MAHA DISCOM Model Questions for Electrical Engineering

1. Find the Fourier sine transform of $f(x)$, where

$f(x)$ = f(x) 1,0<x<a
{ 0, x>a

(a) $\sqrt{2}/p$ (cos *st* / *s*) **(b) $\sqrt{2}/p$ (1 - cos *as* / *s*)**

(c) $\sqrt{2}$ (1 - cos *as*) (d) None of these

2. A random variable X with uniform density in the interval 0 to 1 is Quantized as follows:

If $0 \le X \le 0.3$, $x_q = 0$

If $0.3 \le X \le 1$, $x_q = 0.7$

Where X_q is the quatized value of x

The root mean square value of the quantization noise is

(a) 0.573 **(b) 0.198**

(c) 2.205 (d) 0.266

Solution : Since it is uniform as

$x_q = 0$ in the range $0 \le x \le 0.3$

$x_q = 0.7$ in the range $0.3 \le x \le 1$

The square mean value is

$$s^2 = \int_{-\infty}^{\infty} (x - x_q)^2 f(x)\, dx$$

$$= \int_{0}^{1} (x - x_q)^2 f(x)\, dx$$

$$= \int_{0}^{0.3} (x - 0)^2 f(x)\, dx + \int_{0.3}^{0.1} (x - 0.7)^2 f(x)\, dx$$

$$= [x^3/3]_{0}^{0.3} + [x^3/3 + 0.49x - 1.4]_{0.3}^{1}$$

or $s^2 = 0.039$

The root mean square quantization noise

RMS = $\sqrt{s^2}$

= $\sqrt{0.039} = 0.198$

3. Choose the correct one from among the alternatives A, B, C, D after matching an item from Group 1 with the most appropriate item in Group 2.

Group 1	Group 2
1 : FM	P : Slope overload
2 : DM	Q : m Law
3 : PSK	R : Envelope detector
4 : PCM	S : Capture effect
	T : Hilbert transform
	U : Matched filter

(a) 1 - T, 2 - P, 3 - U, 4 – S (b) 1 - S, 2U, 3 - P, 4 - T

(c) 1 - S, 2 - P, 3U, 4 - Q (d) 1 - U, 2 - R, 3 - S, 4 - Q

Solution : FM --- Capture effect --- Receives only strong signal

DM ---- Slop over load Noise

PSK --- Matched filter

PCM - m law - Non linear quantization by using Companding with a law

$$V = \frac{\log (1 + m |M|)}{\log (1 + m)}$$

4. There analog signals, having bandwidth 1200 Hz, 600 Hz and 600 Hz, are sampled at their respective Nyquist rates, encoded with 12 bit words, and time division multiplexed. The bit rate for the multiplexed signal is

(a) 115.2 kbps (b) 28.8 kbps

(c) 57.6 kbps (d) 38.4 kbps

Solution : The three analog Signals having BW 1200 Hz, 600Hz and 600 Hz are sampled at their respective Nyquist rate i.e. at 2400, 1200, 1200 sample/sec respectively.

The total of (2400 + 1200 + 1200) = 4800 sample/sec

The Bit rate = n. f_s = (4800 sample/sec) x 12 = 57.6 Kbps

Where n = number of bit in a symbol

5. Find the correct match between group 1 and group 2.

Ground I

P - $[1 + km(t)] A \sin(w_c t)$

Q - $km(t) A \sin(w_c t)$

R - $A \sin [w'_c + k]'_{-\infty} m(t) dt$

S - $A \sin [w_c t + k \int_{-\infty} m(t)\, dt]$

Solution :

Group II

W - Phase modulation

X - Frequency modulation

Y - Amplitude modulation

Z - DSB-SC modulation

	P	Q	R	S
(a)	Z	Y	X	W
(b)	W	X	Y	Z
(c)	X	W	Z	Y
(d)	**Y**	**Z**	**W**	**X**

Solution : The correct match is given below

$[1 + km(t)] A \sin (w_c t)$	Amplitude modulation
$km(t) A \sin (w_c t)$	DB-SC modulation
$A \sin [w_c + k] \int_{-\infty} m(t)\, dt$	Phase modulation
$A \sin [w_c t + k \int_{-\infty} m(t)\, dt]$	Frequency modulation

6. Which of the following analog modulation scheme requires the minimum transmitted power and minimum channel bandwidth?

(a) VSB (b) DSB-SC

(c) SSB (d) AM

Solution : VSB $\rightarrow f_m + f_c$

DBS - SC $\rightarrow 2 f_m$

SSB $\rightarrow f_m$

AM $\rightarrow 2 f_m$

Thus SSB has minimum bandwidth and it required minimum power i.e. 17% as compared to AM.

7. A device with input x(t) and output y(t) is characteristic by : $y(t) = x^2(t)$. An FM signal with frequency deviation of 90 KHz and modulation signal bandwidth of 5 KHz is applied to this device. The bandwidth of the output signal is

(a) 370 KHz (b) 190 KHz

(c) 380 KHz (d) 95 KHz

Solution : In present case

$\Delta f = 90$; $f_m = 5$

$\beta = [\Delta f / f_m] = [90/5] = 18$

FM equation

$A \cos [w_c t + \beta = \sin w_m t]$

$= A \cos [w_c t + 18 \sin w_m t]$

$y(t) = x^2 (t) = A^2 \cos^2 [w_c t + 18 \text{ Sin } w_m t]$

Note : $\text{Cos}^2 q = [1 + \text{Cos}2q] / 2$

If there is change in frequency the modulation index also changes in same ratio

$y(t) = A^2 [(1/2) + (1/2) \text{ Cos } \{2w_c t + 36 \text{Sin } w_m t\}]$

$y(t) = [(A^2/2) + (A^2/2) \text{ Cos } \{2w_c t + 36 \text{Sin } w_m t\}]$

After the device,

$\beta_{(new)} = 36 = [\Delta f_{(new)} / f_m]$

$\Delta f_{(new)} = 36 \times 5 = 180$

By carson's rule

Bandwidth $= 2(\Delta f + f_m)$

$= 2 (180 + 5)$

Bandwidth = 370 kHz

9. A carrier is phase modulated (PM) with frequency deviation of 10 KHz by a single tone frequency of 1 KHz. If the single tone frequency is increased to 2 KHz, assuming that **phase deviation remains unchanged**, the bandwidth of the PM signal is

(a) 21 kHz (b) 22 kHz

(c) 42 kHz **(d) 44 kHz**

Solution : $\Delta f = 10$ KHz $f_{m(new)} = 2$ KHz

$f_m = 1$ KHz

By carson's Rule

$BW = 2 (\Delta f + f_m) = 2 (10 + 1) = 22$ KHz

$\Delta f_{(new)} = 2 \times 10 = 20$

$BW_{(new)} = 2 (20 + 2) = 44$ kHz

10 If A and B be the set and A^c and B^c denote the complements of the sets. A and B, then set $(A - B) \cup (B - A) \cup (A \cap B)$ is equal to

(a) $A \cup B$ (b) $A^c \cup B^c$

(c) $A \cap B$ (d) $A^c \cap B^c$

11 Let $G = G(V, E)$ has five vertices, then the maximum number of m of edges in E, if G is a multigraph ?

(a) 5 (b) 2

(c) 10 **(d) Finite or infinite**

12 How many straight line can be drawn through 10 points on a circle ?

(a) 10 (b) 20

(c) 45 (d) Infinite

13 . The Fourier transform of unit step function $u(t)$ is

(a) 1 (b) pd(w)

(c) pd(w) - 1/jw (d) pd(w) + 1/jw

14. The value of the integral $\int_{-\infty} e^{-2(x - t)} d(t - 2)\, dt$ is

(a) $e^{-2(x - 2)}$ (b) $e^{2(x - 2)}$

(c) $e^{-2(x + 2)}$ (d) $e^{2(x + 2)}$

15. The uint of $\tilde{N} \times H$ is

(a) A (b) A/m

(c) A/m^2 (d) A-m