# ENGINEERING & MANAGEMENT EXAMINATIONS, DECEMBER – 2008

## ANALOG COMMUNICATION THEORY

### SEMESTER – 5

Time : 3 Hours ] [ Full Marks : 70

### GROUP – A

### ( Multiple Choice Type Questions )

1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

i) A signal $x(t)$ is called an energy signal, if its energy $E$ and power $P$ satisfy which of the following ?

a) both $E$ and $P$ are infinite b) $E$ is infinite, but $P$ is finite

c) $E$ is finite, $P = 0$ d) $E$ is finite, but $P$ is infinite. ☐

ii) For broadcast system it is more economical to have

a) one costly transmitter b) many costly receivers

c) many costly transmitters d) none of these. ☐

iii) Signal at the output of an AM modulator is given by

$e = 5{\cdot}3\,(1 + 0{\cdot}64 \sin 6280\,t) \sin 10^6\,t$. The modulating frequency is

a) 6·28 kHz

b) 1 kHz

c) 1000 kHz

d) indeterminate from the given data. ☐

iv) Once locked the PLL can track the incoming frequency over a finite range of frequency shift called

a) lock range b) capture range

c) null range d) none of these. ☐

v) Indicate the *false* statement regarding the advantages of SSB-SC over General AM :

a) More channel space is available

b) Signal is more noise resistant

c) Much less power is needed for the same signal strength

d) Transmitter circuits are more stable giving better reception. ☐

vi) The image channel rejection in a superheterodyne receiver comes from

a) IF stages only b) RF stages only

c) Detector and RF stages only d) Detector, RF and IF stages. ☐

vii) The noise performance of a wideband FM system

a) is generally poorer than AM system

b) is independent of signal-to-noise ratio

c) exhibits a threshold

d) is independent of modulation index. ☐

viii) A fair die is tossed. It shows numbers 1 to 6 with equal probabilities. Let the outcome be called the random variable $X$. Then the probability distribution function for the value 6 *i.e.* $P_X(6)$ is

a) 1 b) 5/6

c) 1/6 d) 0. ☐

ix) Modulation is used to

a) reduce the bandwidth used

b) separate different transmissions

c) ensure that intelligence may be transmitted over long distances

d) allow the use of practicable antennae. ☐

x) According to Paley-Wiener criteria the function $\int_{-\infty}^{\infty} \frac{|m|H(\omega)||}{1+\omega^2} d\omega$ should be

a) less than zero b) less than one

c) less than infinity d) none of these.

xi) Demodulation of DSB-SC signals requires

a) an envelope detector b) a synchronous detector

c) a discriminator d) an integrator.

xii) The auto-correlation function of an energy signal has

a) no symmetry b) conjugate symmetry

c) odd symmetry d) even symmetry.

## GROUP – B

### ( Short Answer Type Questions )

Answer any *three* of the following. $3 \times 5 = 15$

2. a) Let $X_1(t)$ be a continuous time periodic signal with fundamental frequency $\omega_1$ and exponential Fourier series coefficient $a_k$. Given that

$X_2(t) = X_1(1-t) + X_1(t-1)$, having exponential Fourier series coefficient as $b_k$. Find a relationship between $a_k$ and $b_k$.

b) Given that $X(t)$ has the Fourier transform of $X(\omega)$. Find the Fourier transform of $X_1(t)$, such that $X_1(t) = X(3t-6)$. 3 + 2

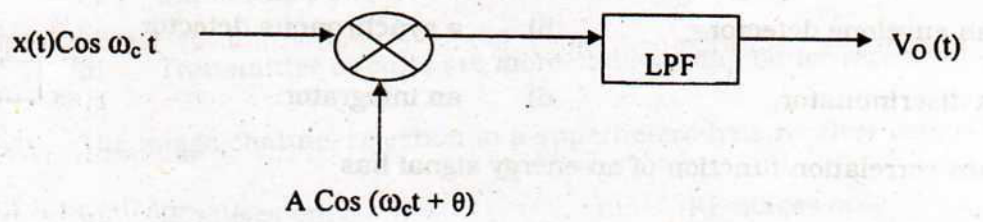
3. Write down the "threshold effect" in an envelope detector. Calculate the input and output signal power in SSB-SC system. $2 + 1\frac{1}{2} + 1\frac{1}{2}$

4. Write down the advantages and disadvantages of SSB system over DSB system. 5

5. a) Find the per cent modulation of an AM wave whose total power content is 2500 W and whose each sideband contains 400 W.

b) Calculate the % power saving in SSB scheme when 50% modulation is used compared to AM transmission. 3 + 2

6. A DSB-SC signal $x(t)\cos\omega_c t$ is demodulated using a locally generated carrier $A\cos(\omega_c t+\theta)$ as shown in the following figure. Show that this scheme can demodulate the signal ( with some attenuation ) as long as $\theta$ is not $\pi/2$. 5




## GROUP – C

### ( Long Answer Type Questions )

Answer any *three* of the following questions. 3 × 15 = 45

7. a) A certain frequency modulated signal is represented as

$v(f)=10\sin[10^8 t+15\sin 2000t]v$. Determine the power delivered to a 20Ω load. Also write all the information that we get from the expression.

b) Discuss one process for NBFM generation.

c) Show with the help of block diagram how NBFM can be converted to WBFM in indirect method of FM generation. 6 + 4 + 5

8. a) Define and explain the terms 'effective noise temperature' and 'equivalent noise bandwidth'.

b) Consider *two* ( 2 ) two-port networks in cascade, each with the same noise bandwidth but with different available power gains and noise figures. Find the overall noise figure of the cascade. Assume perfect impedance matching.

c) Calculate the SNR at the output of a DSB-SC system. 4 + 4 + 7

9. a) What do you mean by the term 'superheterodyne' ? Why is the local oscillation frequency unconverted in case of superheterodyne radio receiver ? What is image frequency ?

b) Explain a superheterodyne AM radio receiver with suitable block diagrams and waveform sketches as where required. 1 + 2 + 2 + 10

10. a) Starting from the definition of frequency/phase modulation, derive the frequency modulated (FM) wave's mathematical expression. What type of spectrum an FM wave has ? If the modulation index, $\beta$ is 2·4, what is the value of carrier frequency component $J_0 \beta$, where $J_n(x)$ is the Bessel function of the first kind of order $n$ for argument $x$ ?

b) State the relation between frequency modulated (FM) and phase modulated (PM) waves. With the help of a neat diagram, explain the operation of a varactor diode type FM oscillator. Give its limitations. 8 + 7

11. Write short notes on any *three* of the following : 3 × 5

a) Pre-emphasis and de-emphasis circuits and their use

b) QAM system

c) Envelope detector

d) VSB-SC modulation and demodulation.

END