NIKHIL MATHUR 05214802719

COMMUNICATION SYSTEMS

Assignment 4

Ans 1

$K = 1.38 \times 10^{-23}$ J/°K

$T = 27°C = 300°K$

$B = (20-18)$ MHz $= 2 \times 106$ Hz

$R = 10 \times 103$ V

$n = 4KTfR$

$= 4 \times 1.38 \times 10^{-23} \times 300K \times 2 \times 106 \times 10 \times 103$

$= 331.2 \times 10^{-12}$

$= 18.2 \times 10^{-6}$ V

$= 18.2 \mu V$

Ans 2

The noise voltage at the input of the RF amplifier is given by:

$$V = \sqrt{4R_{eq}KTB}$$

where, $R_{eq} = R_{Noise} + R_{in}$ T = Temperature

$K = 1.38 \times 10^{-23}$ B = Bandwidth

$R_{eq} = 200 + 300 = 500\Omega$ $B = 6$ MHz $T = 290K$

$V = \sqrt{4 \times 500 \times 1.38 \times 10^{-23} \times 290 \times 6 \times 10^{6}}$

$= \sqrt{2 \times 1.38 \times 29 \times 6 \times 10^{-13}}$

$= 6.92 \mu V$

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Ans 3 $R_1 = R_{in1} + R_{eq1} = 700 + 1800 = 2500\,\Omega$

$R_2 = \frac{(R_{o1} R_{in2})}{R_{o1} + R_{in2}} + R_{eq2} = \frac{30 \times 80}{30+80} + 12 = 40.92\,k\Omega$

$R_3 = R_{o2} = 1.2\,M\Omega$

Equivalent input noise resistance of a two stage amplifier is given by:

$\cancel{R_{eq} = \frac{R_1 + R_2}{A_1^2} + \frac{R_3}{A_1^2 A_2^2}}$ $R_{eq} = R_1 + \frac{R_2}{A_1^2} + \frac{R_3}{A_1^2 A_2^2}$

$R_{eq} = 2500 + \frac{40.92}{(20)^2} + \frac{1.2 \times 10^6}{(20)^2 (25)^2}$

$\boxed{R_{eq} = 2607.1\,\Omega}$

Ans 4 Noise factor $= F = \frac{R_p + R_n}{R_p} = \frac{50+30}{50} = 1.6$

Noise Figure $NF = 10 \log_{10} F = 10 \log_{10} 1.66 = \boxed{2.041\,dB}$

Equivalent Noise temperature $T = (f-1) T_0$

$T = (1.6 - 1)\, 300$ $(T_0 = 300\,K)$

$= 0.6 \times 300$

$= \boxed{180\,K}$

Teacher's Signature : ______________

Ans 5 Gain (G) = 5 dB Noise Figure (F) = 6 dB

$$F_N = F_1 + \frac{(F_2-1)}{G_1} + \frac{(F_3-1)}{G_1 G_2} + \cdots\cdots + \frac{(F_N-1)}{G_1 G_2 G_3 \cdots G_N}$$

$F_1 = 5\,dB$ $F_2 = 5\,dB$ $F_3 = 5\,dB$

$G_1 = 6\,dB$ $G_2 = 6\,dB$ $G_3 = 6\,dB$

$$F_3 = 5 + \frac{(5-1)}{6} + \frac{(5-1)}{6\times 6}$$

$$= 5 + \frac{4}{6} + \frac{4}{36}$$

$$= \frac{5\times 36 + 4\times 6 + 4}{36} = \frac{180 + 24 + 4}{36} = \frac{\cancel{208}\ 104}{\cancel{36}\ 3}$$

$$\boxed{F_3 = 34.67}$$

Ans 6 (b) (i) Figure of Merit in DSB-SC :-

$$F = \frac{(SNR)_{O,DSBSC}}{(SNR)_{C,DSBSC}}$$

$$F = \left(\frac{A_c^2 P}{2WN_0}\right) \Big/ \left(\frac{A_c^2 P}{2WN_0}\right)$$

$$\boxed{F = 1}$$

(ii) Figure of merit in SSB-SC :-

$$F = \frac{(SNR)_{O,SSBSC}}{(SNR)_{C,SSBSC}}$$

$$F = \left(\frac{A_m^2 A_c^2}{8WN_0}\right) \Big/ \left(\frac{A_m^2 A_c^2}{8WN_0}\right)$$

$$\boxed{F = 1}$$

(C) <u>Pre-emphasis</u> :- The noise suppression ability of FM decreases with the increase in the frequencies. Thus, increasing the relative strength or amplitude of the high frequency components of the message signal before modulation is termed as <u>Pre-emphasis</u>.

<u>De-emphasis</u> :- In de-emphasis circuit, by reducing the amplitude level of the received high frequency signal by the same amount as the increase in pre-emphasis is termed as <u>De-emphasis</u>.