Name :- Omar khan

ID :- 13079

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Teacher :- DR. Shahryar shafique

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①

QNO 1

(a)

Ans:- Blackscatter is the portion of the outgoing radar signal that the target redirects directly back towards the radar antenna. Backscattering is the process by which back-scatter is formed. The scattering crosssection in the direction toward the radar is called back scattering, yes the normalized measured of the radar return from a distributed target is called backscatter. and if the signal formed by back-scatter is undesired it is called clutter.

Ans:-
(B)

In telecommunication an interface is that which modifies a signal in a discriptise manner as it travel along a communication channel b/w its source & reciever

Three Types are:-

1) Radio frequency Intefeference :-

This Type of interference is caused by radio frequency (RF) signal on are near the frequency of the effected ~~by~~ wireless reciever.

2) Electrical interference :-

Electrical Interference does not benefits anyone & its almost never intention.

3) Intermodulation :-

Intermodulation is a inter mod type of interference sometimes encounted in wireless.

(C)

Answer

Range resolution :-

Range resolution is the ability at a radar system to the distinguish between two are more target on the same bearing but at d/f ranges the degree of range resolution depend on width of the transmitted pulse

$$S_r = \frac{C_o \cdot P_w}{2} \, [m]$$

Doppler Resolution

A doppler radar is specialized radar that uses the doppler effect to produce velocity data about object at a distance.

Doplar radar can also measure the changes in radio waves which indicate wind speed & direction.

Q_2 (a)

Solution

Given : $d = 3m$

$f_1 = 8 GHz$

$f_2 = 14 GHz$

$$g = \eta_A \left(\frac{\pi d}{\lambda}\right)^2$$

$$g = \eta_A \left(\frac{\pi d}{c/f}\right)^2$$

$$g = \eta_A \left(\frac{\pi f d}{c}\right)^2$$

$$= \eta_A \left(\frac{\pi^2 f^2 d^2}{c^2}\right)$$

$$= \frac{(3.14)^2}{(3 \times 10^8)^2} \times f^2 d^2 \eta_A$$

$$= \frac{9.8596}{9 \times 10^{16}} \times f^2 d^2 \eta_A$$

$$g = 109.55 \times f^2 d^2 \eta_A$$

To find Gain in DB

$$G = 10 \log (109.55 \times f^2 d^2 \eta_A)$$

As we know that $\eta_A = 0.55$

$d = 3$ m so for f_1

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$G_1 = 10 \log (109.55 \times (8)^2 \times (3)^2 \times 0.55)$

$= 10 \log (109.55 \times 8^2 \times 3^2 \times 0.55)$

$= 10 \log (34705.44)$

$G_1 = 45.40 dBi$

For $f_2 = 14GHz$

$G_2 = 10 \log (109.55 \times (14)^2 \times (3)^2 \times 0.55)$

$= 10 \log (106285.41)$

$\boxed{G_2 = 50.26 dBi}$ Ans

(b)
Q2

Solution:

Find $A_e = ?$

gain = 46dB;

$f = 12GHz$

$\eta_A = 0.55$

We know from given formula

$$G = 10\log(109.66 \times f^2 \times d^2 \times \eta_A)$$

$$46 = 10\log(109.66 \times (12)^2 \times d^2 \times 0.55$$

$$46 = 10\log(8685.072d^2)$$

$$46 = \log(8685.07d^2)$$

Taking Antilog

$$8685.072d^2 = 10^{4.6}$$

$$d^2 = \frac{10^{46}}{8685.072}$$

$$d^2 = 4.5858$$

$$d = 2.14m$$

we know $A_e = \eta A$

where

$$A = \pi \frac{d^2}{4}$$

$$A = \frac{3.14 \times (2.14)^2}{4}$$

$$= 3.59m^2$$

(7)

So,

$A_e = (0.55)(3.59)$

$A_e = 1.177 m^2$

Q3

Solution

$r = 760 km$

Service link freq = 1600 MHz = 1.6 GHz
feeder " " U_L = 29.2 GHz
" " " D_L = 19.5 GHz

Find

$L_{fs} = ?$
$L_{fs}(U_L) = ?$
$L_{fs}(D_L) = ?$

We know that formulas for L_{fs} as

$L_{fs} = 20\log(f) + 20\log(r) + 92.44$
$= 20\log(1.6) + 20\log(760) + 92.44$

$L_{fs} = 154.13585$ dB

$L_{fs}(D_L) = L_{fs} + 20\log(f_{DL}/f_s)$

$$= 154.1385 + 20 \log\left(\frac{29.24\ GHz}{1.6\ GHz}\right)$$

$$= 154.1385 + 2 \log(18.275)$$

$$= 154.1385 + 25.23$$

$$L_{FS}(UL) = 179.3685\ dB$$

$$L_{FS(DL)} = L_{FS} + 20 \log\left(f_d / f_s\right)$$

$$= 154.1385 + 20 \log\left(\frac{19.5\ GHz}{1.6\ GHz}\right)$$

$$= 154.1385 + 21.718$$

$$L_{FS}(DL) = 175.8565$$

Q4

Solution:

We have to find the transmitted Power P_t, As we know for VSAT network.

$$\left(\frac{C}{n_0}\right) = \left(\frac{\eta_t \eta_r A_t A_s}{L_0 k}\right)$$

Given data

$\eta_t = 0.65$

$\eta_r = 0.55$

$r = 355900\ km$

$d_t = 3.2m$

$d_r = 1.2m$

Q4

(9)

$K = 1.39 \times 10^{-23}\ J/k$

$\frac{C}{N_0} = 55 dBHz$

$t_s = 400K$

$f = 12.25 GHz$

$L_0 = 1.2 dB$

$A_t = \frac{\pi d^2}{4} = \frac{\pi (3.2)^2}{4}$

$= 8.038 m^2$

$A_e = \frac{\pi d r^2}{4} = \frac{\pi (1.2)^2}{4}$

$= 1.1304 m^2$

Also

$\lambda = \frac{c}{f}$

$= \frac{3 \times 10^8}{12.25 \times 10^9}$

$\lambda = 0.024m$

$L_0 = 1.2 dB$

$= 10^{0.2/10}$

$= 1.318$

$\frac{C}{N_0} = 55 dBHz$

$$\frac{C}{N_0} = 10^{5.5}$$

$$\frac{C}{N_0} = 316227.76$$

From eq (1)

P_t can be written as

$$P_t = \left(C/N_0\right) \frac{\lambda^2 r^2 t_s L_a k}{\eta_t \eta_r A_t A_r}$$

$$= \frac{316227.76 \times (0.024)^2 (35900)^2 \times 400 (1.318}{(1.3,9 \times 10^{-23} \mid (0.65)(0.55)(1.1304)(8.038}$$

$$P_t = 5.295 \times 10^{-10} \, W$$

Q5

solution:-

1

$ERP = P_T \cdot G_T$

$= 2000000 \times 3000$

$= 6000,000,000$

2 $\frac{P}{A_F} = \frac{P_T}{4\pi R_T^2 | G_T^2}$

350nmi equals 648200

$A = 4\pi r^2$

$= 4 \; 3.14 (648200)$

$= 5.28 \times 10^{12}$

Radar cross section $10m^2$

$\frac{1}{3000} \times 5.28 \times 10^{12}$

$= 1760000000 m^2$

The total transmitted Power is 2000000

$$= \frac{2000000}{1760000000}$$

$$= 0.001136 \ w/m^2$$

Direct formula of

$$\frac{P}{A_F} = \frac{2000000 \times 3000}{4(3.14)(648200)}$$

$$= 0.07962 \ w/m^2$$

(3)

$$P_{igt} = \frac{P_T G_T \sigma}{4\pi R_T^2} \quad \frac{1}{4\pi Re^2}$$

$$P/A_B = P_{Tg} + \frac{1}{4\pi Re^2}$$

$$= 0.001136 \times \frac{1}{4(3.14)(648200)}$$

$$= 2.153 \times 10^{-16} \ w/m^2$$

(13)

(4) Effective area = $20m^2$

Power density of echo
$= 2.153 \times 10^{-16}$

$$P_r = 2.153 \times 10^{-16} \times 20$$

$$= 4.36 \times 10^{-15} \; L_o$$

We can also write echo power as

$$P_r = \frac{P_T G_T \sigma A_E}{(4\pi)^2 R^4}$$

Above in simplified version of radar equation but it ignore all losses

$$P_R = \frac{K_R \sigma}{R^4 L_A}$$

$$K_R = \frac{P_T G_T A_E}{(4\pi)^2 L_s}$$

$$K_R = \frac{P_T G_T^2 \lambda^2}{(4\pi)^3 L_s}$$

$$K_R = \frac{(2000000)(3000)(20)}{4(3.14)(1)}$$

$$= 9.42 \times 10^{10}$$

$$P_R = \frac{K_R\, G}{R^4 L_A}$$

$$= \frac{9.42 \times 10^{10} \times 3}{648200}$$

$$= \boxed{4.69 \times 10^{-14}} \rightarrow \text{Ans}$$