MUTHAYAMMAL ENGINEERING COLLEGE

(An Autonomous Institution)

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Rasipuram - 637 408, Namakkal Dist., Tamil Nadu

MUST KNOW CONCEPTS

MKC

ECE **2021-22**

Subject	19ECC08 ANTENNA SYSTEM ENGINEERING			
Unit I Antenna Fundamentals				
S.No	**Term**	**Notation (Symbol)**	**Concept/Definition/Meaning/Units/ Equation/Expression**	**Units**
1	**Antenna**		Antenna is a transition device or a transducer between a guided wave and a free space wave or vice-versa.	
2	**Radiation Pattern**		Radiation pattern is the relative distribution of radiated power as a function of distance in space .	
3	**Isotropic radiator**		It is a hypothetical loss less radiator having equal radiation in all directions.	
4	**Radiation Intensity**		The power radiated from an antenna per unit solid angle is called the radiation intensity U	
5	**Directivity of an antenna**		The ratio of the maximum value of the power radiated	
6	**Radiation Intensity**		The area over which the antenna collects energy from the incident wave and delivers it to the receiver load.	
7	**Beam Efficiency**		The total beam area (WA) consists of the main beam area (WM) plus the minor lobe area (Wm).	
8	**Radiation resistance**		Radiation resistance is defined as a fictitious or hypothetical resistance that would dissipate an amount of power equal to the radiated power.	
9	**The Different Types Of Aperture**		a. Effective aperture. b. Scattering aperture. c. Loss aperture. d. Collecting aperture. e. Physical aperture.	

10	**Self-impedance of an antenna**		Impedance at the point where transmission line is connected is referred to as feed point impedance or antenna input impedance.	
11	**Bandwidth of an antenna**		Bandwidth describes the range of frequencies over which the antenna can properly radiate or receive energy.	
12	**Directive gain of an antenna**		$g_d(\theta,\phi) = \frac{\Phi(\theta,\phi)}{\Phi_{av}} = \frac{4\pi\,\Phi(\theta,\phi)}{W_r}$	
13	**Beam solid angle**		$\Omega_A = \int_0^{2\pi}\int_0^{\pi} P_n(\theta,\phi)\, d\Omega$ steradian $P_n(\theta,\phi) =$ Normalized power pattern	
14	**Half power beam width (HPBW) of an antenna**	**HPBW**	It is an angular width in degrees, measured on the radiation pattern (main lobe) between points where the radiated power has fallen to half its maximum value.	
15	**Gain**	**G**	The ratio of maximum radiation intensity in given direction to the maximum radiation intensity from a reference antenna.	
16	**Mutual Impedance**		The presence of nearby 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.	
17	**Beam Width between First Null**		The angular width in degrees, measured on the radiation pattern between first null points on either side of the main lobe.	
18	**Beam Area**	**A**	The beam area or beam solid angle or WA of an antenna is given by the normalized power pattern over a sphere.	
19	**The Field Zones**		The fields around an antenna may be divided into two principal regions. a. Near field zone (Fresnel zone) b. Far field zone (Fraunhofer zone)	
20	**Effective Height**		It may be defined as the ratio of the induced voltage to the incident field.	
21	**The need for BALUN**		A Balun is used to transform the balanced input of the antenna into unbalanced impedance.	
22	**A half wave length dipole**		A half wave length dipole antenna can be formed from a two wire transmission line.	
23	**Polarization**		Polarization of an antenna means the orientation of the electric field (E-vector) of the electromagnetic wave being radiated by the transmitting antenna in the far field.	
24	**Folded dipole**		A folded dipole consists of two parallel dipoles	

25	**Radiated Power Density**		$W_{rad} = a_r W_r = a_r A_0 \sin\theta / r^2 (W/m^2)$	
		Unit II Antenna Arrays		
26	**Antenna Array**		Antenna array is system of a similar antennas oriented similarly to get greater directivity in a desired direction.	
27	**Uniform Linear Array**		An array is linear when the elements of the array are spaced equally along the straight line.	
28	**The Types of Array**		1.Broad side array. 2.End fire array 3.Collinear array. 4.Parasitic array.	
29	**Broad Side Array**		An arrangement in which the principal direction of radiation is perpendicular to the array axis.	
30	**End Fire Array**		End fire array is defined as an arrangement in which the principal direction of radiation is coincides with the array axis.	
31	**Relationship between Directivity and HPBW**		If HPBW is greater; directivity is less and vice-versa.	
32	**Tapering of array**		The techniques used in reduction of side lobe level are called as tapering.	
33	**Adaptive Array**		Adaptive arrays have an awareness of their environment and adjust to it in a desired fashion.	
34	**Main advantage of Binomial Array**		No side lobe in the radiation pattern of Binomial array.Half Power Beam width is more.	
35	**Uniform linear array**		Uniform linear array is one in which the elements are fed with a current of equal amplitude (magnitude) with uniform progressive phase shift along the line.	
36	**Null Directions in Radiation Pattern**		Direction in which radiation is not present is defined as null direction.	
37	**Non-Uniform amplitude distribution**		non- uniform amplitude distribution to reduce side lobe levels.	
38	**Difference between Uniform and non-uniform Arrays**		Uniform linear array is one in which the elements are fed with a current of equal amplitude. Non-uniform linear array is one in which the elements are fed with currents of un equal amplitude.	
39	**Advantages of Antenna array**		A radiating system composed of several spaced and properly phased radiators is called as an Antenna array.	

40	**Parasitic Array**		The power is given to one element from that other elements get by electromagnetic coupling.	
41	**Pattern Multiplication**		Individual source pattern and the array pattern of isotropic point sources each located at the phase center of the individual source having the same amplitude and phase.	
42	**Advantage of Pattern Multiplication**		Makes it possible to sketch rapidly, almost by inspection, the radiation pattern of complicated arrays without making lengthy calculations.	
43	**Phased Arrays**		An array of many elements with the phase (also amplitude) of each element being a variable, providing control of the beam direction and pattern shape including side lobes.	
44	**Huygen's Principle**		Huygen"s principle states that, „each point on a primary wave front can be considered to be a new source of a secondary spherical wave and that a secondary wave front can be constructed as the envelope of these waves.	
45	**Array pattern**		Array pattern = Element pattern * Array Factor	
46	**Disadvantages of Binomial Arrays**		• The beam width of the main lobe is large which is undesirable. • The directivity is small. • High excitation levels are required for the centre elements of large arrays.	
47	**Difference Between Isotropic and Non-Isotropic Source**		• Isotropic source radiates energy in all directions but non-isotropic source radiates energy only in some desired directions. • Isotropic source is not physically realizable but non-isotropic source is physically realizable.	
48	**Induction Field**		The induction field will predominate at points close to the current element, where the distance from the center of the dipole to the particular point is less.	
49	**A Loop Antenna**		A loop antenna is a radiating coil of any convenient cross-section of one or more turns carrying radio frequency current.	

50	**Types of Loop Antennas**		• Electrically Small (Circumference < λ / 10) • Electrically Small (Dimension comparable to λ)	
Unit III Aperture and Slot Antennas				
51	**Three aperture antennas**		Slot antenna, horn antenna, lens antenna.	
52	**Uniqueness theorem**		Uniqueness theorem states that, for a given set of sources and boundary conditions in a lossy medium, the solution to Maxwell"s equations is unique.	
53	**Application of Lens Antenna**		They are used in the higher end of the microwave spectrum and millimetre wave frequencies.	
54	**Slot radiator**		When a slot in a large metallic plane is coupled to an R.F source, it behaves like a diploe antenna mounted over a reflecting surface.	
55	**Corner Reflector**		A corner reflector is made up of two flat-plate reflectors joined together to form a corner.	
56	**Features of pyramidal horn antenna**		• It is one of the most often used horn antennas. • It is used as a primary feed for reflector antennas. • It is used as standard gain reference antennas in antenna measurements.	
57	**Principle of E-plane metal plate lens antenna**		When the feed antenna is kept at the focal point of the lens antenna, the spherical wave fronts are collimated forming a plane wave front.	
58	**Sectoral Horn**		Horn antenna is a wave guide one end of which is flared out.	
59	**Sectoral E-plane horn**		If flaring is along the direction of electric field, it is called sectoral E-plane horn.	
60	**Sectoral H-plane horn**		If flaring is along the direction of magnetic field, it is called sectoral H-plane horn.	
61	**Two examples for microwave antenna**		Horn antenna, Lens antenna	
62	**'Zoning' in lens antenna**		Zoning is a method used to reduce the bulk (weight) of the antenna.	
63	**'Zoning' in dielectric lens antenna**		Zoning the non-refracting surface, zoning the refracting surface.	
64	**Drawbacks of lens**		• Due to the reflection at the dielectric-air	

	antenna		interface, a matching quarter wave transformer is required • A lens antenna is generally heavy and bulky.	
65	**Advantage of Cassegrain reflector configuration**		The main advantage is that the primary feed horn and the associated receiver or transmitter can be located conveniently behind the main reflector.	
66	**Disadvantage of Cassegrain Reflector Configuration**		The main disadvantage of Cassegrain reflector configuration is the large aperture blockage by the sub-reflector.	
67	**Types of lens antenna**		Dielectric lens antenna, Metallic lens antenna, Zoned lens antenna, Stepped lens antenna.	
68	**Field Equivalence Principle**		The fields in V_2 due to the sources in V_1 can also be generated by an equivalent set of virtual sources on surface **S**, Js=nxH , Ms=Exn.	
69	**Microstrip antenna**		A microstrip patch antenna consists of a thin metallic patch etched on the dielectric substrate using PCB technology.	
70	**Pill Box Antenna**		This is a reflector antenna which has a cylindrical reflector enclosed by two parallel conducting plates perpendicular to the cylinder, spaced less than one wavelength apart.	
71	**Curved Reflector Shapes**		Parabolic, Parabolic cylinder, Hyperboloid	
72	**Features & Advantages of Microstrip Antennas**		These are antennas made from patches of conducting material on a dielectric substrate above a ground plane. Small size, low cost, low weight, ease of installation.	
73	**Applications of Microstrip Antennas**		They are used in space crafts, aircrafts, telemetry, satellite communications and defense radar systems.	
74	**Numerical tools that can be used to analyze an Antenna**		Newton's method, Lagrange interpolation polynomial, Gaussian elimination, or Euler's method.	
75	**Snell's law of refraction**		$\frac{\sin\theta_t}{\sin\theta_i} = \sqrt{\frac{\epsilon_{r1}}{\epsilon_{r2}}}$ $\theta_i = angle\ of\ incidence,\ \theta_t = angle\ of\ refraction$ $\epsilon_{r1} = relative\ dielectric\ constant\ of\ region1$ $\epsilon_{r2} = relative\ dielectric\ constant\ of\ region2$	
Unit IV Special Antennas and Antenna Measurements				
76	**Resonant antenna**		Resonant antennas are those which correspond to a resonant transmission line that is an exact number of half wave length long and is open at both ends.	

77	**Helical antenna**		It is used for extraterrestrial communication	
78	**Radiation pattern of resonant and non-resonant antenna**		Resonant antenna - bidirectional radiation pattern Non-resonant antenna – unidirectional radiation pattern	
79	**Non-resonant antenna**		Non- resonant antennas are also called as travelling wave antenna.	
80	**Modes of radiation of helical antenna**		(i) normal mode (ii) axial mode	
81	**Advantages of indoor antenna measurements**		Absence of electromagnetic interference (EMI) Protection of expensive equipments from environmental severities.	
82	**LPDA**		LPDA is log periodic dipole array and radiation characteristics that are regularly repetitive as a logarithmic function of frequency.	
83	**Anechoic Chamber**		An Anechoic Chamber can be made reflection-free or echo-free by lining all the surfaces of the chamber with absorbing material. It can be made dust free and error free environment.	
84	**Applications of helical antenna**		Used for satellite and space communication. Used in radio astronomy. In the ballistic missiles and satellites used as telemetry links.	
85	**Feed method for Micro strip antenna**		(i) micro strip transmission line (ii) Coaxial transmission line	
86	**Spiral Antenna**		Spiral is a geometrical shape found in nature. A spiral can be geometrically described using polar coordinates.	
87	**Frequency Independent Antennas**		An antenna in which the impedance, radiation pattern and directivity remain constant as a function of frequency is called as frequency independent antenna. Eg; Spiral antenna.	
88	**Advantages of reconfigurable antenna**		Ability to support more than one wireless standard: good isolation between different wireless standards.	
89	**Reconfigurable antenna**		Reconfigurable antenna has the ability to radiate more than one pattern at different frequencies and polarizations.	
90	**Different ranges of antenna measurements**		Outdoor range, Indoor range, Reflection range, Slant range, Elevated range, Compact range, Near field range, Ground range and Radar cross section range.	
91	**Length of driven element**		$\text{Length of driven element} = \frac{478}{f_{MHz}} = \frac{478}{200} = 2.39\ feet$	

92	**Length of reflector**		$\text{Length of reflector} = \frac{492}{f_{MHz}}$	
93	**Length of director**		$\text{Length of director} = \frac{461.5}{f_{MHz}}$	
94	**Element spacing**		$\text{Element spacing} = \frac{142}{f_{MHz}}$:	
95	**Measurement of Antenna**		Antenna gain is measured in decibels as either dBi or dBd.	
96	**Measurement of VSWR**		The voltage standing wave ratio, VSWR is defined as the ratio of the maximum to minimum voltage on a loss-less line.	
97	**Measurement of Directivity**		Directivity is the measure of the concentration of an antenna is radiation pattern in a particular direction.	
98	**Other names of log-periodic antenna**		Log-periodic array or log-periodic aerial.	
99	**Advantages of spiral Antenna**		The planar spiral antennas have any advantages like great performance on circular polarization, easy impedance matching, and superior radiation efficiency.	
100	**Disadvantages of spiral Antenna**		The major disadvantage of the technique being that its bandwidth is limited in circular polarization.	
Unit V Propagation of Radio Waves				
101	**Sky Wave**		Waves that arrive at the receiver after reflection in the ionosphere is called sky wave.	
102	**Tropospheric Wave**		Waves that arrive at the receiver after reflection from the troposphere region is called Tropospheric wave (i.e. 10 Km from Earth surface).	
103	**Ground Wave**		Waves propagated over other paths near the earth surface is called ground wave propagation.	
104	**Type of Ground Wave**		Ground wave classified into two types. a. Space wave. b. Surface wave.	
105	**Space Wave**		It is made up of direct wave and ground 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.	
106	**Surface Wave**		Wave that is guided along the earth’ s surface like an EM wave is guided by a transmission is called surface wave.	

107	**The Type Of Fading**		Two types: a. Inverse fading. b. Multi path fading.	
108	**Fading**		Fading is variation of signal strength occur on line of sight paths as a result of the atmospheric conditions. It cannot be predicted properly.	
109	**Multi Path Fading**		Inverse bending may transform line of sight path into an obstructed one. Multi path fading is caused by interference between the direct and ground reflected waves as well as interference between two are more paths in the atmosphere.	
110	**Attenuation**		Attenuation of this wave is directly affected by the constant of earth along which it travels.	
111	**Diversity Reception**		To minimize the fading and to avoid the multi path interference the technique used are diversity reception.	
112	**Types of Diversity Reception**		1.Space diversity reception. 2.Frequency diversity reception. 3.Polarization diversity.	
113	**Space Diversity Reception**		This method exploits the fact that signals received at different locations do not fade together	
114	**Frequency Diversity Reception**		This method takes advantage of the fact that signals of slightly different frequencies do not fade synchronously.	
115	**Polarization Diversity Reception**		It is used in normally in microwave links, and it is found that signal transmitted over the same path in two polarization have independent fading patterns	
116	**Factors Affect The Propagation of Radio Waves**		1.Curvature of earth. 2.Earth' s magnetic field. 3.Frequency of the signal. 4.Plane earth reflection.	
117	**Critical Frequency**		For any layer, the highest frequency that will be reflected back for vertical incidence is $f_{cr} = 9\sqrt{N_{max}}$	
118	**Define Magneto-ions Splitting**		The phenomenon of splitting the wave into two different components (ordinary and extra-ordinary) by the earths magnetic field is called Magneto-Ions Splitting.	
119	**Refractive Index**		It is defined as $n = c / V_p$ where $n = \sqrt{\varepsilon_r}$	
120	**Maximum Usable Frequency**		The maximum Frequency that can be reflected back for a given distance of transmission is called	

			the maximum usable frequency (MUF) for that distance.	
121	**Skip Distance**		The distance with in which a signal of given frequency fails to be reflected back is the skip distance for that frequency. The higher the frequency the greater the skip distance.	
122	**Optimum Frequency**		Optimum frequency for transmitting between any two points is therefore selected as some frequency lying between about 50 and 85 percent of the predicted maximum usable frequency between those points.	
123	**Antenna Matching**		When the antenna is receiving with a load resistance matched to the antenna radiation resistance, maximum power is transferred to the load and the power is also re-radiated from the dipole.	
124	**Short Dipole**		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 throughout the entire length of the dipole.	
125	**Oscillating Dipole**		The dipole has two equal charges of opposite sign oscillating up and down in a harmonic motion.	
		General & Placement Oriented Questions		
126	**Path difference of two waves with single source traveling by different paths**		β x (λ/2)	
127	**Highest recombination rate of Ionization Layer**		D-region	
128	**The occurrence of sporadic E-region**		90 km – 130 km	
129	**Conditions for Radiation of Wire Antenna**		For a charge oscillating in time motion	
130	**Non-isotropic directional antenna**		Back lobe	
131	**Angle for front to back ratio**		0° & 180°	
132	**Role in determining the radiation pattern in Dipole Antenna**		Current	
133	**Radiation Pattern of an Isotropic Antenna**		Spherical	
134	**Condition of an Ordinary Endfire**		$\alpha = \pm\beta d$	

	Array			
135	**Propagation is adopted in HF antennas**		Ionospheric	
136	**Receiving Antenna in Ionospheric Propagation**		Reflection or Scattering	
137	**Ionospheric Propagation**		Sky wave propagation	
138	**Mid-frequency operation corresponding to Ionospheric Region**		Partial reflection & refraction	
139	**Linear wire Antenna**		Dipole Antenna	
140	**Antennas especially adopted for Apace craft Applications**		Microstrip	
141	**Parabolic Reflector antenna converts**		Spherical to plane wave	
142	**Sterdian is a measurement unit**		Solid angle	
143	**Vector Magnetic Potential shows the inverse relationship with its**		Distance of point from the source (R)	
144	**Nature of Current Distribution over the small dipoles**		Triangular	
145	**Disadvantage of rhombic antenna**		Maximum radiated power along main axis	
146	**Polarization is provided by helical antennas**		Circular	
147	**Effect of selective fading reduced**		By high carrier reception By single side band system	
148	**Functioning role of an antenna in receiving mode**		Sensor	
149	**Self impedance of an antenna is basically**		Its input impedance during the removal of all other antennas	

150	**Applications of an Infinitesimal dipole**		Field pattern estimation due to any length of antenna. Improvement in radiation resistance by increasing dipole length.	
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