El-Shorouk Academy	The Higher Institute of Engineering
Biomedical and system engineering	
Third Year	Electromagnetic Waves
first Semester 2021	

Sheet on antennas

Radiation pattern

[1]For the attached radiation patterns in figures (1) and (2), do the following:

(i) What is the radiation pattern type?

(ii) What is the type of radiation pattern plot?

(iii) Give an example of antennas having this type of radiation pattern.

(iv) Mark the main components of the radiation pattern.

(v) Determine the half power beam width (HPBW).

(vi) Determine the first side lobe levels and directions (the angles at both sides).

(vii) Determine the second lobe levels and direction (the angles at both sides).

(viii) Calculate the first null beam width (FNBW).

(ix) Determine the level and direction of main lobe.

Directivity , gain and antenna efficiency

Approximate formula

[2] Consider a directional antenna has radiation pattern which is identical in both E and H planes and has half power beam width (HPBW) $=60^0$.(i) Calculate the antenna directivity using the approximate formula.(ii) If the gain of antenna is 1.2, calculate the antenna efficiency.

[3] Consider a horn has HPBW in the E plane is $=30^0$ and HPBW in the H plane is $=60^0$ (i) Calculate the antenna directivity using the approximate formula.(ii) Calculate the gain in dB, if the antenna efficiency = 0.6.

[4] If the directivity of a directional antenna is 20 dB using the approximate formula.The HPBW of it in the E and H are equal. (i)Calculate the HPBW of this antenna in degrees. (ii) Calculate the gain in dBi, if the antenna efficiency = 0.9.

Exact formula

[5] If the directional pattern of an antenna is given by $f(\theta,\phi) = 10\sin^2(\theta)$ [mW/m^2] (i) Calculate the directivity of the antenna D_o using the exact formula (ii) Calculate the gain in dBi, if the antenna efficiency η =0.6(iii)Draw the radiation pattern.

[6] Calculate the directivity of the antenna if its directional radiation pattern is given by by $f(\theta,\phi)=10\sin(\theta)$ per unit solid angle [mW/m^2].(ii) Plot the radiation pattern in the θplane (vertical plane). (ii) Calculate the gain in dB, if the antenna efficiency = 0.6.Assuming $0\le\theta\le\pi$ and $0\le\phi\le2\pi$.

[7] (i)Calculate the directivity of the antenna using the exact formula, if the directional radiation pattern of the antenna is given by $f(\theta,\phi)=5\cos(\theta)$ [mW/m^2]. (ii) Calculate the gain in dB, if the antenna efficiency = 0.6. Assuming $0\le\theta\le\pi$ and $0\le\phi\le2\pi$.

[8] If the directional radiation pattern of an antenna is given by $f(\theta,\phi)=10\cos^2(\theta)$ [mW/m^2] (i) Calculate the directivity of the antenna D_0 (ii) Plot the radiation pattern in the θplane (vertical plane).(iii) Calculate the gain in dB, if the antenna efficiency = 0.9. Assuming $0\le\theta\le\pi$ and $0\le\phi\le2\pi$.

[9] If the directional pattern of an antenna is given by $f(\theta,\phi)=10\sin(2\theta)$ [mW/m^2](i) Calculate the directivity of the antenna D_0 (ii) Plot the radiation pattern in the θplane (vertical plane). (iii) Calculate the gain in dB, if the antenna efficiency = 0.6. Assuming $0\le\theta\le\pi$ and $0\le\phi\le2\pi$.

[10] (i)Calculate the directivity of the antenna if the directional radiation pattern of the antenna is given by by $f(\theta,\phi)=\sin(\theta)\sin(\phi)$ [mW/m^2]. (ii) Calculate the gain in dB, if the antenna efficiency = 0.8. Assuming $0\le\theta\le\pi$ and $0\le\phi\le\pi$.

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Best wishes

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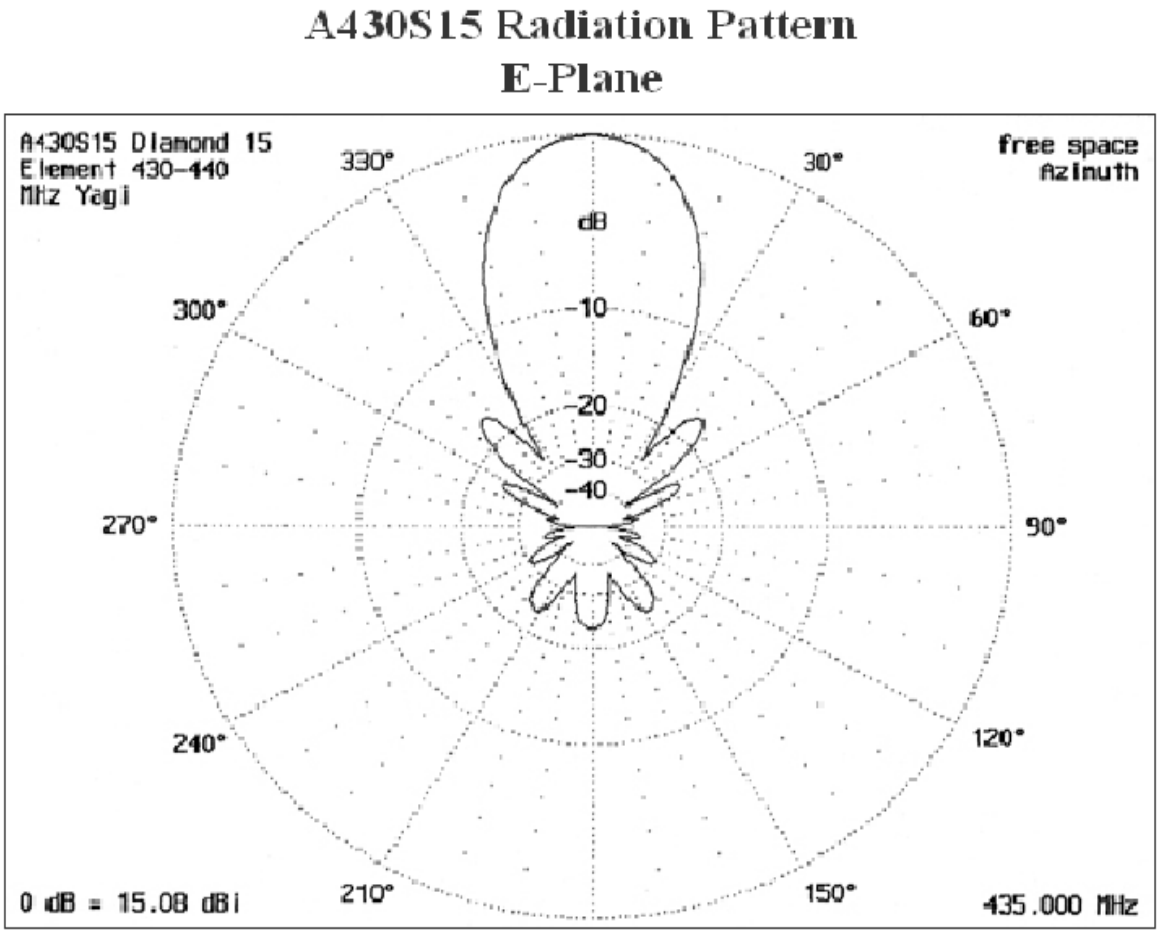

Figure (1) antenna radiation pattern

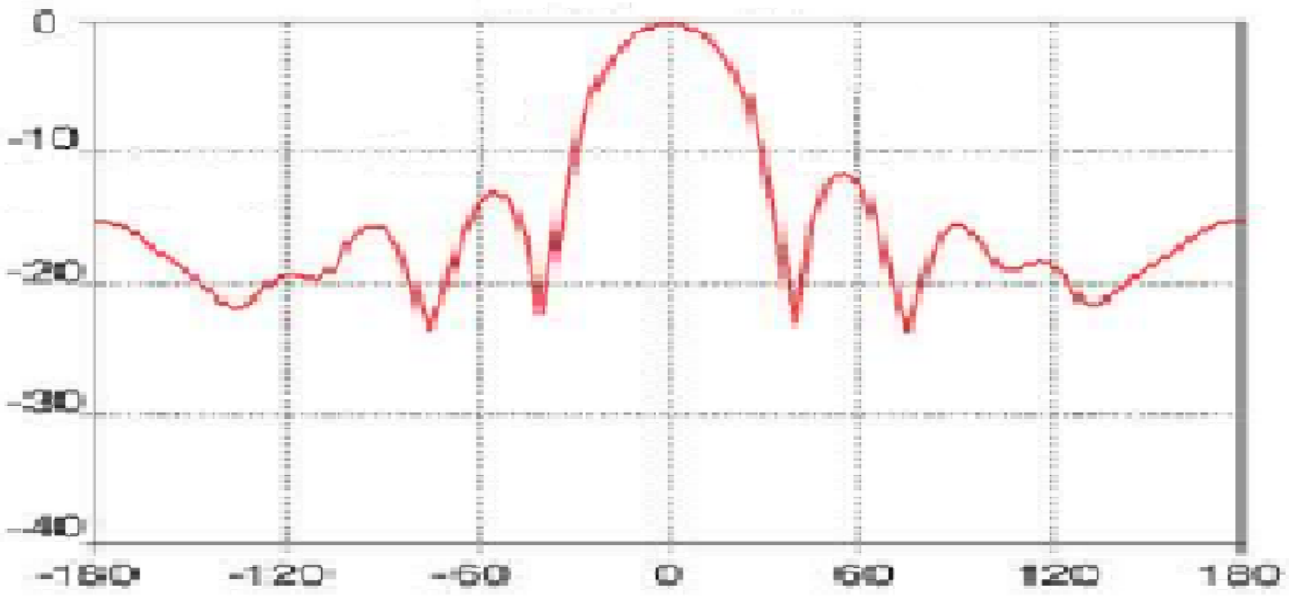

Figure (2) antenna radiation pattern