This set of Antennas Multiple Choice Questions & Answers (MCQs) focuses on “Basics”.

1. Which of the following refers to the pattern of reflector in the reflector antenna?

a) Primary pattern

b) Secondary pattern

c) Reflector pattern

d) Feed pattern

Answer: b
Explanation: In a reflector antenna, primary pattern is the feed pattern and secondary pattern is the pattern of reflector. Reflector antennas are high gain antenna and are used in RADARs and for some communication purpose.

2. Reflector antenna operates on the Geometric optics principle?
a) True
b) False

Answer: a

Explanation: Reflector antenna is high gain antenna and works on the principle of the Geometric optics. Geometrical optics shows that if a beam of parallel rays is incident on a reflector antenna whose geometrical shape is a parabola, then the array beams will converge at the focal point.

3. Which of the following is a dual reflector antenna?

a) Cassegrain antenna

b) Parabolic antenna

c) Offset reflector antenna

d) Wire antenna

Answer: a

Explanation: A dual reflector antenna consists of two reflectors and one feed antenna. Cassegrain antenna is the best example of dual reflector antenna since it contains main reflector as parabolic and sub-reflector as hyperbola.

4. Which of the following combination forms a Cassegrain antenna?
a) The main reflector is parabolic and sub-reflector is hyperbolic
b) The main reflector is parabolic and sub-reflector is concave

c) The main reflector is hyperbolic and sub-reflector is parabolic
d) The main reflector is hyperbolic and sub-reflector is convex

Answer: a

Explanation: A Cassegrain antenna is a dual reflector antenna and is axis symmetry. It consists of two reflectors and one primary feed. The main reflector is parabolic and sub-reflector is hyperbolic (convex).

5. Which of the following efficiency is used to measure the power-loss at the feed pattern which is intercepted by reflector?

a) Spillover

b) Illumination

c) Taper

d) Aperture

Answer: a

Explanation: When the feed pattern exceeds beyond reflectors rim, not all the energy is redirected by the reflector. This power loss is measure results in spillover efficiency. Illumination efficiency is the combination of both taper and spillover efficiency. Aperture efficiency is the ratio of effective aperture to physical aperture. Taper efficiency gives the directivity measure of the antenna.

6. What is the value of magnification of the Cassegrain antenna if its sub-reflector eccentricity is 2?

a) 3

b) 2

c) 1/3

d) 1/2

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Answer: a

Explanation: Given eccentricity e=2

Magnification M=e+1e−1=3

7. Which of the following is false regarding a reflector antenna?

a) Reflector antennas are high gain antennas with two antennas

b) Both the primary and secondary antennas are excited

c) The pattern of the reflector in the reflector antenna is the Secondary pattern

d) A dual reflector contains two reflectors and one primary feed

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Answer: b

Explanation: In a reflector antenna the horn or a dipole acts as a feed and the antenna which is excited is the primary antenna. Reflector is the secondary antenna. Reflector antenna is a high gain antenna consisting of primary and secondary antennas.

8. Which of the following is not a reflector antenna?

a) Convex-convex

b) Corner

c) Gregorian

d) Cassegrain

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Answer: a

Explanation: Corner, Cassegrain and Gregorian belong to reflector antenna. Convex-convex is a type of lens antenna. Gregorian is a dual reflector antenna with a concave sub-reflector.

9. When a reflector is placed at the foci along the feed it is called ____ antenna

a) Dual reflector antenna

b) Plane antenna

c) Wire antenna

d) Convex-Convex

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Answer: a

Explanation: Usually a feed forward is used in reflector antenna and feed antenna is placed at focus of the reflector. When a sub-reflector is placed at the focus along with the feed antenna it is called dual reflector antenna. Example of dual reflector antenna: Cassegrain antenna.

Convex-Convex is a lens antenna.

10. Which of the following is used as a secondary antenna in the reflector antenna?

a) Horn

b) Feed antenna

c) Parabolic

d) Dipole

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Answer: c

Explanation: A parabolic reflector is used as a secondary antenna. Horn and dipole are used for feed antenna. Feed antenna of the reflector antenna is called Primary antenna.

1. Which of the following statements is false for flat reflector?

a) Plane reflector is used to reduce the backward radiation

b) Increases the gain in forward direction

c) A large flat sheet placed in front of dipole increases the directivity

d) Decreases the gain in forward direction

View Answer

Answer: d

Explanation: A plane or a flat reflector is used to radiate energy in desired direction by placing a feed in front of it. It reduces the backward radiation and increases the gain in the forward direction. A reflector antenna is a high gain antenna.

2. A corner reflector is converted to plane reflector when the corner angle is ______

a) 90°

b) 180°

c) 45°

d) 60°

View Answer

Answer: b

Explanation: For a corner reflector to become a plane reflector the corner angle must be 180°.

For a plane reflector N (current element) =1

$\alpha=\pi N=\pi$.

3. Which of the following reflector antenna is formed by joining two plane reflectors at some angle ($\neq n\pi$)?

a) Corner

b) Parabolic

c) Cheese

d) Truncated

View Answer

Answer: a

Explanation: By joining two plane sheet reflectors at some angle we get the corner antenna. A plane or a flat reflector is used to radiate energy in desired direction by placing a feed in front of it. Cheese and Truncated are types of parabolic antenna.

1. Corner reflector is designed for radiation in forward direction unlike in plane reflector.

a) True

b) False

View Answer

Answer: a

Explanation: The plane reflector allows back and side radiation. In order to avoid this it is modifies to a corner reflector which consists of two plane reflectors joined at a corner to allow radiation in forward direction only.

2. In a corner reflector, included angle α refers to _______

a) angle at which two plane reflectors are joined

b) angle between vertex and the feed radiator

c) angle between major axis to the main beam

d) angle between vertex and the main beam axis

View Answer

Answer: a

Explanation: A corner reflector consists of two plane reflectors joined at a corner to allow radiation in forward direction only. Included angle is the angle at which two reflectors are joined, measured at the corner.

3. In order to achieve good system efficiency in a corner reflector, the spacing between the vertex and the feed must be ______ as included angle decreases.

a) Increased

b) Decreased

c) Constant

d) Either increases or decreases

View Answer

Answer: a

Explanation: The system efficiency in a corner reflector depends on the spacing between vertex of the corner and the feed. It is adjusted depending on the included angle. As the included decreases, spacing must be increased.

4. Corner angle of a corner reflector with 4 current elements is ______

a) π4

b) π2

c) π8

d) 4π

View Answer

Answer: a

Explanation: Corner angle of a corner reflector with 4 current elements is given by α=πN

Given N=4

⇨ α=πN=π4.

5. Find the aperture dimension of the corner reflector having reflector sheet side length 1m?

a) 1.414

b) 2.828

c) 2

d) 1

View Answer

Answer: a

Explanation: From the design equations of a corner reflector,

Aperture dimension DA= 1.414l

Where l is side length of reflector sheet and l=2d where d is distance between feed and vertex of the reflector.

6. In a corner reflector antenna, if the spacing between vertex of reflector and feed is 2m then side length of reflector sheet is _____cm.

a) 4

b) 2

c) 400

d) 200

View Answer

Answer: c

Explanation: In a corner reflector antenna, side length of reflector sheet and l=2d

Where, d is distance between feed and vertex of the reflector.

Given d=2m so l=2*2=4m=400cm.

7. Which of the following statements is false for a corner reflector antenna?

a) Increases directivity in the forward direction

b) Back radiation is not reduced compare to the plane reflector

c) System efficiency depends on spacing between reflector vertex and the feed

d) Angle between the reflecting plates is called included angle

View Answer

Answer: b

Explanation: Compared to the plane reflector antenna, back and side radiations are reduced in the corner reflector. A corner reflector consists of two plane reflectors joined at a corner to allow radiation in forward direction only. As the included angle decreases, spacing will increases.

8. The number of images, polarity and position in the analysis of the radiation field of corner reflector depends on what?

a) Only included angle

b) Polarization of feed element

c) Both included angle & Polarization of feed element

d) Neither included angle nor Polarization of feed element

View Answer

Answer: c

Explanation: The number of images, polarity and position in the analysis of the radiation field of corner reflector depends on both included angle & Polarization of feed element with perpendicular polarization. Angle between the reflecting plates is called included angle.

9. Corner angle of a square corner reflector antenna is ______

a) 90°

b) 180°

c) 60°

d) 45°

View Answer

Answer: a

Explanation: For a square reflector angle N=2 and corner angle is given by α=πN=π2=90°. A corner reflector consists of two plane reflectors joined at a corner to allow radiation in forward direction only. This is one of the most practically used antennas.

10. What is the corner angle of a flat reflector antenna?

a) 90°

b) 180°

c) 60°

d) 45°

View Answer

Answer: b

Explanation: The corner angle depends on value of N (current element). For a flat reflector N=1. So the corner angle is α=πN=π=180°.

1. Which of the following wave conversion mechanism is performed in a parabolic reflector antenna?

a) Plane to spherical

b) Spherical to plane

c) Performs both plane to spherical and spherical to plane

d) Elliptic polarization

View Answer

Answer: b

Explanation: In a parabolic reflector antenna, the wave conversion mechanism used is spherical to plane. It works on the principle of geometric optics. The reflected plane waves travel parallel o the major axis of the reflector.

2. The power gain of the parabolic reflector with circular aperture of diameter 10λ?

a) 100π

b) 10π

c) 600π

d) 360π

View Answer

Answer: c

Explanation: The power gain of the parabolic reflector with circular aperture of diameter d is given by

$G\_p = 6\, d\text{^}2/\lambda\text{^}2 \;= 600\pi\text{^}2$

3. Find the aperture ratio of the paraboloid with aperture diameter 1m at 1.5GHz frequency?

a) 5

b) 0.2

c) 1.5

d) 7.5

View Answer

Answer: a
Explanation: Aperture ratio =d/λ
λ=c/f=3×108/1.5×109=0.2m
Aperture ratio=1/0.2=5.

4. BWFN of a paraboloid antenna with circular aperture assuming feed is isotropic is ____
a) 140λ/d
b) 115λ/d
c) 58λ/d
d) 40λ/d
View Answer

Answer: a
Explanation: A paraboloid antenna with a circular aperture has
BWFN (Beam width between two first nulls) = 140λ/d, (d is diameter of circular aperture)
For a rectangular aperture BWFN=115λ/L, (L is length of rectangular aperture).

5. Find the BWFN of a paraboloid with a circular aperture of diameter 10λ?
a) 14 degrees
b) 28 degrees
c) 11.5 degrees
d) 41 degrees
View Answer

Answer: a
Explanation: A paraboloid antenna with a circular aperture has
BWFN (Beam width between two first nulls) = 140λd, (d is diameter of circular aperture)
⇨ BWFN=140λ/10λ=14degrees.

6. What is the ratio of focal length to diameter for practical applications in a parabolic reflector?
a) 0.25 to 0.5
b) < 0.25
c) 0.125 to 0.3
d) 0.5 to 1
View Answer

Answer: a
Explanation: The ratio of focal length (f) to diameter (d) f/d < 14 indicates radiation away from the parabolic surface of the reflector. So for practical applications it lies between 0.125 and 0.5.
7. Which of the following is false regarding a paraboloid antenna?
a) Spill over decreases due to back lobe of primary radiator
b) Feed placed at the focus is used to improve the beam pattern
c) Pill box provides wide beam in one plane and narrow beam in other plane
d) At lower frequencies parabolic antennas are not used frequently
View Answer

Answer: a

Explanation: Spill over occurs due to the non-captured radiation by the reflector. From the primary radiators also some of forward radiation gets added up with the desired parallel beams. This is called back lobe radiation. It increases due to the back lobe of the primary radiator.
8. Which of the following paraboloid reflector is formed by cutting some part of paraboloid to meet requirements?
a) Truncated paraboloid
b) Cassegrain
c) Corner
d) Pill box
View Answer

Answer: a
Explanation: When a portion of the paraboloid reflector is cut off or truncated it is called as truncated paraboloid. Pill box provides wide beam in one plane and narrow beam in other plane. Cassegrain is a dual reflector antenna and Corner reflector is also a type of reflector antenna.
9. Which of the following is used to produce wide beam in one plane and narrow beam in other plane?
a) Pill box
b) Truncated paraboloid
c) Cassegrain
d) Paraboloid with rectangular aperture
View Answer

Answer: a
Explanation: Pill box is short parabolic right cylinder enclosed by parallel plates. It produces a wide beam in one plane and narrow beam in other plane. Cassegrain is a dual reflector. Truncated is a type of paraboloid.

10. In a paraboloid antenna, all rays leaving the focal point are collimated along the reflector's axis after reflection.
a) True
b) False
View Answer

Answer: a
Explanation: According to the geometry of the paraboloid reflector,
⇨ All rays leaving the focal point are collimated along the reflector's axis after reflection.
⇨ All overall ray path lengths (from the focal point to the reflector and on to the aperture plane) are the same and equal to 2F.

This set of Antennas Multiple Choice Questions & Answers (MCQs) focuses on "Feeding Systems".

1. Which of the following is called as the source placed at the focus?
a) Feed radiator
b) Reflector
c) Secondary radiator
d) Primary / reflector
View Answer

Answer: a
Explanation: The source placed at the focus is called as feed radiator. It is also known as primary radiator. The reflector is called as the secondary radiator. A reflector antenna contains primary and secondary radiators.
2. In which of the following cases, a parabolic reflector primary radiator is said to be ideal feed?
a) The entire reflector is illuminated with no radiation in unwanted direction when feed radiated entire energy towards it
b) Some part of reflector is illuminated with no radiation in unwanted direction when feed radiated entire energy towards it
c) Some part of reflector is illuminated with radiation in unwanted direction when feed radiated entire energy towards it
d) The entire reflector is illuminated with small radiation in unwanted direction when feed radiated entire energy towards it
View Answer

Answer: a
Explanation: A parabolic reflector primary radiator is said to be ideal feed, when the feed radiates entire energy, the reflector is fully illuminated and there is no energy radiation in unwanted direction.

3. To obtain maximum beam pattern, the primary radiator is placed ______ in a reflector antenna.
a) between Focus and Directrix
b) after the focus
c) at the focus point
d) can be placed anywhere
View Answer

Answer: c
Explanation: Maximum beam pattern is obtained only when the feed is placed at the focus of the parabola. Reflector antenna is a high gain antenna. So this is one of the important points to obtain the maximized gain.

4. When the feed is moved along the main axis in a reflector antenna what happens to the beam pattern?
a) It broadens
b) It deteriorates
c) Beam remains unchanged
d) Side lobes are increased

View Answer

Answer: a
Explanation: Maximum beam pattern is obtained only when the feed is placed at the focus of the parabola. When the feed is moved along the main axis, beam gets broadened.
5. The beam gets deteriorated when it is moved along a line perpendicular to the main axis passing through focus?
a) True
b) False
View Answer

Answer: a
Explanation: Beam pattern is maximum only when the feed is placed at the focus of the parabola. When the feed is moved along the main axis, beam gets broadened. When it is moved along perpendicular line beam gets deteriorated.
6. In a Cassegrain feed system; the feed is placed at _____
a) Focus
b) Vertex
c) Directrix
d) Anywhere between vertex and focus
View Answer

Answer: b
Explanation: Cassegrain is a dual reflector antenna. In this the feed is placed at the vertex of the parabolic reflector. The focus of the sub-reflector coincides with the focus of parabolic reflector and it illuminates the reflector.
7. Which of the following coincides with the focus of the parabolic reflector in a Cassegrain antenna?
a) Feed
b) Parabolic reflector
c) Focus of hyperboloid reflector
d) Focus of primary radiator
View Answer

Answer: c
Explanation: The focus of the sub-reflector coincides with the focus of parabolic reflector and it illuminates the reflector. Since it is a Cassegrain, the sub-reflector is a hyperboloid reflector.
8. Which of the following regarding the Cassegrain feed system is false?
a) Spill over is reduced
b) It is a dual reflector antenna
c) Minor lobe radiation increases
d) A convex sub-reflector is used
View Answer

Answer: c

Explanation: Spill over is the power loss when the reflector fails to redirect the energy. With the use of sub-reflector, this is reduced. Thus the minor lobe radiation also decreased. A convex hyperboloid is used as a sub-reflector. It is a dual reflector antenna with primary and two secondary radiators.

9. When a dipole with a parasitic reflector is used as a feed system, the distance between them is _____

a) 0.125λ

b) 0.4λ

c) 1λ

d) 0.625λ

View Answer

Answer: a

Explanation: In a parabolic reflector antenna, a dipole along a parasitic reflector serves well as a feed radiator. The distance between parasitic reflector and the dipole is 0.125λ. The distance between dipole to dipole is approximately 0.4λ.

10. Which of the following uses a concave sub-reflector in a dual reflector antenna?

a) Cassegrain

b) Gregorian

c) Both Gregorian &Cassegrain

d) Neither Gregorian nor Cassegrain

View Answer

Answer: b

Explanation: Cassegrain and Gregorian are dual reflector antennas. Gregorian antenna has a concave sub-reflector which is elliptic. Cassegrain uses a hyperboloid reflector which is convex towards the feed. The sub-reflectors are used to reduce the spillover efficiency.

1. Which of the following is used to avoid the aperture blockage due to secondary reflector?

a) Offset feed system

b) Cassegrain

c) Plane reflector

d) Parabolic antenna

View Answer

Answer: a

Explanation: Offset feed system is used to avoid the aperture blocking effect due to the dependence of secondary reflector. In this a feed radiator is placed at the focus in an inclined position such that all rays are collimated without formation of blockage region. In Cassegrain, plane reflector there is a blocking effect.

2. Which of the following causes aperture blockage in a Cassegrain antenna?

a) Main reflector

b) Sub-reflector

c) Feed radiator

d) Noise from surroundings

View Answer

Answer: b
Explanation: The sub-reflector causes the aperture blockage in a Cassegrain antenna. It can be reduced by reducing the size of the sub-reflector.
3. In which of the following the secondary reflector faces the primary reflector?
a) Cassegrain
b) Gregorian
c) Corner reflector
d) Plane reflector
View Answer

Answer: b
Explanation: In Gregorian antenna, sub-reflector is ellipsoidal and has its concave side faces the primary reflector. In Cassegrain, sub-reflector is hyperboloid with its convex side facing the feed. Corner and plane reflectors are normal reflector antennas while Cassegrain and Gregorian are dual reflector antennas.

4. Which of the following statement is true regarding a Gregorian antenna?
a) Sub-reflector ellipsoidal lies closer to the focus of the paraboloid
b) Sub-reflector is a hyperboloid with its convex facing feed
c) Sub-reflector is an ellipsoidal with its concave facing reflector
d) Sub-reflector is an ellipsoidal with its concave facing feed
View Answer

Answer: c
Explanation: Gregorian antenna is a dual reflector antenna having a concave secondary reflector. The secondary reflector also known as sub-reflector is a ellipsoidal. It lies beyond the focus of the paraboloid.
5. In which of the following the aperture blocking is reduced by permitting antenna to operate in a single polarization?
a) Truncated reflector
b) Cassegrain
c) Polarization-twist reflector
d) Plane reflector
View Answer

Answer: c
Explanation: Aperture blocking is reduced by permitting the antenna to operate with a single polarization in Polarization-twist reflector. Truncated reflector is a type of parabolic reflector. Cassegrain is a dual reflector.
6. In which of the following a sub-reflector called trans-reflector is present?
a) Polarization-twist reflector
b) Plane reflector
c) Cassegrain
d) Gregorian
View Answer

Answer: a

Explanation: It is present in Polarization-twist reflector. Sub-reflector consists of a horizontal grating of wires. Cassegrain contains a hyperboloid sub-reflector. Gregorian contains an ellipsoidal sub-reflector.
7. Which of the following is not used for aperture blocking?
a) Reducing size of sub-reflector
b) Offset feed system
c) High directive feed
d) Reducing spillover
View Answer

Answer: c
Explanation: A high directive feed means a large feed. It partially shadows the primary reflector and becomes an obstacle for blockage. Aperture blocking can be avoided by reducing size of sub-reflector, thereby spillover and by using Offset feed system.
8. Which of the following condition holds good for minimum total aperture blocking in Cassegrain?
a) Area of sub-reflector and projected area of feed are equal
b) Area of primary reflector and projected area of feed are equal
c) Area of sub-reflector greater than area of primary reflector
d) Area of sub-reflector is less than projected area of feed
View Answer

Answer: a
Explanation: Minimum total aperture blocking occurs when the area of sub-reflector and projected area of feed are approximately equal. In other conditions, the main ray back radiated ray gets added up with collinear rays from the primary reflector.
9. In Polarization-twist reflector, sub-reflector consists of a horizontal grating of wires.
a) True
b) False
View Answer

Answer: a
Explanation: In Polarization-twist reflector, sub-reflector consists of a horizontal grating of wires called trans-reflector. In this the antenna is permitted to operate only at a single polarization. The polarized radiation is rotated by 90° by sub-reflector at the primary reflector with the help of twist reflector.

1. Which one of the following antennas is mostly used in TV Dish?
a) Parabolic reflector
b) Lens antenna
c) Log periodic
d) Rhombus antenna
View Answer

Answer: a

Explanation: Parabolic reflector antenna also known as Dish antenna is widely used in the TV dishes. It is a high gain antenna used in VHF. Due to its narrow beamwidth it is widely used as dish antenna.
2. Which of the following antenna has a shape of letter 'C'?
a) Orange peel antenna
b) Pill box
c) Yagi-Uda antenna
d) Wire dipole
View Answer

Answer: a
Explanation: Orange peel antenna is one of the types of parabolic antenna with its shape in form of letter C. It is mainly used in the search radars. Pill box antenna gives wide and narrow beams in different planes. Yagi-Uda antenna is formed with the help of dipoles and reflectors placed at some distances to get a unidirectional beam with good directivity.

3. Which of the following statements is false about Array-fed antenna?
a) It is widely used to create a downlink radiation in satellite communication
b) An array of feed horns are clustered at focal point to produce arbitrary shaped beam
c) It uses only a single horn feed and a multiple array of passive reflectors
d) It can also be used with secondary reflector antennas
View Answer

Answer: c
Explanation: Array-fed antenna uses a cluster of horn feeds instead of a single horn to produce an arbitrary beam. It is mainly used in direct satellite communication for downlink radiation. It is also used with secondary reflectors like Cassegrain.

4. Which type of feed in parabolic antenna blocks the beam limiting aperture efficiency to 55%?
a) Axial feed
b) Offset feed
c) Cassegrain
d) Gregorian
View Answer

Answer: a
Explanation: In Axial feed, the feed is located at the focal point along the beam axis infront of dish and is pointed back and blocks some part of beam. Offset is used to avoid the aperture blocking. In Cassegrain and Gregorian the aperture efficiency is approximately 70%.
5. Which of the following reflector antenna doesn't require a directive feed?
a) Parabolic
b) Hyperbolic
c) Corner
d) Truncated
View Answer

Answer: c
Explanation: Corner reflector doesn’t require a directional feed because the direct and reflected waves are combined properly and also it doesn’t require any specific focal point. In Parabolic, hyperbolic the feed is directed towards the focal point.
6. In which of the following secondary reflector is concave?
a) Gregorian
b) Cassegrain
c) Parabolic
d) Corner
View Answer

Answer: a
Explanation: Cassegrain and Gregorian are dual reflector antennas having primary and secondary reflectors. In Gregorian concave ellipsoidal is used as secondary reflector whereas in Cassegrain convex hyperboloid. Corner and parabolic are reflector antennas and secondary reflectors are not used widely.
7. In which of the following secondary reflector is convex?
a) Gregorian
b) Cassegrain
c) Parabolic
d) Corner
View Answer

Answer: b
Explanation: Dual reflector antennas have both primary and secondary reflectors. Cassegrain and Gregorian antennas are dual reflector antennas. Secondary reflector is convex for Cassegrain antenna. In Gregorian concave ellipsoidal is used as secondary reflector. Parabolic and corner antennas are normal reflector antennas.
8. Cassegrain antennas cannot be used in radio telescopes.
a) True
b) False
View Answer

Answer: b
Explanation: One of the advantages of Cassegrain antenna is that its feed is not placed in front of the dish or at the focal point. So, it can be used with bulky feeds which requires in radio telescopes and large satellite communications.
9. Which of the following antenna is a combination of pillbox and parabolic cylinder?
a) Cheese antenna
b) Orange peel antenna
c) Corner antenna
d) Cassegrain
View Answer

Answer: a

Explanation: A pillbox alone sometimes is called as a Cheese antenna as it is made from the parabolic cylinder. It is a thin slice of the parabolic cylinder cross-section covered with plates. Orange peel antenna consists of array of feeds and is C shaped. Cassegrain is a dual reflector antenna. Corner antenna is made from joining two plane sheet reflectors.
10. Which of the following is formed by moving parabolic counter parallel to itself?
a) Parabolic cylinder
b) Pill box
c) Cheese antenna
d) Truncated antenna
View Answer

Answer: a
Explanation: A parabolic cylinder is formed by moving the parabolic counter parallel to itself. It consists of a line of focus unlike the focal point in basic parabolic antenna. Pillbox or cheese antenna is obtained from the parabolic cylinder reflector. Truncated is obtained by cutting some part of parabolic antenna.
11. Large f/D ratio is used for deep-dish reflectors.
a) True
b) False
View Answer

Answer: b
Explanation: The ratio of focal length to the aperture size is known as the f/D ratio. Large f/D ratio is used for shallow-dish reflectors. Small f/D ratio is used for deep-dish reflectors. As the f/D ratio increases, the spillover efficiency of antenna reduces.
12. In which of the following feed there is no impedance mismatch?
a) Offset feed
b) Cassegrain feed
c) Front feed
d) Gregorian feed
View Answer

Answer: a
Explanation: In Front feed, due to the reflections from the dishes impedance mismatch occurs. Cassegrain and Gregorian are front feed dual reflectors. Offset feed there is no aperture blocking and no impedance mismatch.

Antenna Array

This set of Antennas Multiple Choice Questions & Answers (MCQs) focuses on “Introduction”.

1. Which of the following is false regarding Antenna array?

a) Directivity increases

b) Directivity decreases

c) Beam width decreases

d) Gain increases

View Answer

Answer: b

Explanation: A single antenna provides low gain and less directivity. To increase the directivity antenna arrays are used. With the antenna arrays, directivity and gain increases and beam width decreases.

2. Electrical size of antenna is increased by which of the following?

a) Antenna Array

b) Decreasing the coverage area

c) Increasing the coverage area

d) Using a single antenna

View Answer

Answer: a

Explanation: To increase the directivity antenna arrays are used. With the antenna arrays, directivity and gain increases and beam width decreases. The electrical size of the antenna is increased by placing an array antenna together to achieve high directivity.

3. For long distance communication, which of the property is mainly necessary for the antenna?

a) High directivity

b) Low directivity

c) Low gain

d) Broad beam width

View Answer

Answer: a

Explanation: Long distance communication requires antenna with high directivity. To increase the directivity antenna arrays are used. With the antenna arrays, directivity and gain increases and beam width decreases.

4. Which of the following is false about the single antenna for long distance communication?

a) Enlarging may create side lobes

b) No side lobes

c) High directivity is required

d) High Gain is required

View Answer

Answer: b

Explanation: High directive antennas are required for the long distance communications. The array of antennas is used to increase the directivity. The directivity can be increased by increasing the dimensions of antenna but it creates side lobes.

5. The electrical size of antenna is increased by antenna array to avoid size lobes compared to single antenna.

a) True

b) False

View Answer

Answer: a

Explanation: Increasing the dimensions of antennas may lead to the appearance of the side lobes. So by placing a group of antennas together the electrical size of antenna can be increased. With the antenna arrays, directivity and gain increases and beam width decreases.

6. A uniform linear array contains ______________

a) N elements placed at equidistance and fed currents of equal magnitude and progressive phase shift

b) N elements at non-equidistance and fed currents of equal magnitude and progressive phase shift

c) N elements at equidistance and fed currents of unequal magnitude and progressive phase shift

d) N elements at equidistance and fed currents of unequal magnitude and equal phase shift

View Answer

Answer: a

Explanation: An array is said to be linear if N elements are spaced equally long the line and is a uniform array if the current is fed with equal magnitude to all elements and progressive phase shift along the line. High directivity can be obtained by antenna array.

7. Total resultant field obtained by the antenna array is given by which of following?

a) Vector superposition of individual field from the element

b) Maximum field from individual sources in the array

c) Minimum field from individual sources in the array

d) Field from the individual source

View Answer

Answer: a

Explanation: The total resultant field is obtained by adding all the fields obtained by the individual sources in the array. An Array containing N elements has the resultant field equal to the vector superposition of individual field from the elements.

8. If the progressive shift in antenna array is equal to zero then it is called _________

a) Broad side

b) End-fire

c) Yagi-uda

d) Fishbone antenna

View Answer

Answer: a

Explanation: The total phase difference of the fields is given by $\Psi=kd\cos\theta+\beta$

Here β is the progressive phase shift

⇨ $\beta=0$, array is a uniform broadside array

⇨ $\beta=180$, array is a uniform end-fire array

Yagi-uda antenna, fishbone antenna are end-fire antenna array.

9. What is the progressive phase shift of the end-fire array?

a) 0

b) 90

c) 180

d) 60

View Answer

Answer: c

Explanation: The progressive phase shift of the end-fire array is 180°. It is a linear array whose direction of radiation is along the axis of the array. For a broadside array it is 0°.

10. Which of the following statement about antenna array is false?

a) Field pattern is the product of individual elements in array

b) Field pattern is the sum of individual elements in array

c) Resultant field is the vector superposition of the fields from individual elements in array

d) High directivity can be achieved for long distance communications

View Answer

Answer: b

Explanation: The total resultant field is obtained by adding all the fields obtained by the individual sources in the array. Radiation pattern is obtained by multiplying the individual pattern of the element. Field pattern is the product of individual elements in array. Antenna arrays are used to get high directivity with less side lobes.

1. Which of the following statement is true?

a) As the number of elements increase in array it becomes more directive

b) As the number of elements increase in array it becomes less directive

c) Point to point communication is not possible with more number of array elements

d) There is no uniform progressive phase shift in linear uniform array

View Answer

Answer: a

Explanation: To get a single beam for the point to point communication more number of array elements is used. It increases the directivity of the antenna. An array is said to be uniform if the elements are excited equally and there is a uniform progressive phase shift.

2. Normalized array factor of N –element linear array is ________

a) $(sin(N\Psi/2))/(N\Psi/2)$

b) $(cos(N\Psi/2))/(N\Psi/2)$

c) $N\ (sin(\Psi/2))/(\Psi/2)$

d) $N\ (cos(N\Psi/2))/(N\Psi/2)$

View Answer

Answer: a

Explanation: The N-element linear uniform array, having a constant phase difference will have the array factor $AF = \sum\_(n = 1)\verb|^|N\ e\verb|^|(j(n-1)\Psi)$

Normalized array factor is given by sin(NΨ/2)NΨ/2.

3. Which of the following expression gives the nulls for the N- element linear array?

$a)\ \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right)$

$b)\ \theta_n = \sin^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right)$

$c)\ \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{\pi n}{N}\right]\right)$

$d)\ \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[\beta \pm \frac{2\pi n}{N}\right]\right)$

Answer: a Explanation: To determine Null points the array factor is set equal to zero. $\frac{\sin\left(\frac{N_q}{2}\right)}{\frac{N_v}{2}} = 0$

$$\Rightarrow \sin\left(\frac{N_{\text{श}\top}}{2}\right) = 0$$

$$\Rightarrow \frac{N_{\mathrm{q}}}{2} = \pm n\pi$$

$$\Rightarrow kd\cos\ \theta + \beta = \pm\frac{2n\pi}{N}$$

$$\Rightarrow \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right)$$

4 Maximum value of array factor for N -element linear array occurs at

a) $\theta_m = \cos^{-1}\left(\frac{\lambda}{2\pi d}[-\beta \pm 2\pi m]\right)$

b) $\theta_m = \cos^{-1}\left(\frac{\lambda}{2\pi d}[\beta \pm 2\pi m]\right)$

c) $\theta_m = \sin^{-1}\left(\frac{\lambda}{2\pi d}[-\beta \pm 2\pi m]\right)$

d) $\theta_m = \sin^{-1}\left(\frac{\lambda}{2\pi d}[-\beta \pm 2\pi m]\right)$

Answer: a Explanation: Normalized array factor is given by $\frac{\sin\ (N_{\mathrm{T}},}{\mathrm{N}\sin(-3}$ To get maximum denominator is equal to zero. $\Rightarrow \sin\left(\frac{w}{2}\right) = 0$

$\Rightarrow \frac{\mathbf{w}}{2} = \pm n\pi$

$\Rightarrow \mathrm{kdcos}\ \theta + \beta = \pm 2\pi \mathrm{m}$

$\Rightarrow \theta_m = \cos^{-1}\left(\frac{\lambda}{2\pi d}[-\beta \pm 2\pi m]\right)$

5 Find the maximum value of array factor when elements are separated by a $\lambda/4$ and phase difference is 0?

a) $\theta_m = \cos^{-1}(4m)$

b) $\theta_m = \sin^{-1}(4\pi m)$

c) $\theta_m = \cos^{-1}(4\pi m)$

d) $\theta_m = \sin^{-1}(2m)$

Answer: a Explanation: The maximum value of array factor is $\theta_m = \cos^{-1}\left(\frac{\lambda}{2\pi d}[-\beta \pm 2\pi m]\right)$.

$\theta_m = \cos^{-1}\left(\frac{\lambda}{2\pi\lambda/d}[0 \pm 2\pi m]\right)$

$\theta_{\mathrm{m}} = \cos^{-1}(4\ \mathrm{m})$

6 Find the Nulls of the N-element array in which elements are separated by $\lambda/4$ and phase difference is 0 ?

a) $\theta_n = \cos^{-1}\left(\left[\pm\frac{4n}{N}\right]\right)$

b) $\theta_n = \cos^{-1}\left(\left[\pm\frac{2n}{N}\right]\right)$

c) $\theta_n = \sin\left(\left[\pm\frac{4n}{N}\right]\right)$

d) $\theta_n = \sin^{-1}\left(\left[\pm\frac{4n}{N}\right]\right)$

Answer: a Explanation: The nulls of the N - element array is given by $\theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right)$

$\Rightarrow \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi\lambda/4}\left[0 \pm \frac{2\pi n}{N}\right]\right)$

$\Rightarrow \theta_n = \cos^{-1}\left(\left[\pm\frac{4n}{N}\right]\right)$

7 Find the Nulls of the 8 -element array in which elements are separated by $\lambda/4$ and phase difference is 0 ?

a) $\theta_n = \cos^{-1}\left(\left[\pm\frac{n}{2}\right]\right)$

b) $\theta_n = \cos^{-1}\left(\left[\pm\frac{n}{4}\right]\right)$

c) $\theta_n = \sin^{-1}\left(\left[\pm\frac{n}{2}\right]\right)$

d) $\theta_n = \sin^{-1}\left(\left[\pm\frac{n}{4}\right]\right)$

Answer: a

Explanation: The nulls of the N - element array is given by $\theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right)$

$\Rightarrow \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi\lambda/4}\left[0 \pm \frac{2\pi n}{N}\right]\right)$

$\Rightarrow \theta_n = \cos^{-1}\left(\left[\pm\frac{4n}{8}\right]\right)$

$$\Rightarrow \theta_n = \cos^{-1}\left(\left[\pm\frac{n}{2}\right]\right)$$

8. The radiating pattern of single element multiplied by the array factor simply gives the ___________

a) Pattern multiplication

b) Normalized array factor

c) Beamwidth of the array

d) Field strength of the array

View Answer

Answer: a

Explanation: The radiation pattern of the single array antenna is multiplied by the antenna factor then it is called pattern multiplication. Array factor is the function of antenna positions in the array and its weights. Total array field is the field generated by the sum of the individual elements in array.

9 Condition for the half power width of the Array factor is given by
a) $\frac{N_{\mathrm{v}}}{2} = \pm 1.391$
b) $\frac{N_{*}}{2} = \pm 3$
c) $\frac{N_{\text{शे}}}{2} = \pm 0.5$
d) $\frac{N_{\mathrm{m}}}{2} = \pm 1$

Answer: a

Explanation: Array factor is the function of antenna positions in the array and its weights. Half power beamwidth is also known as the 3 decibel points. The half power beam widths of the array factor will occur at $\frac{N_{\mathrm{q}}}{2} = \pm 1.391$

10 The maximum of the first minor lobe of array factor occurs at $13.46\ \mathrm{dB}$ down the maximum major lobe.
a) True
b) False
View Answer
Answer: a

Explanation: The maximum of 1 st minor lobe occurs at $\frac{N_{\mathrm{w}}}{2} = \pm 3\pi/2 \Rightarrow AF = \frac{\sin\left(\frac{Nr}{2}\right)}{\frac{N_{\nabla}}{2}} = 0.212 = -13.46dB$

1 The normalized array factor of a two element array antenna is given by

a) $AF_n = \cos\left(\frac{kd\cos\,\theta + \beta}{2}\right)$

b) $AF_n = 2\cos\left(\frac{kd\cos\,\theta + \beta}{2}\right)$

c) $AF_n = \cos\left(\frac{kd\cos\,\theta}{2} + \beta\right)$

d) $AF_n = \cos\left(\frac{kd\sin\,\theta + \beta}{2}\right)$

Answer: a

Explanation: Array factor is the function of antenna positions in the array and its weights. The array factor for a two element array antenna is given by $AF = 2\cos\left(\frac{kd\cos\,\theta + \beta}{2}\right)$

The normalized array factor is given by $AF_n = \frac{AF}{2} = \cos\left(\frac{kd\cos\,\theta + \beta}{2}\right)$.

2. Which of the following is a function of position of antennas in array and the weights?

a) Array Factor

b) Field pattern

c) Total array field

d) Beamwidth

View Answer

Answer: a

Explanation: Array factor is the function of antenna positions in the array and its weights. The normalized array factor is given by AFn=AF/2=cos(kdcosθ+β/2). Field pattern is multiplication of single element with the array factor. Total array field is the field generated by the sum of the individual elements in array.

3 Find the normalized Array factor when two antenna elements are separated by a distance of $\lambda/4$ and phase difference is 0 and $\theta = 0$?

a) $\cos\left(\frac{\pi}{4}\right)$

b) $\cos\left(\frac{\pi}{2}\right)$

c) $\cos\left(\frac{3\pi}{4}\right)$

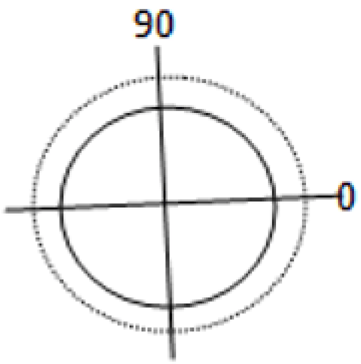
d) $\cos\left(\frac{3\pi}{2}\right)$

Answer: a

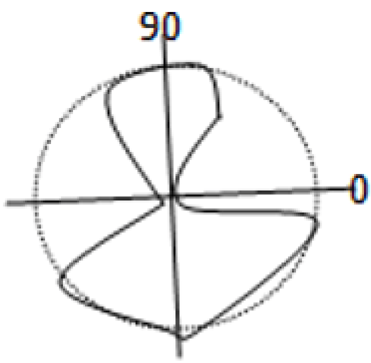
Explanation: The normalized array factor is given by $AF_n = \frac{AF}{2} = \cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)$

$$\Rightarrow AF_n = \cos\left(\frac{kd\cos\,\theta + \beta}{2}\right) = \cos\left(\frac{\left(\frac{2\pi}{\lambda}\right)(\lambda/4)\cos\,\theta + 0}{2}\right) = \cos\left(\frac{\pi}{4}\right)$$

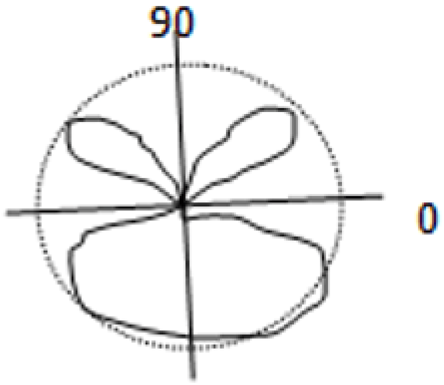
4. Which of the following pattern represents the array factor of a two element array separated by a distance of λ/4 and phase difference is 0?



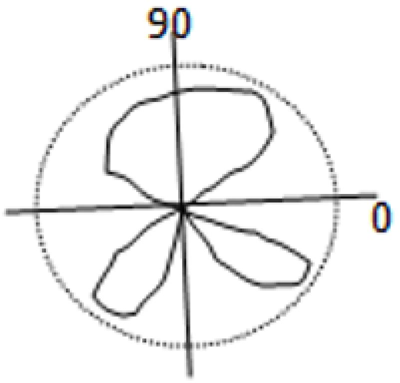
a)



b)



c)



d)

Answer: a

Explanation: The normalized array factor is given by $AF_n = AF2 = \cos(kd\cos\theta + \beta/2)$

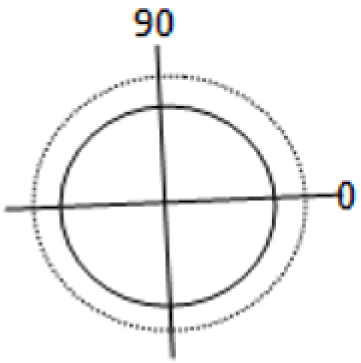
⇨ $AF_n = 0$

⇨ $\cos(kd\cos\theta + \beta/2) = 0$

⇨ $(2\pi/\lambda)(\lambda/4)\cos\theta + 0/2) = \pi/2$

⇨ $\cos\theta = 2$

No Nulls will occur for the given pattern. So the pattern is represented as



5. Which of the following is true for uniform linear array elements, to obtain the total field?

a) The single element field is multiplied by the array factor

b) The single element field is multiplied by the normalized array factor

c) The single element field is multiplied by the beamwidth

d) The single element field is multiplied by the directivity

View Answer

Answer: a

Explanation: Total array field is the field generated by the sum of the individual elements in array and is given simple by multiplying the field due to single element by the array factor. Array factor is the function of antenna positions in the array and its weights. Multiplying the normalized field with the normalized array factor gives the pattern multiplication.

6. Multiplying the normalized field with the normalized array factor gives ___________

a) pattern multiplication

b) array factor

c) beamwidth

d) null

View Answer

Answer: a

Explanation: The radiation pattern of the single array antenna is multiplied by the antenna factor then it is called pattern multiplication. So multiplying the normalized field with the normalized array factor gives the pattern multiplication. Array factor is the function of antenna positions in the array and its weights. Nulls are known by equating array factor to zero.

7. Find the angle at which nulls occur for the two element array antenna with separation λ/4 and phase difference is π/2?

a) 0

b) π/2

c) π/4

d) π

Answer: a

Explanation: The normalized array factor is given by $AF_n = \frac{AF}{2} = \cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)$

$\Rightarrow \mathrm{AF_n} = 0$

$\Rightarrow \cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)=0$
$\Rightarrow \frac{\left(\frac{2\pi}{\lambda}\right)(\lambda/4)\cos\,\theta+\frac{\pi}{2}}{2}=\frac{\pi}{2}$
$\Rightarrow \text{Cos}\,\theta=1$
$\Rightarrow \theta=0$
So Nulls occur at 0°.

8 Find the angle at which nulls occur for the two element array antenna with separation $\lambda/4$ and phase difference is $-\pi/2$?
a) 0
b) $\pi/2$
c) $\pi/4$
d) II

Answer:

d

Explanation: The normalized array factor is given by $AF_n=\frac{AF}{2}=\cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)$
$\Rightarrow \mathrm{AF_n}=0$
$\Rightarrow \cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)=0$
$\Rightarrow \frac{\left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{4}\right)\cos\,\theta-\frac{\pi}{2}}{2}=\pm\frac{\pi}{2}$
$\Rightarrow \text{Cos}\,\theta=-1$
$\Rightarrow \theta=180$ or π
So Nulls occur at 180°.

9 Find the angle at which nulls occur for the two element array antenna with separation $\lambda/4$ and phase difference is 0 ?
a) Doesn't exist
b) 0
c) $\pi/2$
d) $\pi/4$
A View Answer
Answer:

a

Explanation: The normalized array factor is given by $AF_n=\frac{AF}{2}=\cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)$
$\Rightarrow \mathrm{AF_n}=0$
$\Rightarrow \cos\left(\frac{kd\cos\,\theta+\beta}{2}\right)=0$
$\Rightarrow \frac{\left(\frac{2\pi}{\lambda}\right)(\lambda/4)\cos\,\theta+0}{2}=\frac{\pi}{2}$
$\Rightarrow \cos\,\theta=2$
No Nulls will occur for the given pattern.

10 For N - element linear uniform array, the normalized array factor is represented as
a) $\frac{\sin\,(N\%/2)}{N\text{श}/2}$

b) $\frac{\cos(N\mathbf{q}/2)}{N_{\equiv/2}}$
c) $N\frac{\sin(\Phi/2)}{2/2}$
d) $N\frac{\cos(N_{\mathrm{q}}/2)}{N"/2}$

Answer: a

Explanation: The N-element linear uniform array, having a constant phase difference will have the array factor $\mathrm{AF} = \sum_{n=1}^{N} e^{j(n-1)\mathbf{q}}$
Normalized array factor is given by $\frac{\sin(N\varpi/2)}{N_{\mathrm{q}}/2}$

1. Pattern multiplication is the multiplication of single array radiation pattern with ___
a) Array Factor
b) Beamwidth
c) Total Field
d) Directivity
View Answer

Answer: a
Explanation: The radiation pattern of the single array antenna is multiplied by the antenna factor then it is called pattern multiplication. Array factor is the function of antenna positions in the array and its weights.Total array field is the field generated by the sum of the individual elements in array.

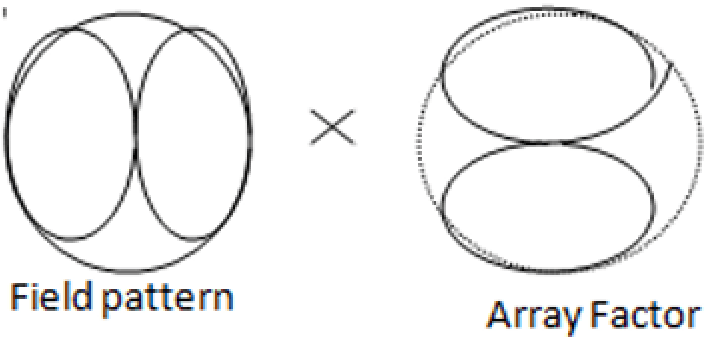
2. Which of the following expression represents the pattern multiplication?
a) $E_{total}=E_\theta$ × Array Factor
b) $E_{total}=E_\theta$ × Directivity
c) $E_{total}=E_{all\ elements}$ × Array Factor
d) $E_{total}=E_\theta$ × Beamwidth
View Answer

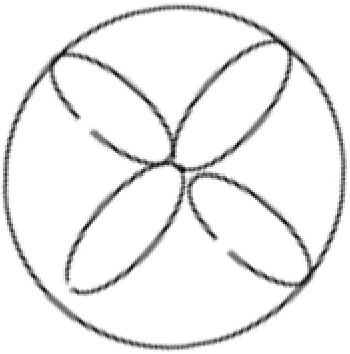
Answer: a
Explanation: The pattern multiplication is the product of the radiation pattern of the single array antenna by the antenna factor. This helps to sketch the radiation pattern of the entire array. An Array factor is defined as the function of antenna positions in the array and its weights.

3. All the elements must be identical to apply pattern multiplication principle.
a) True
b) False
View Answer

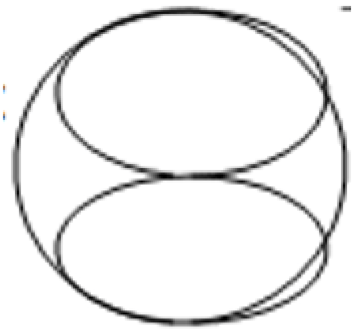
Answer: a
Explanation: This pattern multiplication principle works only for the identical elements in the array. This is one of the disadvantages of the pattern multiplication. This is used to sketch the radiation pattern of the entire array.

4. Which of the following is the resultant pattern obtained by pattern multiplication principle for the figure shown below?

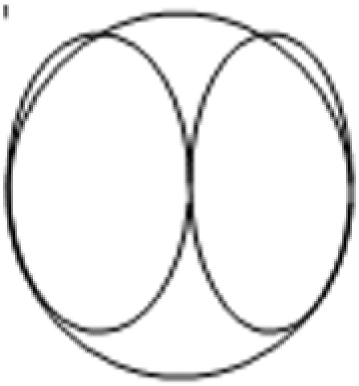




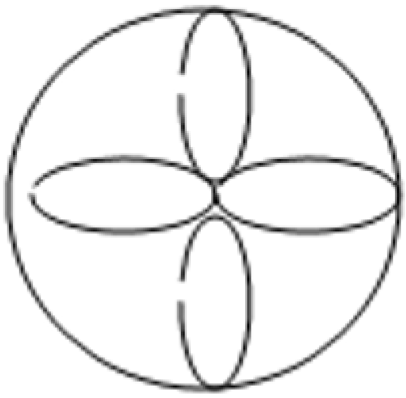
a)



b)

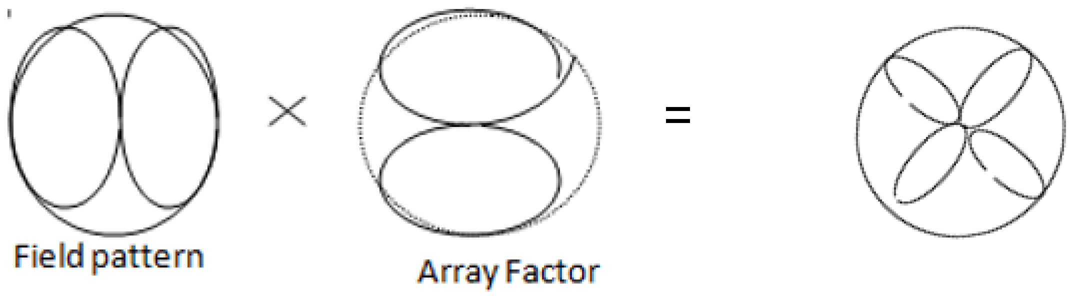


c)



d)
View Answer

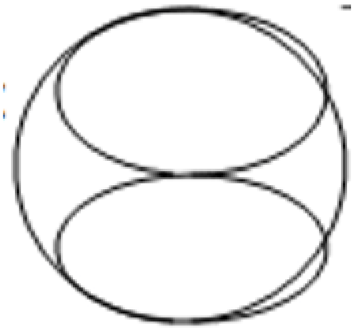
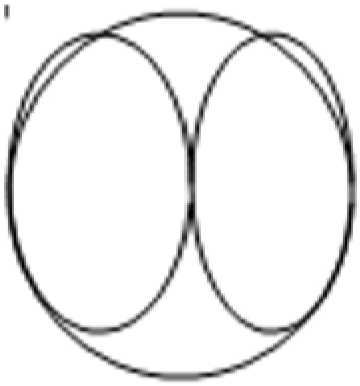
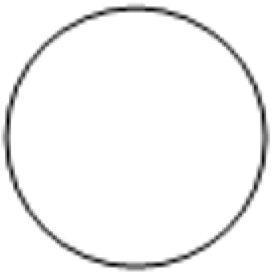
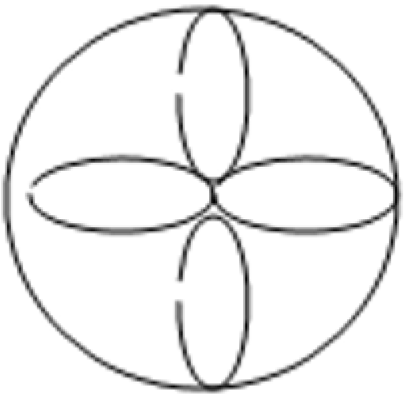
Answer: a
Explanation:The radiation pattern of the single array antenna is multiplied by the antenna factor then it is called pattern multiplication. At nulls the final pattern will also have same nulls from bath patterns.



5. Which of the following statements is false?
a) Pattern multiplications gives use the radiation pattern of the array
b) All elements must be identical to apply pattern multiplication principle
c) The radiation pattern of the single array antenna is multiplied by the antenna factor then is pattern multiplication
d) Pattern multiplication is also applicable for array with different unequal elements
View Answer

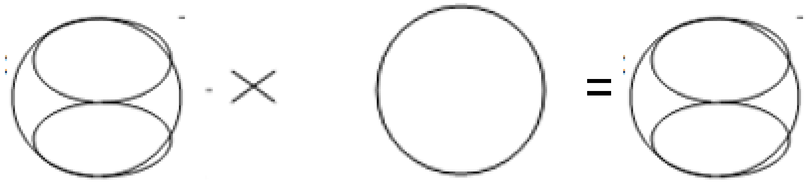
Answer: d
Explanation: The pattern of the individual array element is multiplied by the array factor. This is pattern multiplication. To apply this principle all elements must be identical. This shows the radiation pattern of the entire array.

6. Which of the following is the resultant pattern obtained by pattern multiplication principle for the figure shown below?


a)

b)

c)

d)
View Answer

Answer: a
Explanation: The radiation pattern of the single array antenna is multiplied by the antenna factor then it is called pattern multiplication. At nulls the final pattern will also have same nulls from bath

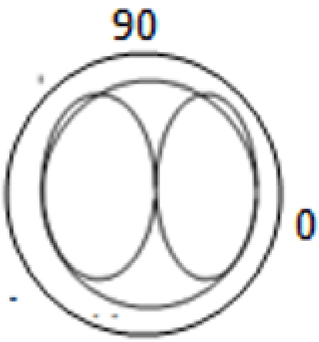
patterns.



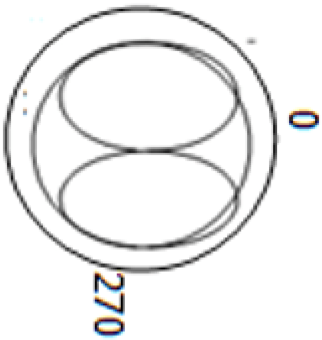
7. Which of the following doesn't applicable for pattern multiplication?
a) It is the product of the individual radiation pattern of the element with the array factor of the array
b) All elements must be identical
c) All elements need not be identical
d) This gives the radiation pattern of the entire array
View Answer

Answer: c
Explanation: The pattern of the individual array element is multiplied by the array factor. This is pattern multiplication. To apply this principle all elements must be identical. This shows the radiation pattern of the entire array.

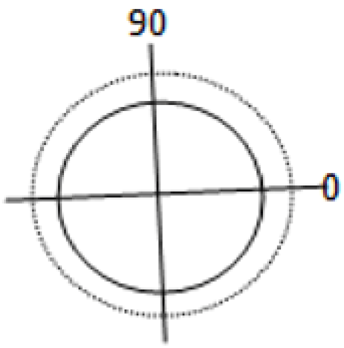
8. For two elements array find the radiation pattern of array separated by λ/4 and phase difference is 0?



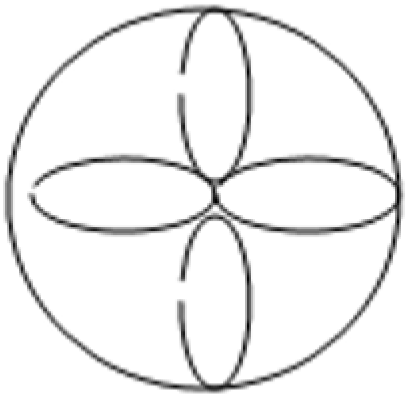
a)



b)



c)



d)

View Answer

Answer: a

Explanation: Consider the far field pattern, equation the field pattern to zero to get nulls.

$E_{total}=E_\theta\times$Array Factor=0

$E_\theta=0 \Rightarrow \cos\theta=0, \theta=\pm\pi/2$

Or

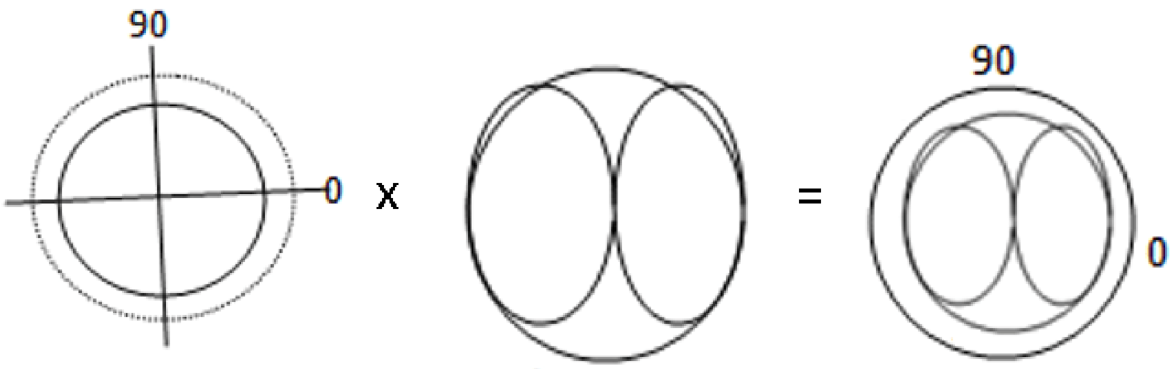
⇨ Array Factor=0

⇨ $AF_n=0$

⇨ $\cos(kd\cos\theta+\beta 2)=0$

⇨ $(2\pi\lambda)(\lambda/4)\cos\theta+0/2=\pi 2$

⇨ $\cos\theta=2$



9. The total radiation pattern of a two element array, elements separated by a distance λ/4 and phase difference π2, the nulls occur at (for far field) ____________

a) 0, ±π/2

b) π, ±π/2

c) π, ±π/4

d) π/4, ±π/2
View Answer

Answer: a
Explanation: The normalized array factor is given by AFn=AF2=cos(kdcosθ+β2)
⇨ AF_n=0
⇨ cos(kdcosθ+β2)=0
⇨ (2πλ)(λ/4)cosθ+π22=π2
⇨ Cosθ=1
⇨ θ=0
So Nulls occur at 0°.
For far field, the E_θ=0 => cosθ=0, θE_θ=0 cosθ=0, θ=±π/2
Therefore nulls occur atθ=±π2, 0.

10. The isotropic element array radiation pattern depends on the nulls of the array factor only.
a) True
b) False
View Answer

Answer: a
Explanation: For isotropic elements it radiated n all directions. The radiation pattern of the array is the pattern of the individual array element is multiplied by the array factor. So its total radiation pattern depends on the nulls of the array factor only.

1 The array factor of 4 - isotropic elements of broadside array is given by
a) $\frac{\sin(2kd\cos\theta)}{2kd\cos\theta}$
b) $\frac{\sin(kd\cos\theta)}{2kd\cos\theta}$
c) $\frac{\sin(2kd\cos\theta)}{kd\cos\theta}$
d) $\frac{\cos(2kd\cos\theta)}{2kd\cos\theta}$
A View Answer
Answer: a Explanation: Normalized array factor is given by $AF=\frac{\sin(N_{\mathrm{m}}/2)}{N\frac{\mathrm{v}}{2}}$
And $\psi=kd\cos\theta+\beta$
Since its given broad side array $\beta=0, \psi=kd\cos\theta+\beta=kd\cos\theta$
$\frac{N_{\mathbf{P}}}{2}=2kd\cos\theta$
$AF=\frac{\sin(N^{\varpi}/2)}{N\frac{v}{2}}=\frac{\sin(2kd\cos\theta)}{2kd\cos\theta}$

2 A 4-isotropic element broadside array separated by a $\lambda/2$ distance has nulls occurring at
a) $\cos^{-1}\left(\pm\frac{n}{2}\right)$
b) $\cos^{-1}\left(\pm\frac{4n}{2}\right)$
c) $\sin^{-1}\left(\pm\frac{n}{2}\right)$
d) $\sin^{-1}\left(\pm\frac{n}{4}\right)$
A View Answer

Answer: a Explanation: The nulls of the N - element array is given by $\theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right) = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[\pm \frac{2\pi n}{N}\right]\right)$

$\Rightarrow \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi(\lambda/2)}\left[\pm \frac{2\pi n}{N}\right]\right) = \cos^{-1}\left(\pm \frac{2n}{4}\right) = \cos^{-1}\left(\pm \frac{n}{2}\right)$

3 A 4-isotropic element broadside array separated by a $\lambda/4$ distance has nulls occurring at

a) $\cos^{-1}(\pm n)$

b) $\cos^{-1}\left(\pm \frac{n}{2}\right)$

c) $\sin^{-1}\left(\pm \frac{n}{2}\right)$

d) $\sin^{-1}(\pm n)$

Answer:

a

Explanation: The nulls of the N - element array is given by $\theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right) = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[\pm \frac{2\pi n}{N}\right]\right)$

$\Rightarrow \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi(\lambda/4)}\left[\pm \frac{2\pi n}{N}\right]\right) = \cos^{-1}\left(\pm \frac{4n}{4}\right) = \cos^{-1}(\pm n)[n = 1,2,3 \text{ and } n \neq N, 2N \ldots]$

4. The array factor of 4- isotropic elements of broadside array separated by a λ/4 is given by

____

a) sinc(cosθ)

b) cos(sinθ)

c) sin(sinθ)

d) sin(cosθ)

View Answer

Answer: a

Explanation: Normalized array factor is given by AF=sin(Nψ/2)Nψ2

And ψ=kdcosθ+β

Since its given broad side array β=0,

ψ=kdcosθ+β=kdcosθ

Nψ2=2kdcosθ=2(2πλ)(λ4)cosθ=πcosθ

AF=sin(Nψ/2)Nψ2=sin(πcosθ)/πcosθ=sinc(cosθ).

5. The array factor of 4- isotropic elements of broadside array separated by a λ/2 is given by

____

a) sinc(2cosθ)

b) sin(2πcosθ)

c) sinc(2πsinθ)

d) sin(2sinθ)

Answer: a Explanation: Normalized array factor is given by $AF = \frac{\sin(N^*/2)}{N\frac{Y}{2}}$ And $\psi = \mathrm{kdcos}\ \theta + \beta$

Since its given broad side array $\beta = 0, \psi = kd\cos\ \theta + \beta = kd\cos\ \theta$

$$\frac{N\Psi}{2} = 2kd\cos\ \theta = 2\left(\frac{2\pi}{\lambda}\right)\left(\frac{\lambda}{2}\right)\cos\ \theta = 2\pi\cos\ \theta$$

$$AF = \frac{\sin(N_{\mathbb{Z}}/2)}{N\frac{r}{2}} = \frac{\sin(2\pi\cos\ \theta)}{2\pi\cos\ \theta} = \mathrm{sinc}\ (2\cos\ \theta)$$

6. What is the direction of first null of broadside 4 -element isotropic antenna having a separation of λ 2?

a) 60°

b) 30°

c) 180°

d) 0°

View Answer

Answer: a

Explanation: The nulls of the N - element array is given by $\theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[-\beta \pm \frac{2\pi n}{N}\right]\right) = \cos^{-1}\left(\frac{\lambda}{2\pi d}\left[\pm\frac{2\pi n}{N}\right]\right)$

$$\Rightarrow \theta_n = \cos^{-1}\left(\frac{\lambda}{2\pi(\lambda/2)}\left[\pm\frac{2\pi n}{N}\right]\right) = \cos^{-1}\left(\pm\frac{2n}{4}\right) = \cos^{-1}\left(\pm\frac{n}{2}\right)$$

$\Rightarrow n = 1$(first null)$\cos^{-1}\left(\pm\frac{n}{2}\right) = \cos^{-1}\left(\pm\frac{1}{2}\right) = 60°$ or $120°$.

7. What is the direction of first null of broadside 4-element isotropic antenna having a separation of λ/4?

a) 0

b) 60

c) 30

d) 120

View Answer

Answer: a

Explanation: The nulls of the N- element array is given by

θn=cos−1(λ2πd[−β±2πnN])=cos−1(λ2πd[±2πnN])

θn=cos−1(λ2π(λ/4)[±2πnN])=cos−1(±4n4)=cos−1(±n)=0

8. The necessary condition for maximum of the second side lobe of n element array is ___________

a) NΨ2=±5π2

b) NΨ2=±3π2

c) NΨ2=±π2

d) NΨ2=±4π2

View Answer

Answer: a

Explanation: The secondary maxima occur when the numerator of the array factor equals to 1.

⇨ sin(NΨ2)=±1

⇨ $N\psi 2=\pm 2s+12\pi$
⇨ $N\psi 2=\pm 5\pi 2$ [s=2 for second minor lobe].

9. The direction of the first minor lobe of 4 element isotropic broadside array separated by $\lambda/2$ is ___________
a) 41.4°
b) 30°
c) 60°
d) 90°
View Answer

Answer: a
Explanation: The direction of the secondary maxima (minor lobes) occur at θ_s
$\theta s=\cos-1(\lambda 2\pi d[-\beta\pm(2s+1)N\pi])$
⇨ $\theta s=\cos-1(\lambda 2\pi(\lambda/2)[\pm 34\pi])$ (s=1 for 1^{st} minor lobe)
⇨ $\theta s=\cos-1(\pm 34)=41.4°$

10. A 4-isotropic element end-fire array separated by a $\lambda/4$ distance has first null occurring at ____________
a) 60
b) 30
c) 90
d) 150
View Answer

Answer: c
Explanation: The nulls of the N- element array is given by $\theta n=\cos-1(\lambda 2\pi d[-\beta\pm 2\pi nN])$
Since its given broad side array $\beta=\pm kd=\pm 2\pi d\lambda=\pm\pi 2$,
$\theta n=\cos-1(2\pi[\mp\pi 2\pm 2\pi n4])$
$=\cos^{-1}([\mp 1\pm n])$
First null at n=1; $\theta_n=\cos^{-1}([1\pm 1)$ (considering $\beta=-\pi 2$)
$\theta_n = \cos^{-1}(0)$ or $\cos^{-1}(2)$
$\theta_n = \cos^{-1}(1)=90.$

1. The array factor of 8 – isotropic elements of broadside array is given by _____
a) $\sin(2kd\cos\theta)2kd\cos\theta$
b) $\sin(4kd\cos\theta)4kd\cos\theta$
c) $\sin(2kd\cos\theta)kd\cos\theta$
d) $\cos(2kd\cos\theta)2kd\cos\theta$
View Answer

Answer: b
Explanation: Normalized array factor is given by $AF=\sin(N\psi/2)N\psi 2$
And $\psi=kd\cos\theta+\beta$
Since its given broad side array $\beta=0$,
$\psi=kd\cos\theta+\beta=kd\cos\theta$

$N\psi 2=4kd\cos\theta$
$AF=\sin(N\psi/2)N\psi 2=\sin(4kd\cos\theta)4kd\cos\theta$

2. An 8-isotropic element broadside array separated by a λ/2 distance has nulls occurring at ____
a) $\cos-1(\pm n4)$
b) $\cos-1(\pm n2)$
c) $\sin-1(\pm n2)$
d) $\sin-1(\pm n4)$
View Answer

Answer: a
Explanation: The nulls of the N- element array is given by
$\theta n=\cos-1(\lambda 2\pi d[-\beta\pm 2\pi nN])=\cos-1(\lambda 2\pi d[\pm 2\pi nN])$
⇨ $\theta n=\cos-1(\lambda 2\pi(\lambda/2)[\pm 2\pi nN])=\cos-1(\pm 2n8)=\cos-1(\pm n4)$

3. An 8-isotropic element broadside array separated by a λ/4 distance has nulls occurring at ____
a) $\cos^{-1}(\pm n)$
b) $\cos-1(\pm n2)$
c) $\sin-1(\pm n2)$
d) $\sin-1(\pm n)$
View Answer

Answer: b
Explanation: The nulls of the N- element array is given by
$\theta n=\cos-1(\lambda 2\pi d[-\beta\pm 2\pi nN])=\cos-1(\lambda 2\pi d[\pm 2\pi nN])$
⇨ $\theta n=\cos-1(\lambda 2\pi(\lambda/4))[\pm 2\pi nN])=\cos-1(\pm 4n8)=\cos-1(\pm n2)[n=1,2,3andn\neq N,2N\ldots]$

4. The array factor of 8- isotropic elements of broadside array separated by a λ/4 is given by ____
a) $\mathrm{sinc}(\cos\theta)$
b) $\cos(\sin\theta)$
c) $\sin(\sin\theta)$
d) $\mathrm{sinc}(2\cos\theta)$
View Answer

Answer: d
Explanation: Normalized array factor is given by
$AF=\sin(N\psi/2)N\psi 2$
And $\psi=kd\cos\theta+\beta$
Since its given broad side array $\beta=0$,
$\psi=kd\cos\theta+\beta=kd\cos\theta$
$N\psi 2=4kd\cos\theta=4(2\pi\lambda)(\lambda 4)\cos\theta=2\pi\cos\theta$
$AF=\sin(N\psi/2)N\psi 2=\sin(2\pi\cos\theta)2\pi\cos\theta=\mathrm{sinc}(2\cos\theta)$.

5. The array factor of 8 – isotropic elements of broadside array separated by a λ/2 is given by ____
a) $\mathrm{sinc}(4\cos\theta)$
b) $\sin(2\pi\cos\theta)$
c) $\mathrm{sinc}(4\pi\sin\theta)$
d) $\sin(2\sin\theta)$
View Answer

Answer: a
Explanation: Normalized array factor is given by $AF=sin(N\psi/2)N\psi2$
And $\psi=kdcos\theta+\beta$
Since its given broad side array $\beta=0$,
$\psi=kdcos\theta+\beta=kdcos\theta$
$N\psi2=4kdcos\theta=4(2\pi\lambda)(\lambda2)cos\theta=4\pi cos\theta$
$AF=sin(N\psi/2)N\psi2=sin(4\pi cos\theta)4\pi cos\theta=sinc(4cos\theta)$.

6. What is the direction of first null of broadside 8-element isotropic antenna having a separation of $\lambda/2$?
a) 60°
b) 75.5°
c) 37.5°
d) 57.5°
View Answer

Answer: b
Explanation: The nulls of the N- element array is given by
$\theta n=cos-1(\lambda2\pi d[-\beta\pm2\pi nN])=cos-1(\lambda2\pi d[\pm2\pi nN])$
⇨ $\theta n=cos-1(\lambda2\pi(\lambda/2)[\pm2\pi nN])=cos-1(\pm2n8)=cos-1(\pm n4)$
⇨ $n=1(firstnull)cos-1(\pm n4)=cos-1(\pm14)=75.5°$.

7. What is the direction of first null of broadside 8-element isotropic antenna having a separation of \frac{λ}{4}?
a) 0
b) 60
c) 30
d) 120
View Answer

Answer: b
Explanation: The nulls of the N- element array is given by
$\theta n=cos-1(\lambda2\pi d[-\beta\pm2\pi nN])=cos-1(\lambda2\pi d[\pm2\pi nN])$
$\theta n=cos-1(\lambda2\pi(\lambda4)[\pm2\pi nN])=cos-1(\pm4n8)=cos-1(\pm n2)=cos-1(\pm1/2)=60$

8. The necessary condition for maximum of the first side lobe of n element array is ______
a) $N\psi2=\pm5\pi2$
b) $N\psi2=\pm3\pi2$
c) $N\psi2=\pm\pi2$
d) $N\psi2=\pm4\pi2$
View Answer

Answer: b
Explanation: The secondary maxima occur when the numerator of the array factor equals to 1.
⇨ $sin(N\psi2)=\pm1$
⇨ $N\psi2=\pm2s+12\pi$
⇨ $N\psi2=\pm3\pi2$ [s=1 for first minor lobe].

9. The direction of the first minor lobe of 8 element isotropic broadside array separated by λ/2 is ___
a) 41.4°
b) 76.6°
c) 67.7°
d) 90°
View Answer

Answer: b
Explanation: The direction of the secondary maxima (minor lobes) occur at θ_s
θs=cos−1(λ2πd[−β±(2s+1)Nπ])
⇨ θs=cos−1(λ2π(λ/2)[±38π]) (s=1 for 1st minor lobe)
⇨ θs=cos−1(±38)=67.7°

10. An 8-isotropic element end-fire array separated by a λ/4 distance has first null occurring at ____
a) 60
b) 30
c) 90
d) 150
View Answer

Answer: a
Explanation: The nulls of the N- element array is given by θn=cos−1(λ2πd[−β±2πnN])
Since its given broad side array β=±kd=±2πdλ=±π2,
θn=cos−1(2π[∓π2±2πn8])
=cos−1([∓1±n2])
First null at n=1; θn==cos−1([1±12])(consideringβ=−π2)
θn=cos−1(12)orcos−1(3/2)
θn=cos−1(12)=60.

1. In Broadside array the maximum radiation is directed with respected to the array axis at an angle____
a) 90°
b) 45°
c) 0°
d) 180°
View Answer

Answer: a
Explanation: In a Broadside array the maximum radiated is directed towards the normal to the axis of the array. So it is at angle 90°. In the end-fire array maximum radiation is along the axis of the array.

2. What is the phase excitation difference for a broadside array?
a) 0
b) π/2

c) π
d) 3π/2
View Answer

Answer: a
Explanation: The maximum array factor occurs when sinNϕ2Nϕ2 maximum that is Nϕ2=0. And ϕ=kdcosθ+β
=> kdcosθ+β=0 For a broadside maximum radiation is normal to axis of array so θ=90
=> β=0

3. Which of the following statements is false regarding a broadside array?
a) The maximum radiation is normal to the axis of the array
b) Must have same amplitude excitation but different phase excitation among different elements
c) The spacing between elements must not equal to the integral multiples of λ
d) The phase excitation difference must be equal to zero
View Answer

Answer: b
Explanation: Since the phase excitation difference is zero it means that all are equally excited with same phase. In a Broadside array the maximum radiated is directed towards the normal to the axis of the array. The spacing between elements is not equal to integral multiples of λ to avoid grating lobes.

4. Which of the following cannot be the separation between elements in a broadside array to avoid grating lobes?
a) 4λ/2
b) λ/2
c) 3λ/2
d) 5λ/2
View Answer

Answer: a
Explanation: The spacing between elements should not equal to integral multiples of λ to avoid grating lobes. The option 4λ/2=2λ
So when d=2λ grating lobes occurs which means maxima are found at other angles also. So this is not a desired spacing.

5. Find the value θ_n at which null occurs for an 8-element broadside array with spacing d.
a) cos−1λnNd
b) sin−1λnNd
c) cos−12λnNd
d) sin−12λnNd
View Answer

Answer: a
Explanation: Nulls occurs when array factor AF=sinNϕ2Nϕ2=0

⇨ $\sin\frac{N\phi}{2}=0 \Rightarrow \frac{N\phi}{2}=\pm n\pi$ and $\phi=kd\cos\theta+\beta=kd\cos\theta_n=\frac{2\pi}{\lambda}d\cos\theta_n$
⇨ Null occurs at $\theta_n=\cos^{-1}\frac{\lambda n}{Nd}$

6. What would be the directivity of a linear broadside array in dB consisting 5 isotropic elements with element spacing λ/4?
a) 9.37
b) 3.97
c) 6.53
d) 3.79
View Answer

Answer: b
Explanation: Directivity $D=\frac{2Nd}{\lambda}=\frac{2\times5\times\lambda}{4\lambda}=2.5$
D (dB) = $10\log2.5=3.97$ dB

7. In a broadside array all the elements must have equal ______ excitation with similar amplitude excitations to get maximum radiation.
a) Phase
b) Frequency
c) Voltage
d) Current
View Answer

Answer: a
Explanation: Since the phase excitation difference is zero it means that all are equally excited with same phase. So in order to get maximum radiation it should have equal phase excitations along with similar amplitude excitations.

8. The directivity of a linear broadside array with half wave length spacing is equal to _____
a) Unity
b) Zero
c) Half of the number of elements present in array
d) Number of elements present in array
View Answer

Answer: d
Explanation: The directivity of N isotropic elements with spacing d is given by
Directivity $D=\frac{2Nd}{\lambda}$
⇨ $D=\frac{2Nd}{\lambda}=\frac{2N\lambda/2}{\lambda}=N$

9. Which of the following is false regarding a linear broadside array with 2 elements and spacing λ?
a) Directivity = 6.02 dB
b) No grating lobes are present
c) Nulls occur at $\cos^{-1}\frac{1}{2}$
d) The maxima occurs normal to the axis of array and also at other angles
View Answer

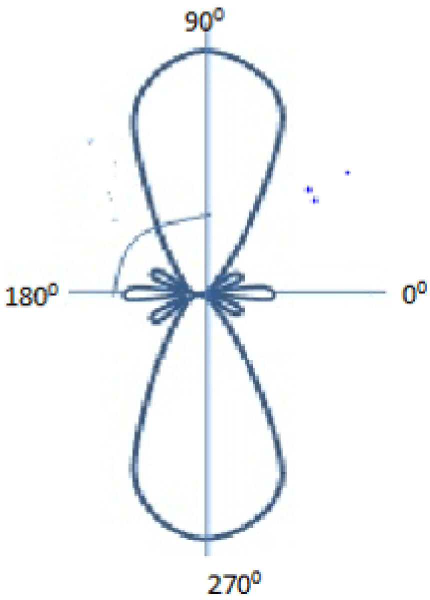
Answer: b

Explanation: Since the spacing between elements is an integral multiple of λ (n=1), grating lobes occurs.

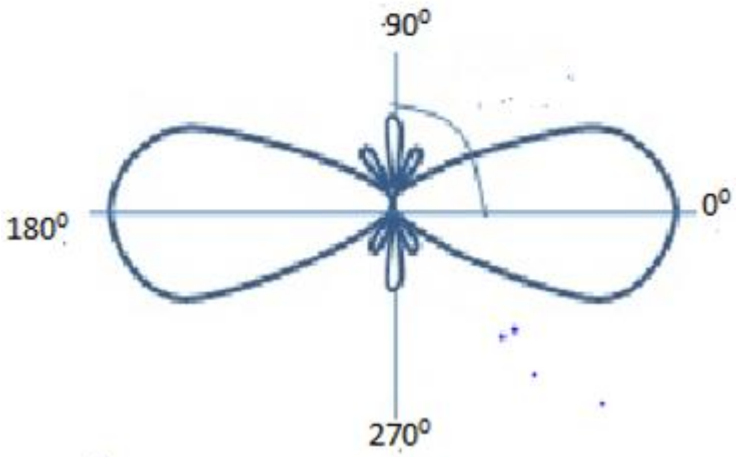
Directivity D=2Ndλ=4=6.02dB

⇨ Null occurs at θn=cos−1λnNd=cos−112

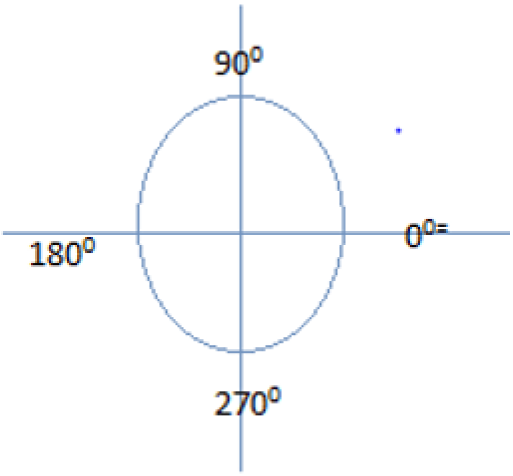
10. What is the radiation pattern of a broadside array when array element axis coincides with the 0° line?



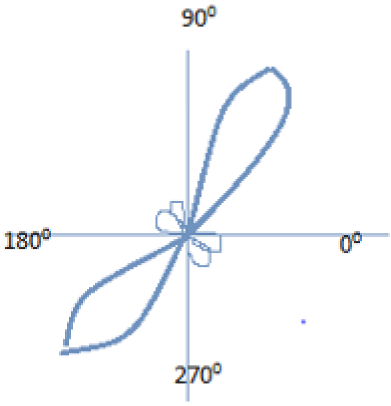
a)



b)



c)

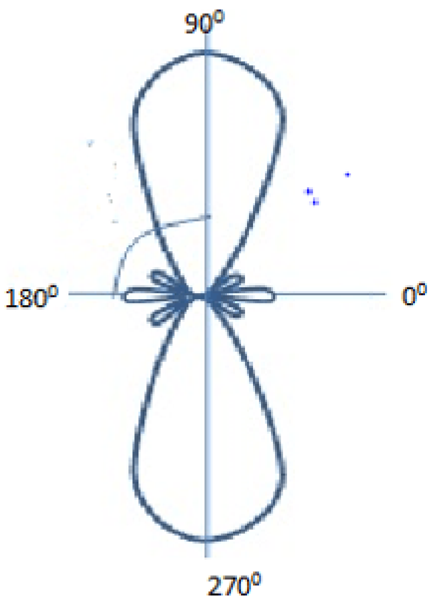


d)

View Answer

Answer: a

Explanation: In a Broadside array the maximum radiated is directed towards the normal to the axis of the array. Broadside array is a bidirectional antenna and when axis coincides with 00 then maximum radiation is at 90°.



1. The direction of nulls for broadside array of N –Isotropic sources is given by _____
a) $\cos^{-1}([\pm n\lambda Nd])$
b) $\cos^{-1}([\pm 2n\lambda Nd])$
c) $\cos^{-1}([\pm 2\pi n\lambda 2Nd])$
d) $\cos^{-1}([\pm n\lambda Nd])$
View Answer

Answer: a
Explanation: The nulls of the N- element array is given by $\theta n=\cos^{-1}(\lambda 2\pi d[-\beta\pm 2\pi nN])$
Given it's a broadside array so $\beta=0$
$\theta n=\cos^{-1}(\lambda 2\pi d[\pm 2\pi nN])=\cos^{-1}([\pm n\lambda Nd])$.

2. The direction of first null of the broadside array of N-Isotropic sources is _____
a) $\cos^{-1}([\pm\lambda Nd])$
b) $\cos^{-1}([\pm\pi\lambda Nd])$
c) $\cos^{-1}([\pm 2\pi\lambda Nd])$
d) $\cos^{-1}([\pm\lambda 2Nd])$
View Answer

Answer: a
Explanation: The nulls of the N- element array is given by $\theta n=\cos^{-1}(\lambda 2\pi d[-\beta\pm 2\pi nN])$
Given it's a broadside array so $\beta=0$ and n=1 for first null
$\theta n=\cos^{-1}(\lambda 2\pi d[\pm 2\pi nN])=\cos^{-1}([\pm n\lambda Nd])=\cos^{-1}([\pm\lambda Nd])$

3. The direction of nulls for end-fire array of N –Isotropic sources separated by λ/4 is given by _____
a) $\theta n=\cos^{-1}([\mp 1\pm 4nN])$
b) $\theta n=\sin^{-1}([\mp 1\pm 4nN])$
c) $\theta n=\cos^{-1}([\mp 1\pm 2nN])$
d) $\theta n=\cos^{-1}([\mp 1\pm nN])$
View Answer

Answer: a
Explanation: The nulls of the N- element array is given by $\theta n=\cos^{-1}(\lambda 2\pi d[-\beta\pm 2\pi nN])$
Since its given broad side array $\beta=\pm kd=\pm 2\pi d\lambda=\pm\pi 2$,
$\theta n=\cos^{-1}(2\pi[\mp\pi 2\pm 2\pi nN])$
$\theta n=\cos^{-1}([\mp 1\pm 4nN])$

4. The necessary condition for the direction of maximum side lobe level of the N-element isotropic array is _______
a) $\psi=\pm 2s+1N\pi$
b) $\psi=\pm 2s+2N\pi$
c) $\psi=\pm 2sN\pi$
d) $\psi=\pm 2(s+1)N\pi$
View Answer

Answer: a
Explanation: The secondary maxima occur when the numerator of the array factor equals to 1.
⇨ $\sin(N\psi 2)=\pm 1$
⇨ $N\psi 2=\pm 2s+12\pi$
⇨ $\psi=\pm 2s+1N\pi$.

5. The necessary condition for the direction of maximum first side lobe level of the 8-element isotropic array is _______
a) 38π
b) 34π
c) 18π
d) 58π
View Answer

Answer: a
Explanation: The secondary maxima occur when the numerator of the array factor equals to 1.
⇨ $\sin(N\psi 2)=\pm 1$
⇨ $N\psi 2=\pm 2s+12\pi$
⇨ $\psi=\pm 2s+1N\pi=2+18\pi=38\pi$.

6. The necessary condition for the direction of maximum second side lobe level of the 4-element isotropic array is _______
a) 54π
b) 34π
c) 18π
d) 58π
View Answer

Answer: a
Explanation: The secondary maxima occur when the numerator of the array factor equals to 1.
⇨ $\sin(N\psi 2)=\pm 1$
⇨ $N\psi 2=\pm 2s+12\pi$
⇨ $\psi=\pm 2s+1N\pi=2(2)+14\pi=54\pi$.

7. The Half-power beam width of the N-element isotropic source array can be known when _____
a) $\psi=2.782N$
b) $\psi=1.391N$
c) $\psi=1.414N$
d) $\psi=3N$
View Answer

Answer: a
Explanation: Normalized array factor is given by $AF=\sin(N\psi/2)N\psi 2=1\sqrt{2}$
⇨ $N\psi 2=1.391$
⇨ $\psi=2.782N$

8. Which of the following is the necessary condition to avoid grating lobes in N-Isotropic element array?

a) $d\lambda \leq 11+|\cos\theta m|$
b) $d\lambda \geq 11+|\cos\theta m|$
c) $\lambda d \leq 11+|\cos\theta m|$
d) $\lambda d=11+|\cos\theta m|$
View Answer

Answer: a
Explanation: Grating lobes are the minor and unnecessary lobes other than the major lobe.
To avoid grating lobes, $kd(\cos\theta-\cos\theta_m) \leq 2\pi$
θ_m – Direction of maximum radiation
⇨ $2\pi d\lambda(\cos\theta-\cos\theta m) \leq 2\pi$
$d\lambda \leq 1\cos\theta-\cos\theta m$
$d\lambda \leq 11+|\cos\theta m|$

9. Which of the following is the necessary condition to avoid grating lobes in N-Isotropic element broadside array?
a) $d < \lambda$
b) $d > \lambda$
c) $d=\lambda$
d) $d < 2\lambda$
View Answer

Answer: a
Explanation: Grating lobes are the minor and unnecessary lobes other than the major lobe.
To avoid grating lobes, $kd(\cos\theta-\cos\theta_m) \leq 2\pi$
$d\lambda \leq 11+|\cos\theta m|$
For broadside to avoid grating lobes (θ_m=90)
⇨ $d\lambda < 1$
⇨ $d < \lambda$

10. Which of the following is the necessary condition to avoid grating lobes in N-Isotropic element end-fire array?
a) $d < \lambda/2$
b) $d < \lambda$
c) $d > \lambda/2$
d) $d=\lambda$
View Answer

Answer: a
Explanation: Grating lobes are the minor and unnecessary lobes other than the major lobe.
To avoid grating lobes, $kd(\cos\theta-\cos\theta_m) \leq 2\pi$
$d\lambda \leq 11+|\cos\theta m|$
For broadside to avoid grating lobes (θ_m=0)
⇨ $d\lambda < 1/2$
⇨ $d < \lambda/2$

1. The direction of maximum radiation in end-fire array is _______ with respect to the array axis.
a) 0° or 180°
b) 90°

c) 45°
d) 270°
View Answer

Answer: a
Explanation: In an End-fire array the maximum radiation is along the axis of the array. So it is at either 0° or 180°. In broad-side array the maximum radiation is perpendicular to the axis of array that is at 90°.

2. What is the phase excitation difference for an end-fire array?
a) 0
b) ±kd /2
c) π
d) ±kd
View Answer

Answer: d
Explanation: The maximum array factor occurs when sinNϕ2Nϕ2 maximum that is Nϕ2=0.
And ϕ=kdcosθ+β
=> kdcosθ+β=0 For an end-fire array maximum radiation is along the axis of array so
θ=0° or 180°
=> β=kd when θ=180°
=> β=-kd when θ=0°

3. The phase excitation difference is zero in end-fire array.
a) True
b) False
View Answer

Answer: b
Explanation: In end-fire array the phase excitation difference is ±kd and their phase vary progressively and get unidirectional maximum radiation finally. In broadside side array the phase excitation difference is zero.

4. What is the phase excitation difference in end-fire array with array spacing d at θ=0°?
a) −2πλd
b) 2πλd
c) −πλd
d) πλd
View Answer

Answer: a
Explanation: In end-fire array the phase excitation difference is –kd for θ=0°.
kdcosθ+β=0
β=-kd
β=−2πλd

5. Which of the following statements is true regarding end-fire array?
a) The necessary condition of an ordinary end-fire array is $\beta=\pm kd+n\pi$
b) The phase excitation difference is zero
c) Same input current is fed through the array, but the phase excitation is varies progressively
d) Maximum radiation occurs at normal to the axis of array
View Answer

Answer: c
Explanation: For end-fire array:
Phase excitation difference $\beta=\pm kd$
Maximum radiation occurs along the axis of the array that is at $\theta=0°$ or $180°$.
Even though same input current s fed to the arrays of equal magnitude, the phase vary progressively along the line to get the unidirectional pattern.

6. What is the progressive phase excitation of an end-fire array with element spacing $\lambda/4$ at $\theta=180°$?
a) $\pi 2$
b) $-\pi 2$
c) π
d) $\pi 4$
View Answer

Answer: a
Explanation: At $\theta=180°$, for end-fire array progressive phase excitation$=kd=2\pi\lambda d=2\pi\lambda\lambda 4=\pi 2$
Therefore $\beta=\pi 2$

7. Find the overall length of an end-fire array with 10 elements and spacing $\lambda/4$.
a) $9\lambda 4$
b) $5\lambda 4$
c) $5\lambda 2$
d) $9\lambda 2$
View Answer

Answer: a
Explanation: For an N-element end-fire array, the overall length of the array is given by $\rho=(N-1)d$
⇨ $\rho=(N-1)d=(10-1)(\lambda/4)=9\ \lambda/4$

8. Which of the following is the correct condition of an ordinary end-fire array?
a) $\beta=\pm kd$
b) $\beta=kd$
c) $\beta > kd$
d) $\beta < \pm kd$
View Answer

Answer: a
Explanation: For an end-fire array maximum radiation is along the axis of array so
$\theta=0°$ or $180°$
=> $\beta=kd$ when $\theta=180°$
=> $\beta=-kd$ when $\theta=0°$