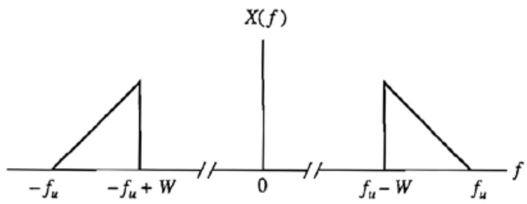
University of Technology
Department of Communication Engineering
2nd Semester Final Exam. 2016-2017

Division: Optical Comm. Eng. Systems *Year: 2nd*
Subject : Analog Comm. Systems II *Time: 3 Hrs.*
Examiner: Assist. Prof. Dr. Ali Y. Fattah *Date: / / 2017*

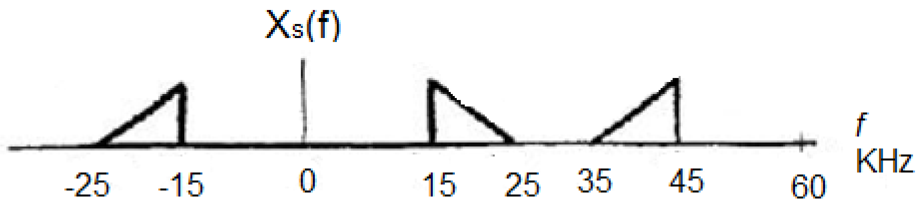
Q1:



For ideally sampling of $x(t)$, the Fourier transform of $x_s(t)$ is given by :

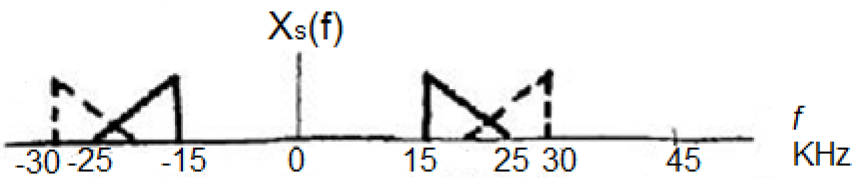
$$X_s(f)=\frac{1}{T_s}\sum_{n=-\infty}^{\infty}X(f-nf_s)$$

1. f_s= 60 KHz



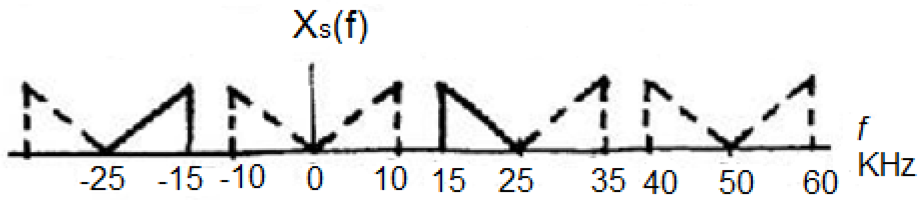
In this case $x(t)$ can be reconstructed using LPF with a cutoff frequency f_c such that 25 < f_c < 35 KHz .

2. f_s = 45 KHz



In this case the signal $x(t)$ can 't be reconstructed from $x_s(t)$ (aliasing distortion) .

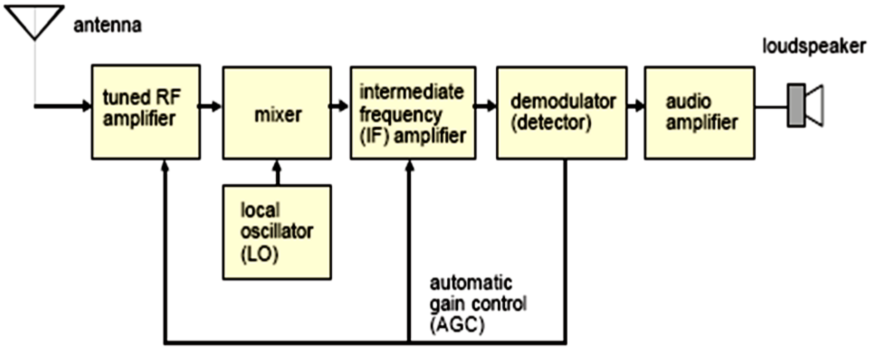
3. f_s = 25 KHz



In this case $x(t)$ can be reconstructed using BPF over $f_1 \le |f| \le 25$ KHz with 10 < f_1 < 15 KHz .

Q2:

(a) Superheterodyne Receiver:



Most modern radio and TV receivers (whether for AM or FM bands, other frequency ranges, or other modulation methods) use the superheterodyne ("superhet" for short) technique. This enables important signal processing operations, such as demodulation, to be done at a more convenient lower frequency, rather than at the original high frequency of the incoming signal, as well as providing other advantages. The signal is mixed with a local oscillator (LO) signal and shifted down to an intermediate frequency (IF) before demodulation.

(b)

(i) The highest and lowest frequencies broadcast will correspond to the "outside edges" of the two AM sidebands. These will be at :

1550 - 5 = 1545 kHz and

1550 + 5 = 1555 kHz.

(ii) The original carrier frequency will be shifted down to the IF frequency

of 455 kHz by the mixer. Hence the highest and lowest corresponding frequencies which must be passed by the IF amplifier are:

455 - 5 = 450 kHz and

455 + 5 = 460 kHz.

Q3:

(1)

$$F = F_1 + \frac{F_2 - 1}{G_1} + \frac{F_3 - 1}{G_2 G_1} + \dots\dots\dots$$

$$T_e = T_{e1} + \frac{T_{e2}}{G_1} + \frac{T_{e3}}{G_2 G_1} + \dots\dots$$

Amplifier No.	F (ratio)	Gain (ratio)
1	3.981	10
2	6.309	15.848
3	12.589	10

2)

$$F = F_1 + \frac{(F_2 - 1)}{G_1} + \frac{(F_3 - 1)}{G_1 G_2}$$

$$= 3.981 + \frac{6.309 - 1}{10} + \frac{12.589 - 1}{10 \times 15.848} = 4.585$$

$$F_{dB} = 10 \log 4.585 = 6.613 \text{ dB}$$

(3)

$$F = 6.309 + \frac{3.981 - 1}{15.848} + \frac{12.589 - 1}{15.848 \times 10} = 6.57$$

$$F_{dB} = 10 \log 6.57 = 8.175 \text{ dB}$$

(4) for part (2):

$$T_e = (F - 1) T_o = (4.585 - 1) \times 300 = 1075.5 \ \mathring{K}$$

for part (3)

$$T_e = (6.57 - 1) \times 300 = 1671 \ K^\circ$$

(5)

$$F = \frac{(S/N)_i}{(S/N)_o} = \frac{S_i}{N_i} \times \frac{N_o}{S_o} = 4.585$$

$(S/N)_o = 30 dB \equiv 1000$

But: $N_i = K T_o B_n = 207 \times 10^{-8} W$

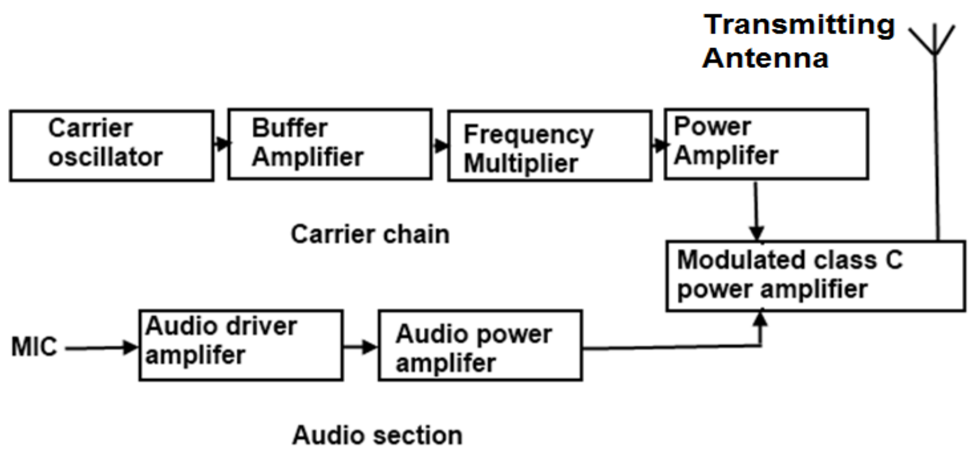
$\therefore S_i = 94.9 \times 10^{-14} W$

or $S_i = -120.2 dB$

Q4:

(i) High-Level AM Transmitters:

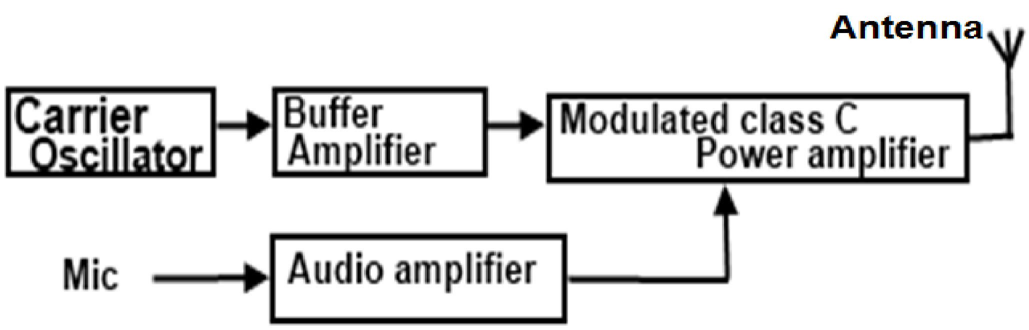
In high-level transmission, the powers of the carrier and modulating signals are amplified before applying them to the modulator stage .The required transmitting power is obtained from the last stage of the transmitter, the class C power amplifier.



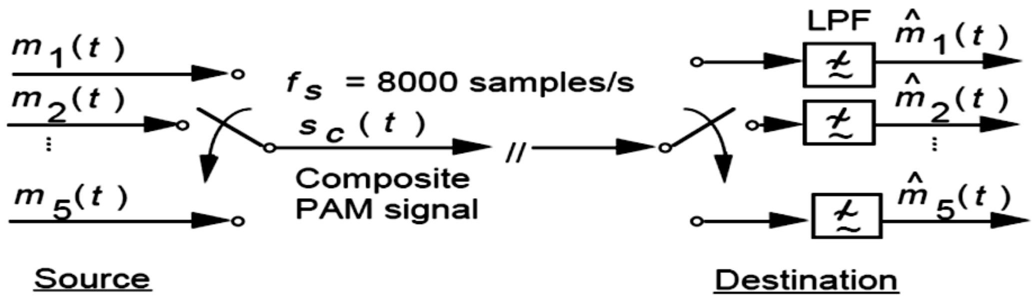
(ii) Low-Level AM Transmitters:

The low-level AM transmitter is similar to a high-level transmitter, except that the powers of the carrier and audio signals are not amplified. These two signals are directly applied to the modulated class C power amplifier.

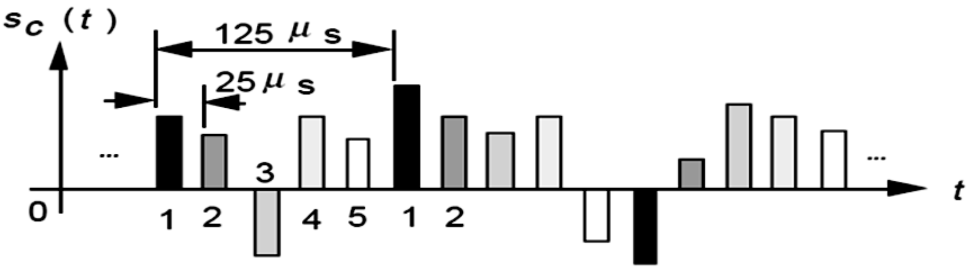
Modulation takes place at the stage , and the power of the modulated signal is amplified to the required transmitting power level . The transmitting antenna then transmits the signal.



Q5: TDM System:



(a) Transmitter and receiver



(b) Waveform of TDM signal