplitude of currents in the linear array source is non-uniform; hence the central source radiates more energy than the ends. Tapering is done from  
center to end. Tapering of array is a technique used for reduction  
  
46.What is a binomial array?  
antenna elements in the array are arranged according to the coefficients of the binomial series. It is a array in which the amplitudes of the  
  
47.What are the advantages of binomial array?  
Advantage:  
TMNo minor lobes  
Disadvantages:  
TMIncreased beam width  
TMMaintaining the large ratio of current amplitude in large arrays is difficult  
  
48.What is the difference between isotropic and non-  
isotropic source TMIsotropic source radiates energy in all directions but non-isotropic source radiates  
energy only in some desired directions. TMIsotropic source is not physically realizable but non-isotropic source is physically realizable.  
  
49.Define Side Lobe Ratio  
Side Lobe Ratio is defined as the ratio of power density in the principal or main lobe to the power  
density of the longest minor lobe.  
  
50. List the arrays used for array tapering  
TMBinomial Array:Tapering follows the coefficient of binomial series TMDolph Tchebycheff Array: Tapering follows the coefficient of Tchebycheff polynomial  
  
51.What is a Short Dipole?  
Ans: A short dipole is one in which the field is oscillating because of the oscillating voltage and current.It  
is called so, because the length of the dipole is short and the current is almost constant throughtout the entire length of the dipole.It is also called as Hertzian Dipole which is a hypothetical antenna and is defined as a short isolated conductor carrying uniform alternating current.  
  
52.How radiations are created from a short Dipole?  
Ans:The dipole has two equal charges of opposite sign oscillating up and down in a harmonic  
motion.The charges will move towards each other and electric filed lines were created.When the charges meet at the midpoint, the field lines cut each other and new field are created.This process is spontaneous and so more fields are created around the antenna.This is how radiations are obtained from a short dipole.(See Figure from class notes)  
  
53.Why a short dipole is also called an elemental dipole?  
A short dipole that does have a uniform current will be known as the elemental dipole.Such a dipole will generally be considerably shorter than the tenth wave length maximum specified for a short dipole.Elemental dipole is also called as elementary dipole,elementary doublet and hertzian dipole.  
  
54.What is a Infinitesimal Dipole?  
When the length of the short dipole is vanishingly small,then such a dipole is called a infinitesimal dipole.If dl be the infinitesimally small length and I be the current,then Idl is called as the current element.  
  
55.Why a short dipole is called a oscillating dipole?  
A short dipole is initially in neutral condition and the moment a current starts to flow in one direction,one half of the dipole require an excess of charge and the other a deficit because a current is a flow of electricalcharge.Then ,there will be a voltage between the two halves of the dipole.When the current changes its direction this charge unbalance will cause oscillations.Hence an oscillating current will result in an oscillating voltage.Since,in such dipole,electric charge oscillates ,it may be called as Oscilllating electric dipole.  
  
56.What do you understand by retarded current?  
Since,the short electric dipole is so short,the current which is flowing through the dipole is  
assumed to be constant throughtout its length.The effect of this current is not felt instantaneous at a distance point only after an interval equal to the time required for the wave to propagate over the distance r is called the retardation time.  
The retarded current [I]=Io exp(j W-r/c))  
  
57.Define induction field  
The induction field will predominate at points close to the current element ,where the distance from the  
centre of the dipole to the particular point is less.This field is more effective in the vicinity of the current element only.It represents the energy stored in the magnetic field surrounding the current element or conductor.This field is also known as near field.  
  
58.Define Radiation field  
The radiation field will be produced at a larger distance from the the current element ,where the distance from the centre of the dipole to the particular point is very large.It is also called as distant field or far field.  
  
59.At what distance from the dipole is the induction field equal to the radiation field?  
As the distance from the current element or the short dipole increases ,both induction and radiation fields emerge and start decreasing .However,a distance reaches from the conductor at which both the induction and radiation field becomes equal and the particular distance depends upon the wavelength.The two fields will thus have equal amplitude at that particular distance.This distance is given by  U  
  
60.Define Radiation Resistance  
It is defined as the fictitious resistance which when inserted in series with the antenna will consume the same amount of power as it is actually radiated.The antenna appears to the transmission line as a resistive component and this is known as the radiation resistance.  
  
61.Give the expression for the effective aperture of a short dipole

ANs:The effective aperture of a short dipole is given by------  
  
62.What is a dipole antenna?  
A dipole antenna may be defined as a symmetrical antenna in which the two ends are at equal potential relative to the midpoint.  
  
63.What is a half wave dipole?  
A half wave antenna is the fundamental radio antenna of metal rod or tubing or thin wire which has a physical length of half wavelength in free space at the frequency of operation  
  
64.Give the expression for the effective aperture of a Half wave Dipole  
The effective aperture of a half wave dipole is given by Ae=0 2  
  
65.What is the radiation resistance of a half wave dipole  
The radiation resistance of a half wave dipole is given by Rr=73 ohm  
  
66.What is a loop antenna?  
turns carrying radio frequency current.it may assume any shape (e.g. rectangular,square,triangular and hexagonal)

67.Give an expression of radiation resistance of a small loop  
Radiation resistance of a small loop is given by A loop antenna is a radiating coil of any convenient cross-section of one or more Rr=31,200 (A/ 2)2  
  
68.How to increase the radiation resistance of a loop antenna  
The radiation resistance of a loop antenna can be increased by:  
1. increasing the number of turns  
2. inserting a ferrite core of very high permeability with loop antenna‟s circumference which will rise the magnetic field intensity called ferrite loop.  
  
69.What are the types of loop antennas?  
Loop antennas are classified into  
refer class notes  
  
70.What are Electrically Small loop antennas?  
Electrically Small loop antennas is one in which the overall length of the loop is less than one-tenth of the wavelength. Electrically Small loop antennas have small radiation resistances that are usually smaller than their loop resistances.They are very poor radiators and seldom employed for transmission in radio communication.  
  
71.What are Electrically large loop antennas?

Electrically Large loop antennas is one in which the overall length of the loop approaches the wavelength.  
  
72.List out the uses of loop antenna  
Various uses of loop antenna are: TM It is used as receiving antenna in portable radio and pagers  
TM It is used as probes for field measurements and as directional antennas for radio wave navigation  
TM It is used to estimate the direction of radio wave propagation  
  
73.What are the parameters to be considered for the design of an helical antenna?  
The parameters to be considered for the design of an helical antenna are:  
1. Bandwidth  
2. Gain  
3. Impedance  
4. Axial Ratio  
  
74.What are the types of radiation modes of operation for an helical antenna  
The two types of radiation modes of operation possible for an helical antenna are:  
1. Normal mode of operation  
2. Axial mode of operation  
  
75.Which antenna will produce circularly polarized waves  
Helical antenna radiates circularly polarized wave.  
  
76.List the applications of helical antenna  
The applications of helical antenna are:  
TM It became thw workhouse of space communications for telephone,television and data,being employed both on satellites and at ground stations  
TM Many satellites including weather satellites,data relay satellites all have helical antennas,  
TM It is on many othe probes of planets and comets,including moon and mars,being used alone,in arrays or as feeds for parabolic reflectors,its circular polarization and high gain and simplicity making it effective for space application  
  
77.Define Sky wave.  
the ionosphere is called sky wave.  
  
78.Define Tropospheric wave.  
Waves that arrive at the receiver after reflection from the troposphere region is called Tropospheric wave.(ie 10 Km from Earth surface).  
  
79. Define Ground wave.  
Waves propagated over other paths near the earth surface is called ground wave propagation.  
  
80.What are the type of Ground wave.  
i. Space wave Waves that arrive at the receiver after reflection in Ground wave classified into two types.  
ii. Surface wave.  
  
81 What is meant by Space Wave.?  
reflected wave. Also includes the portion of energy received as a result of diffraction around the earth surface and the reflection from the upper atmosphere.  
  
82. What is meant by Surface Wave.?  
an EM wave is guided by a transmission is called surface wave. Attenuation of this wave is directly affected by the constant of earth along which it travels.  
  
83. What is meant by fading.?  
paths as a result of the atmospheric conditions and it is called .It can not be predicted properly.  
  
84. What are the type of fading.?  
iii. Multi path fading.  
  
85. What is inverse and multi path fading.?  
path into an obstructed one. between the direct and ground reflected waves as well as interference between two are more paths in the atmosphere.  
  
86.What is meant by diversity reception.?  
path interference the technique used are diversity reception. It is obtained by two ways. It is made up of direct wave and ground Wave that is guided along the earth‟s surface like Variation of signal strength occur on line of sight Two types. i. Inverse bending. Inverse bending may transform line of sight  
Multi path fading is caused by interference  
To minimize the fading and to avoid the multi  
i. Space diversity reception.  
ii. Frequency diversity reception.  
iii. Polarization diversity.  
  
87. Define Space diversity Reception.  
received at different locations do not fade together. It-----  
and the antenna which high signal strength at the moment dominates.  
  
88 .Define frequency diversity Reception.

This method exploits the fact that signals This method takes advantage of the fact that signals of slightly different frequencies do not fade synchronously. This fact is utilized to minimize fading in radio telegraph circuits.  
  
89. Define polarization diversity reception.  
is found that signal transmitted over the same path in two polarizations have independent fading patterns.in broad band dish antenna system, Polarization diversity combined with frequency diversity reception achieve excellent results.  
  
90. What is meant by Faraday‟s rotation.?  
ionosheric medium becomes anisotropic and the incident plane wave entering the ionosphere will split into ordinary and extra ordinary waves/modes. ionosphere they recombine into a single plane wave again. have changed, this phenomenon is known as Faraday‟s rotation.  
It is used in normally in microwave links, and it Due to the earth‟s magnetic fields, the  
When these modes re-emerge from the Finally the plane of polarization will usually----------  
  
91. What are the factors that affect the propagation of radio waves.?  
i. Curvature of earth.  
ii. Earth‟s magnetic field.  
iii. Frequency of the signal.  
iv. Plane earth reflection.  
  
92. Define gyro frequency.  
period of an electron in its orbit under the influence of the earths magnetic flux density B.  
  
93. Define critical frequency.  
be reflected back for vertical incidence is Frequency whose period is equal to the For any layer , the highest frequency that will fcr = 9¥1max  
  
94. Define Magneto-Ions Splitting.  
two different components (ordinary and extra-ordinary) by the earths magnetic field is called Magneto-Ions Splitting.  
  
95.Define LUHF. and transmitter power is defined as the lowest frequency that will give satisfactory reception for that distance and power. It depends on The phenomenon of splitting the wave into  
The lowest useful HF for a given distance  
i. The effective radiated power  
ii. Absorption character of ionosphere for the paths between transmitter and receive  
iii. The required field strength which in turn depends upon the radio noise at the receiving location and type of service involved .  
  
96. Define Refractive index.  
It is defined as n = c / vp   
  
97Define maximum Usable Frequency.  
reflected back for a given distance of transmission is called the maximum usable frequency (MUF) for that distance.  
  
98. Define skip distance.  
given frequency fails to be reflected back is the skip distance for that frequency.The higher the frequency the greater the skip distance.  
  
99. Define Optimum frequency.?  
any two points is therefore selected as some frequency The maximum Frequency that can be  
MUF = fcr VHF I The distance with in which a signal of Otimum frequency for transmitting between  
lying between about 50 and 85 percent of the predicted maximum usable frequency between those points.  
  
100. What is wave impedance.?  
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101. Define wave velocity and Group velocity.?  
wave velocity vp = ---- and Group velocity=-------