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(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 3043 Roll No. | | | | | | | | | | |

B.Tech.

SIXTH SEMESTER EXAMINATION, 2005-2006

COMMUNICATION ENGINEERING

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt ALL questions.*

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data whearever not provided.

(iv) Be precise in your answer.

1. Attempt ***any four*** parts of the following : **(5x4=20)**

(a) Evaluate the Fourier transform of the following signal $g(t) = t \exp(-t) \cos(2\pi f_c t)$

where f_c is a constant.

(b) In DSB system the carrier is $c(t) = A \cos(2\pi f_c t)$ and the message signal is given by $m(t) = \text{sinc}(t)$. Find the frequency domain representation and the bandwidth of the modulated signal.

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(c) A SSB AM signal is generated by modulating an 800 kHz carrier by the signal $m(t) = \cos(2000\pi t) + 2 \sin(2000\pi t)$. The amplitude of the carrier is Ac = 100. Determine the time-domain expression of the modulated signal.

(d) Describe briefly the operation of the Ring modulator to generate the DSB-SC signal.

(e) An angle modulated signal has the form

$$s(t) = 100 \cos((2 \times 10^7 \pi t) + 4 \sin(2000\pi t))$$

Determine the average transmitted power, and peak frequency deviation. Is this an FM or a PM signal ? Explain.

(f) Describe briefly the indirect method of generation of FM signals.

2. Attempt *any four* parts of the following : **(5x4=20)**

(a) State and prove the Parseval's property of the Fourier transform.

(b) Suppose an amplifier is designed of three identical stages, each of which has a gain of $G_i = 5$ and a noise figure $F_i = 6$; $i = 1, 2, 3$. Determine the overall noise figure (in dB) of the cascade of the three stages. Derive the expression used for your calculation.

(c) A signal $g(t) = \cos(5\pi t) + 0.5 \cos(10\pi t)$ is instantaneously sampled with sample period T_s. Find the maximum allowable value for T_s.

(d) Describe briefly the method of generation of PAM signals.

(e) Describe briefly the Pulse Width Modulation technique.

(f) What do you mean by *under-sampling* ? Describe briefly the *aliasing effect* in the under-sampling process.

3. Attempt ***any two*** parts of the following : **(10x2=20)**

(a) (i) Discuss briefly the functions of a compander and an expander in a nonunifrom quantizer. **(3)**

(ii) Show that for a sinusoidal modulating signal, the output signal-to-quantization noise ratio of a uniform quantizer is (1.8+6 R) dB, where R is the number of bits per sample used in the construction of binary codes. **(5)**

(iii) What is the Manchester code ? Explain with a suitable example. **(2)**

(b) Describe briefly the operation of an Adaptive Differential Pulse Code Modulation system.

(c) A PCM system uses a uniform quantizer followed by a 7-bit binary encoder. The bit rate of the system is equal to 50×10^6 bits/sec.

(i) What is the maximum message bandwidth for which the system operates satisfactorily ? **(3)**

(ii) Determine the output signal to quantization noise ratio when a full-load sinusoidal modulating wave of frequency 1 MHz is applied to the input. **(7)**

4. Attempt *any two* parts of the following : (10x2=20)

(a) Six independent message sources of bandwidths W, W, 2W, 2W, 3W and 3W Hz are to be transmitted on a Time Division Multiplexed basis using a common communication channel.

(i) Set up a scheme for accomplishing the multiplexing requirement, with each message signal sampled a Nyquist rate. (7)

(ii) Determine the minimum transmission bandwidth required for the transmission of the multiplexed signal through the channel. (3)

(b) (i) Draw the waveform of the coherent QPSK signal corresponding to the input data sequence : 011010001. (3)

(ii) Derive an expression for the impulse response of a matched filter corresponding to any arbitrary input signal $g(t)$; $0 \leq t \leq T$. (7)

(c) Discuss briefly the operation of the transmitter and receiver of a noncoherent PSK system. Also derive an expression for the probability of error of the receiver.

5. Attempt *any two* parts of the following : (10x2=20)

(a) (i) A Source has an alphabet $\{a_1, a_2, a_3, a_4, a_5, a_6\}$ with corresponding probabilities {0.1, 0.2, 0.3, 0.05, 0.15, 0.2}. Find the entropy of the source. Compare this entropy with the entropy of a uniformly distributed source with the same alphabet. (3)

(ii) Show that : $I(X ; Y) = H(X) + H(Y) - H(X, Y)$ (7)

(b) Consider a sequence of symbols emitted by a source with their probabilities as given below :

Symbol	x1	x2	x3	x4	x5	x6	x7	x8
Probability	0.18	0.18	0.14	0.13	0.11	0.10	0.10	0.06

Determine the code words of the symbols using Shannon-Fano coding technique. Also determine the average code-word length.

(c) Design a Huffman code for a source with n output letters and corresponding probabilities $\left\{\frac{1}{2}, \frac{1}{2^2}, \ldots\ldots, \frac{1}{2^{n-1}}, \frac{1}{2^n}\right\}$. Show that the average code word length for such a source is equal to the source entropy.

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