Registration No :

6th Semester Back Examination 2017-18
COMMUNICATION ENGINEERING
BRANCH : CSE, EEE, ELECTRICAL
Time : 3 Hours
Max Marks : 70
Q.CODE : C568
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Q1   **Answer the following questions:**   **(2 x 10)**

a) Write at least two channel models equations for the analysis and design of communication systems.

b) Can the response of an LTI system to $x(t)=\text{sinc}(t)$ be $y(t)=\text{sinc}^2(t)$? Justify your answer.

c) For a low-pass signal with a bandwidth of 5000 Hz, what is the minimum sampling frequency for perfect reconstruction of the signal? What is the minimum required sampling frequency if a guard band of 1000 Hz is required?

d) Show that the energy content of a signal is equal to the energy content of its Hilbert transform.

e) The message signal $m(t)=2\cos 400t + 4\sin(500t+\frac{2\pi}{3})$ modulates the carrier signal $c(t)=A\cos(8000\pi t)$, using DSB amplitude modulation. Find power content of the modulated signal.

f) What is the total channel bandwidth required to transmit the video and audio signals and justify the answer?

g) Find the smallest value of the modulation index in an FM system that guarantees that all the modulated signal power is contained in the sidebands and no power is transmitted at the carrier frequency.

h) The messages band limited to 2W, 3W and 4W respectively are to be multiplexed using TDM. What is the minimum bandwidth required to transmit this TDM signal.

i) If a delta modulator has the message signal $m(t)=6\cos(20\pi t)+4\sin(40\pi t)$, then determine the minimum sampling frequency required to prevent slope overload , assuming that the step size of the modulator is 0.2π.

j) For PCM with n=8 , determine the output SNR for a Gaussian signal.

Q2 **a)** A linear time-invariant system with impulse response $h(t)=e^{-\alpha t}\cos(\beta t)u_{-1}(t)$ is driven by the input $x(t)=e^{-\beta t}u_{-1}(t)$. It is assumed that $\alpha, \beta >0$. Using frequency domain analysis, find the output of the system. Is the output power-type or energy type? Find its power or energy.   **(5)**

b) Let the signal $x(t)=A\,\text{sinc}(500t)$ be sampled with a sampling frequency of 1000 samples per second. Determine the most general class of reconstruction filters for perfect reconstruction of this signal.   **(5)**

Q3 **a)** Let $X(f) \equiv 0$ for $|f| \geq W$. Let $x(t)$ be sampled at multiples of some basic sampling interval T_s, where $T_s \leq \frac{1}{2W}$, to get the sequence $\{x(nT_s)\}_{n=-\infty}^{+\infty}$ Then reconstruct the original signal $x(t)$ from the sampled values by using the reconstruction formula.   **(5)**

b) Determine the Fourier transform of the following signals (α is positive).   **(5)**
$$2te^{-\alpha t}\text{sinc}^3 t$$

Q4 **a)** Assume that an AM receiver with an envelope detector is tuned to an SSB-AM signal that has a modulation waveform given by m(t). Find the mathematical expression for the audio signal that appears at the receiver output in terms of m(t). Is the audio output distorted? **(5)**

b) Explain the Armstrong method of FM generation. **(5)**

Q5 **a)** Explain the transmission of primary-color signals and multiplexing of chrominance and luminance signals, with suitable block diagram. **(5)**

b) A SSB AM signal is generated by modulating an 500-kHz carrier by the signal m(t)=cos 2000πt +2 sin 2000πt. The amplitude of the carrier is A_c =100. **(5)**
   i. Determine the signal $\hat{m}(t)$.
   ii. Determine the (time domain) expression for the upper sideband of the SSB AM signal.
   iii. Determine the magnitude spectrum of the upper sideband SSB signal.

Q6 **a)** Explain the methods of demodulation of PAM signals. **(5)**

b) A unipolar NRZ line code is converted to a multilevel signal for transmission over a channel. The number of possible values in the multilevel signal is 32, and the signal consists of rectangular pulses that have a pulse width of 0.3472 ms. For the multilevel signal, **(5)**
   i. What is the baud rate?
   ii. What is the equivalent bit rate?
   iii. What is the null bandwidth?

Q7 In a single integration DM system, the voice signal is sampled at a rate of 64 kHz.The maximum signal amplitude is 2. **(10)**
   i. Determine the minimum value of the step size of the modulator to avoid slope overload.
   ii. Determine the granular noise power, if the voice signal has bandwidth of 4 kHz.
   iii. Determine the SNR of the system, assuming the voice signal to be sinusoidal, with rms bandwidth of1.3 kHz.
   iv. If the acceptable level of SNR is 19 dB, then determinehow many similar voice channels can be transmitted over the same communication link for maximum utilization of the link.

Q8 **Write short answer on any TWO :** **(5 x 2)**
   a) Sampling of band-limited signals
   b) Comparison between PCM and DM.
   c) Quadrature-carrier multiplexing.
   d) Companding