Muzaffarpur Institute of Technology (MIT), Muzaffarpur
(Under the Department of Science & Technology Govt. of Bihar, Patna)
Department of Electronics and Communication
B.Tech 5th Semester Mid-Semester Exam, 2018
INTRODUCTION TO COMMUNICATION SYSTEM

TIME: 2 Hrs.   **FULL MARKS: 20**

ANSWER THE FOLLOWING QUESTIONS. ALL QUESTIONS ARE COMPULSORY. (1 X 10 = 10 Marks)

(1) Minimum frequency of human voice is

(a) 20 Hz   **(b) 300 Hz**   (c) 20 KHz   (d) 0 Hz

(2) For proper transmission antenna height should be approximately what fraction of wavelength of electromagnetic wave

(a) 1/4   (b) 1/2   (c) 3/4   (d) 1/8

(3) If a function f(t) starts from t = 6, then f(3t) will start from

(a) 2   (b) 9   (c) 1   (d) 6

(4) Mirror image about y-axis is the property of

(a) Amplitude scaling   (b) Time scaling   (c) Amplitude reversal   **(d) Time reversal**

(5) Amplitude of a function change in which operation

(a) Amplitude scaling   (b) Time scaling   (c) Shifting   (d) Time reversal

(6) What is the height of the antenna required for proper transmission and reception of radio channel which can be tuned at 88.0 Mhz .
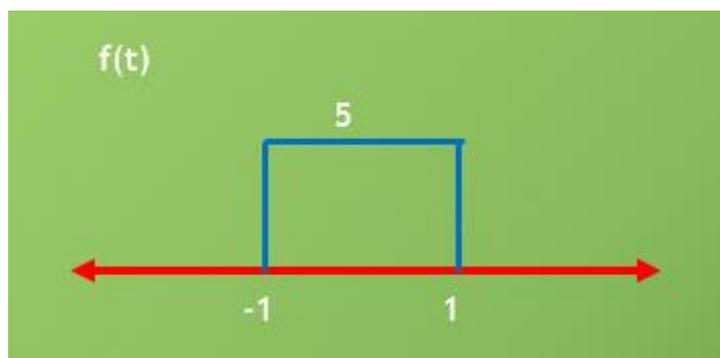
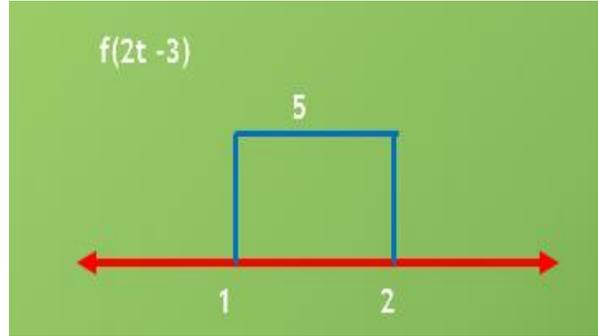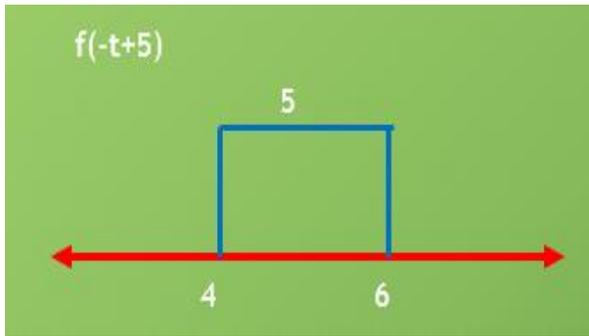**Ans: Height =** $\frac{\lambda}{4} = \frac{c}{4f} = \frac{3 \times 10^8}{4 \times 88 \times 10^6} =$ **0.85 m**

(7) Delta function is a **GENERALIZED** function while sinc (x) is a **WELL-DEFINED** function.

(8) For a rectangular pulse f(t) defined as

$$f(t) = 5 \qquad -1 \le t \le 1$$
$$0 \qquad Otherwise$$
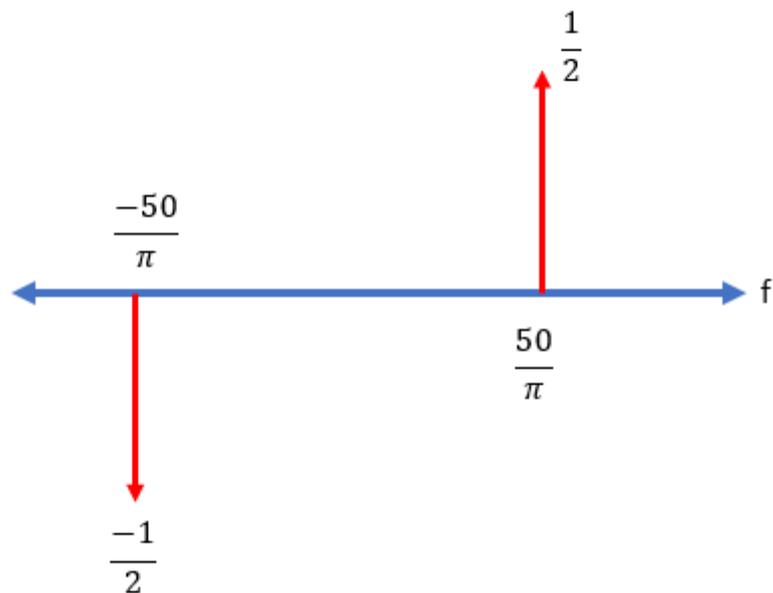
Sketch   f (-t + 5)   and   f(2t -3)

f(-t+5)
5
4   6

f(2t -3)
5
1   2

(9) Find the value of $\int_{-\pi/6}^{\pi/6} \sin\left(t - \frac{\pi}{2}\right)\delta(3t - \pi)dt$

Ans: $\frac{1}{3}\int_{-\pi/6}^{\pi/6} \sin\left(t - \frac{\pi}{2}\right)\delta\left(t - \frac{\pi}{3}\right)dt$

$= \frac{1}{3}\sin\left(\frac{\pi}{3} - \frac{\pi}{2}\right)$

$= \frac{1}{3}\sin\left(-\frac{\pi}{6}\right) = \frac{-1}{6}$

(10) Plot the spectrum of $\sin(100t - 30°)$ and find its power.

Ans: Power = 0.5 W

(11) An AM signal is given by s(t) = 4 cos (3200x pi x t) + 10 cos (4 x pi x 10^3 t) + 4 cos (4800x pi x t) Find all the possible parameters of AM. **(2 Marks)**

$A_c = 10$

$f_c = 2000\ Hz$

$A_m = 8$

$f_m = 400\ Hz$

$\mu = 0.8$
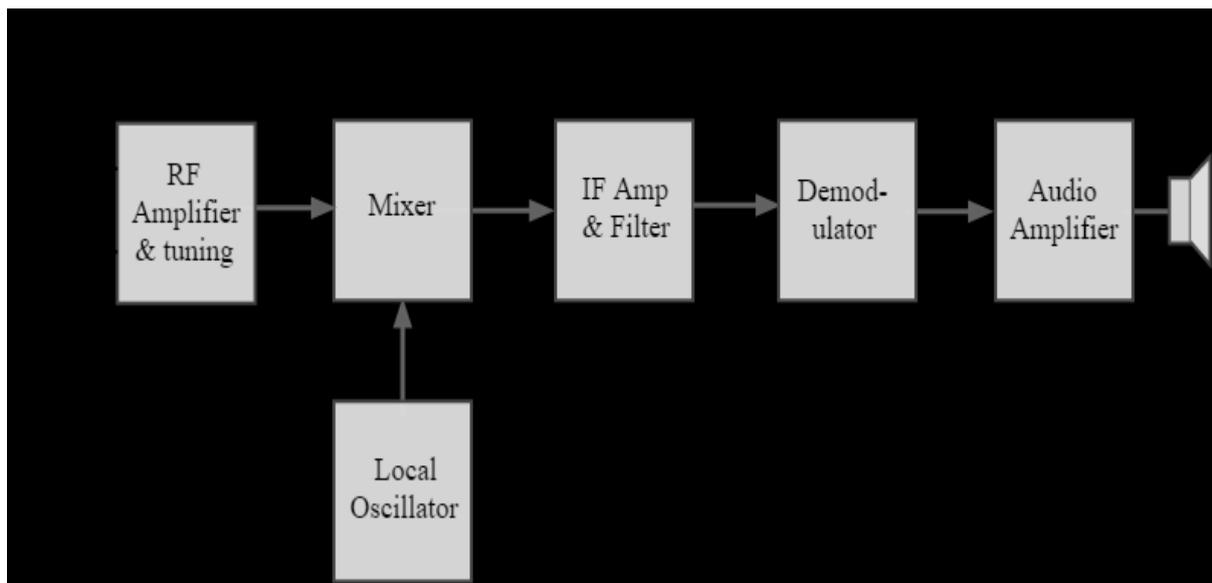
BW = 800 Hz

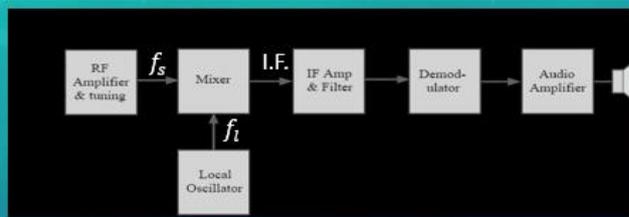$P_t = 66\ W$

$P_c = 50\ W$

$P_{SB} = 16\ W$

$P_{USB} = 8\ W$

$P_{LSB} = 8\ W$

$\eta = 24.24\ \%$

(12) Explain working of

   (i) Super Heterodyne receiver.

MIXER

(1) Always performs Down conversion
(2) f_l is always greater than f_s

IF AMPLIFIER

$I.F. = |f_l - f_s| = 455\ KHz$
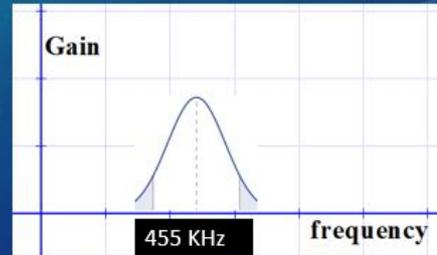
CASE - 1

Receiver is tuned to 600 KHz station

$455\ KHz = f_l - 600\ KHz$

$f_l = 1055\ KHz$

CASE - 2

Receiver is tuned to 1000 KHz station

$455\ KHz = f_l - 1000\ KHz$

$f_l = 1455\ KHz$

IMAGE FREQUENCY

$I.F. = |f_l - f_s| \approx 500\ KHz$

$f_l = 1100\ KHz,$

$f_s = 600\ KHz\ or\ 1600KHz$

Thus image frequency $f_{si} = 1600\ KHz$

$f_{si} = f_s + 2IF$

(ii) Armstrong Method of FM generation. **(4 Marks)**

INDIRECT/ ARMSTRONG METHOD

$m(t)$ → NBFM MODULATOR → $S_{NBFM}(t)$ → FREQUENCY MULTIPLIER → MIXER → $S_{WBFM}(t)$

$c(t)$

NBFM MODULATOR

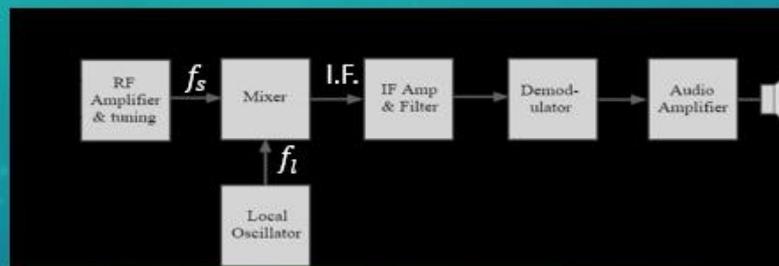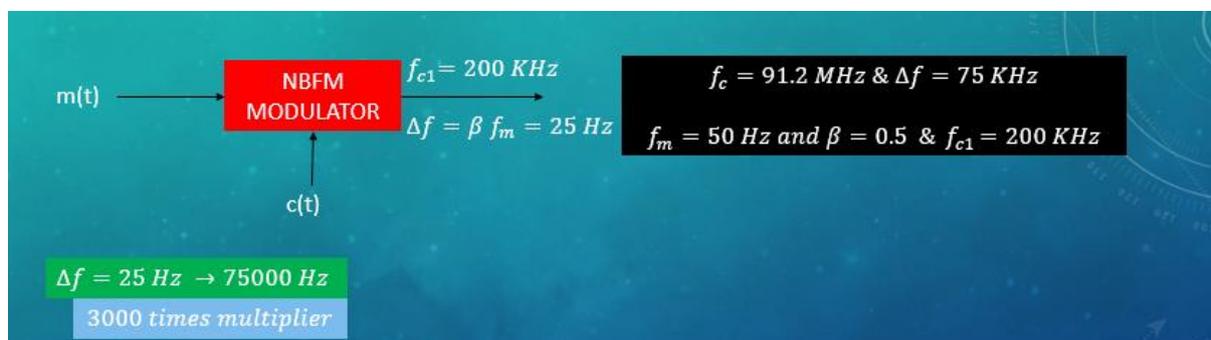$$S_{FM}(t) = A_c \cos\left(2\pi f_c t + 2\pi k_f \int m(t)\, dt \right) \qquad m(t) = A_m \cos(2\pi f_m t)$$

$$S_{FM}(t) = A_c \cos(2\pi f_c t + \beta \sin(2\pi f_m t))$$

$$S_{FM}(t) = A_c \cos(2\pi f_c t)\cos(\beta \sin(2\pi f_m t)) - A_c \sin(2\pi f_c t)\sin(\beta \sin(2\pi f_m t))$$

$$S_{NBFM}(t) \approx A_c \cos(2\pi f_c t) - A_c \sin(2\pi f_c t)(\beta \sin(2\pi f_m t))$$

$m(t)$ → DSB -SC MODULATOR → $m(t)c(t)$

$c(t)$

$m(t)$ → $\int$ → $\int m(t)$ → DSB-SC MODULATOR → $-\sum$ (with +) → NBFM

90° *Phase shifter*

$c(t)$

$m(t)$ → NBFM MODULATOR → $f_{c1} = 200\ KHz$, $\Delta f = \beta f_m = 25\ Hz$

$c(t)$

$f_c = 91.2\ MHz$ & $\Delta f = 75\ KHz$

$f_m = 50\ Hz$ and $\beta = 0.5$ & $f_{c1} = 200\ KHz$

$\Delta f = 25\ Hz \rightarrow 75000\ Hz$

3000 *times multiplier*

SQUARE LAW DEVICE

$v_1(t)$ → SQUARE LAW DEVICE → $v_2(t)$ → BAND PASS FILTER

$$v_2(t) = a_1 v_1 + a_2 v_1^2 + a_3 v_1^3 + \dots$$

$$v_1(t) = A \cos\theta$$

$$v_2(t) = a_1 v_1 + a_2 v_1^2 + a_3 v_1^3 + \dots$$

$$v_2(t) = a_1 A \cos\theta + a_2 (A \cos\theta)^2 + a_3 (A \cos\theta)^3 + \dots + a_n (A \cos\theta)^n$$

MIXER

It finds the difference of frequencies which are comparable with the input frequency and passes other frequencies as it is.

INDIRECT / ARMSTRONG METHOD

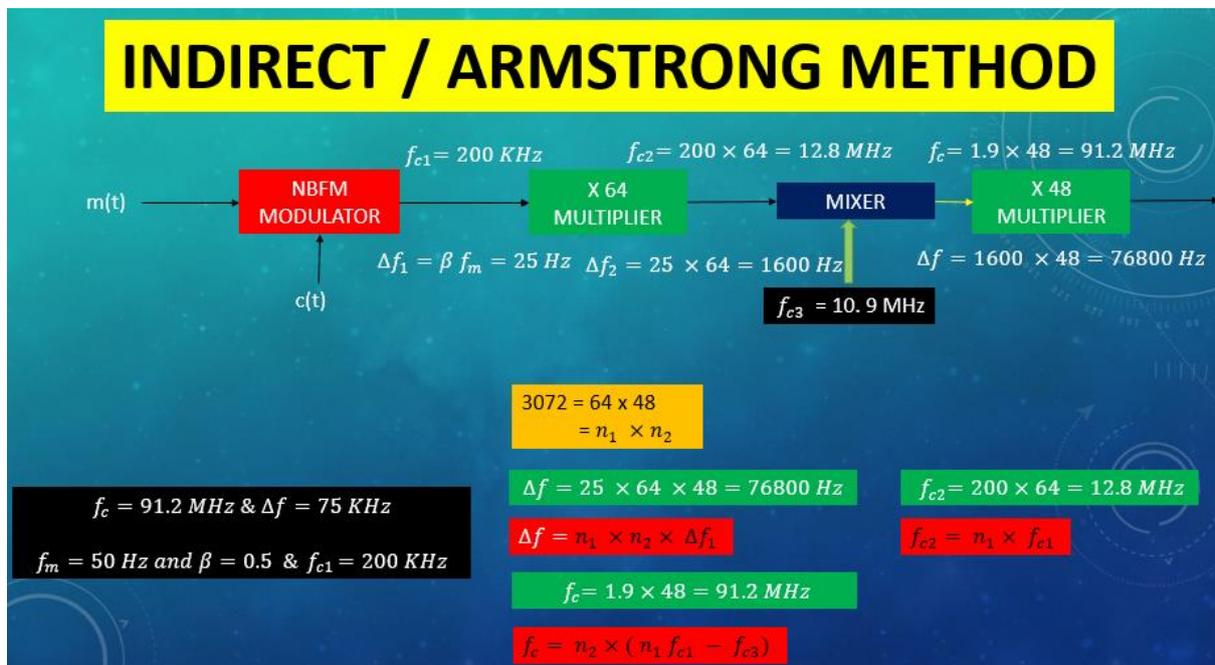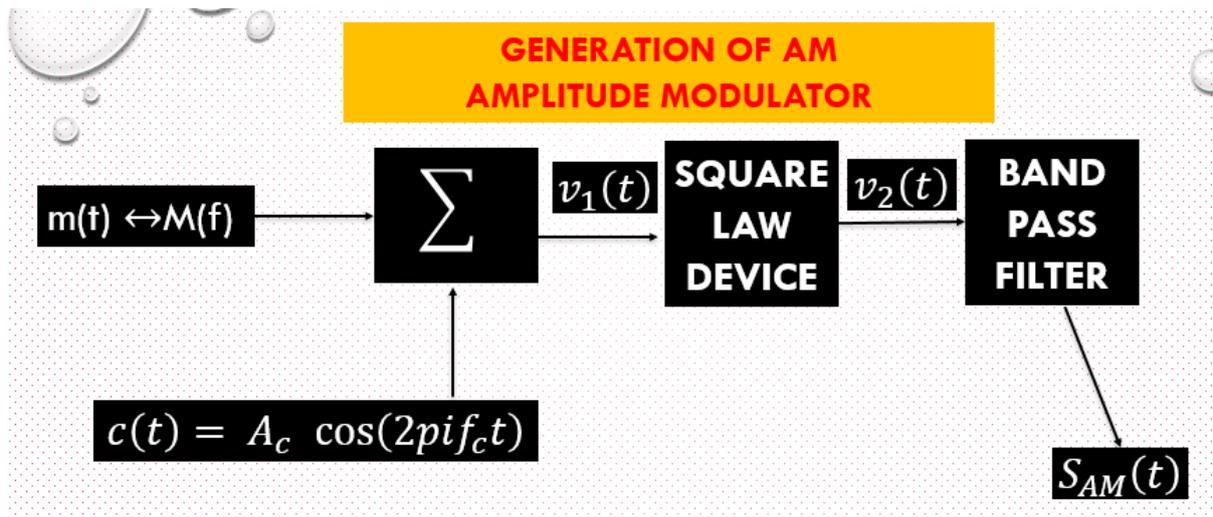m(t) → NBFM MODULATOR → X 64 MULTIPLIER → MIXER → X 48 MULTIPLIER →

c(t) → NBFM MODULATOR

$f_{c1} = 200\ KHz$

$f_{c2} = 200 \times 64 = 12.8\ MHz$

$f_c = 1.9 \times 48 = 91.2\ MHz$

$\Delta f_1 = \beta f_m = 25\ Hz$ $\Delta f_2 = 25 \times 64 = 1600\ Hz$

$\Delta f = 1600 \times 48 = 76800\ Hz$

$f_{c3} = 10.9\ MHz$

$3072 = 64 \times 48 = n_1 \times n_2$

$f_c = 91.2\ MHz\ \&\ \Delta f = 75\ KHz$

$f_m = 50\ Hz\ and\ \beta = 0.5\ \&\ f_{c1} = 200\ KHz$

$\Delta f = 25 \times 64 \times 48 = 76800\ Hz$

$\Delta f = n_1 \times n_2 \times \Delta f_1$

$f_c = 1.9 \times 48 = 91.2\ MHz$

$f_c = n_2 \times (n_1 f_{c1} - f_{c3})$

$f_{c2} = 200 \times 64 = 12.8\ MHz$

$f_{c2} = n_1 \times f_{c1}$

(13) Explain generation and detection of Amplitude modulation in detail?   **(4 Marks)**

GENERATION OF AM
AMPLITUDE MODULATOR

$m(t) \leftrightarrow M(f)$ → $\sum$ → $v_1(t)$ → SQUARE LAW DEVICE → $v_2(t)$ → BAND PASS FILTER → $S_{AM}(t)$

$c(t) = A_c \; \cos(2pif_ct)$

ENVELOPE DETECTOR

Input, $S\{t\}$

D

C R
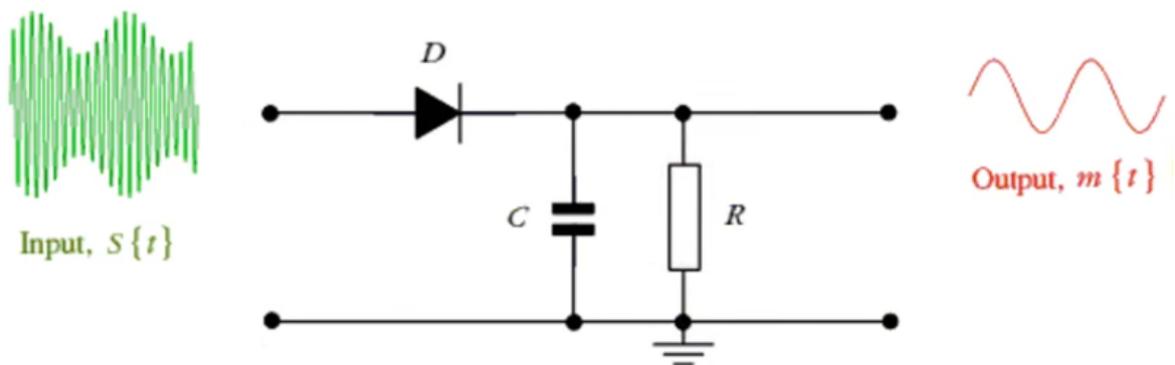
Output, $m\{t\}$

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