QUESTION 1

(a) Define each of the following:

i) Information

Information is any kind of audio, picture, computer data or signals.

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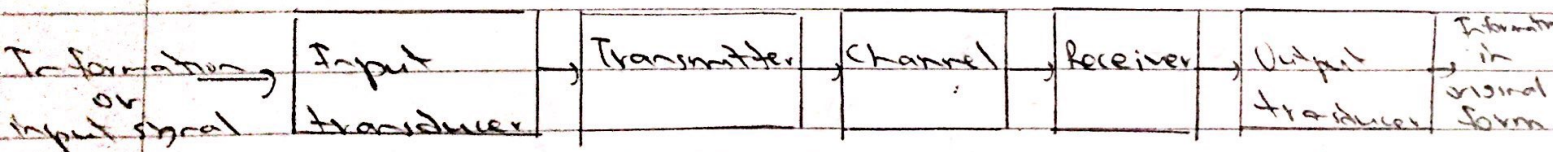
ii) Noise

Unwanted signal that coincide with the desired signals. Two types of noise: internal and external noise.

iii) Electronic communication system

Transmission, reception and processing of information between two or more locations using electronic circuits.

(b) Briefly explain the elements of communication systems.



1. Information in any form such audio, picture or data and it is needed to be converted into electric signals.
2. Input transducer like microphone or camera does the job.
3. Transmitter amplifies the signal to cover a large area for communication. Transmitter processes the input signal to suit it as transmitter signal. Example: modulating, mixing, translate.
4. Channel acts a bridge to the source and distance.

5. Receiver receive the message in the received signal and convert it into a form suitable for output transducer. Examples of processes undergone are: demodulation, decoding, conversion of electric signal back to its original form is happened.

6. Output transducers like monitor or speaker display or show the information to us in its original form.

(c) $A_{p1} = 180$ $P_{in} = 29$ dBm

$A_{p2} = 0.5$

$A_{p3} = 55$

(i) P in mW

$$dBm = 10 \log \left(\frac{P}{1mW} \right)$$

$$29\ dBm = 10 \log \left(\frac{P}{1mW} \right)$$

$$\text{antilog} \left(\frac{29\ dBm}{10} \right) \times 1mW = P$$

$$P = 0.79\ W$$

(ii) A_{pT} in dB

$A_{p1} = 10 \log (180) = 22.55$ dB

$A_{p2} = 10 \log (0.5) = -3.01$ dB

$A_{p3} = 10 \log (55) = 19.13$ dB

$A_{pT} = 22.55\ dB + (-3.01\ dB) + 19.13\ dB$

$= 37.67\ dB$

(iii) P_{out} in watts, dBm

$P_{out} = P_{in} + P_{AMP}$

$= 29 + 37.67$ dB

$= 66.67$ dBm

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$dBm = 10 \log \left(\frac{P_{out}}{1mW}\right)$

$66.67 \text{ dBm} = 10 \log \left(\frac{P_{out}}{1mW}\right)$

$\text{antilog}\left(\frac{66.67 \text{ dBm}}{10}\right) \times 1mW = P_{out}$

$P_{out} = 4645.15$ W

QUESTION 2

(a)

Coherent receiver	Non-coherent receiver
• Synchronous	• Asynchronous
• Frequency is generated in receiver and demodulated by oscillating frequency to suit the transmitter	• Either no frequency or all the frequency have been used up
• Eg: SSB	• Eg: AM envelope

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(b)(i) $A_{TT} = 20 \text{ dB} + (-3 \text{ dB}) + 60 \text{ dB}$

$= 77$ dB

(ii) $NF(\text{cascaded}) = 10 \log F(\text{TOTAL})$

$F_{TOT} = \frac{F-1}{G_1} + \frac{F-2}{G_1 G_2} + \frac{F-3}{G_1 G_2}$

Subject :

Date :

$F_1 = 6\,dB = 10^{(6/10)} = 3.98 = 4$

$F_2 = 3\,dB = 10^{(3/10)} = 1.995 = 2$

$F_3 = 16\,dB = 10^{(16/10)} = 39.8 = 40$

$G_1 = 20\,dB = 10^{(20/10)} = 100$

$G_2 = -3\,dB = 10^{(-3/10)} = 0.5$

$G_3 = 16\,dB = 10^{(16/10)} = 39.8 = 40$

$F_{(dB)} = F_1 + \frac{F_2 - 1}{A_1} + \frac{F_3 - 1}{F_1 A_1}$

$= 4 + \frac{2-1}{100} + \frac{40-1}{50}$

$= 4.79$ (4)

$NF_{(dB)} = 10 \log_{10}(F_{dB}) = 10 \log_{10}(4.79)$

$= 6.80$ dB

(c) (i) $f_{usf} = f_c + f_m = 250k + 30k = 280k$

$f_{lsf} = f_c - f_m = 250k - 30k = 220k$ (2)

(ii) $m = \frac{E_m}{E_c} = \frac{15}{19} = 0.83$

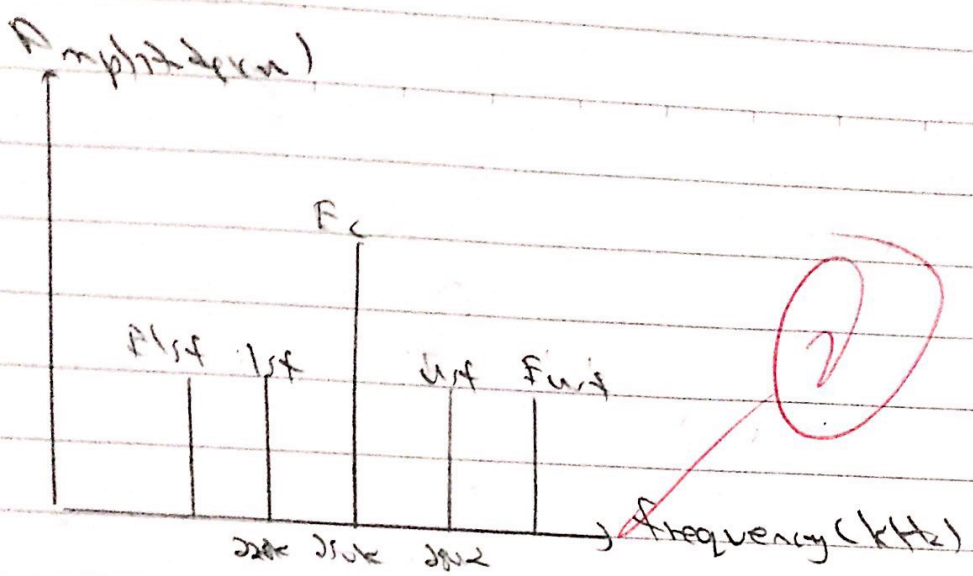
$\%m = 0.83 \times 100 = 83\%$ (2)

$E_{c(modulated)} = E_{c(unmodulated)} = 19\ V_p$

(iii) $E_{usf} = E_{lsf} = \frac{mE_c}{2} = \frac{mE_c}{2} = \frac{0.83 \times 19}{2} = 7.47$

(iv) $B = 2 \times f_{m(max)} = 2 \times 30kHz = 60kHz$ (1)

(c)



QUESTION 3

(a) (i) $P_N = KTB$

$= (1.38\times10^{-23})(25+273)(2\times10^{3}\ Hz)$

$= 1.0281\times10^{-17}\ W$

$P_N(dB) = 10\log\left(\frac{1.0281\times10^{-17}\ W}{1\ mW}\right)$

$= 10\log(1.0281\times10^{-14})$

$= -139.88\ dBm$

(ii) $V_N = \sqrt{4RKTB}$

$= \sqrt{4(50\,\Omega)(1.38\times10^{-23})(298)(25\,kHz)}$

$= \sqrt{2.052\,f}$

$= 1.43\times10^{-7}\ V$

(b) (i) Local oscillator frequency, f_{LO}

$f_{LO} = f_{RF} + f_{IF}$

$= 1000\ kHz + 450\,kHz$

$= 1450\ kHz$

(ii) Image frequency, f_{IM}

$f_{IM} = f_{LO} + f_{IF}$

$= 1450\,kHz + 450\,kHz$

$= 1900\ kHz$

(iii) Image frequency rejection ratio (IFRR)

$IFRR = \sqrt{I + \rho^2}\,\rho^2$

$\rho = \left(\frac{f_{IM}}{f_{RF}}\right) - \left(\frac{f_{RF}}{f_{IM}}\right) = \left(\frac{1900\,kHz}{1000\,kHz}\right) - \left(\frac{1000\,kHz}{1900\,kHz}\right) = 1.37$

$IFRR = \sqrt{1 + (1.37)^2}\,(1.37)^2$

$= \sqrt{1877.0}$

$= 137$

(c) (i) The amount of carrier power, P_c

$$P_c = \frac{V_c^2}{2R} = \frac{(30)^2}{2(40)} = 11.25\ W$$

(ii) The amount of power using DSB-SC

$$P_{LSB} = P_{USB} = \frac{m^2 P_c}{4} = \frac{(0.4)^2 (11.25)}{4} = 0.45\ W$$

$$P_c = P_{LSB} + P_{USB} = 0.45 + 0.45 = 0.9\ W$$

(iii) The amount of power using SSB-FC

$$P_T = P_c + P_{USB} = 11.25 + 0.45 = 11.7\ W$$

(iv) The percentage of power saving of SSB-FC compared to DSB-FC

DSB-FC

$P_T = P_c + P_{USB} + P_{LSB} = 11.25 + 0.45 + 0.45 = 12.15\ W$

$P_{saved} = 12.15 - 11.7 = 0.45\ W$

$\%\ P_{saved} = \frac{0.45}{12.15} \times 100 = 3.7\%$