Registration No : | | | | | | | | | | |

Total Number of Pages : 03 **B.Tech.**
PEL6I101

6th Semester Regular Examination 2017-18
COMMUNICATION ENGINEERING
BRANCH : EEE
Time : 3 Hours
Max Marks : 100
Q.CODE : C153

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 **Answer the following questions: *multiple type or dash fill up type :*** **(2 x 10)**

a) If the signal f(t) has energy E, the energy of the signal f(2t)
(i) E (ii) $2E$ (iii) $\frac{E}{2}$ (iv) $\frac{3E}{4}$

b) The Fourier transform of $te^{-\alpha t}\cos(\beta t)$_____.

c) The input to alinear delta modulator having step size Δ=0.424 is a sine wave with frequency f_m and peak amplitude E_m. If the sampling frequency is 30 kHz, for slope over load to happen, f_m= _____ and E_m=_____.

d) For the DSB-modulated signal, the envelope of the resulting bandpass signals is proportional to the *absolute value* of the message signal.Then _____ will be its mathematical representation.

e) A super-heterodyne receiver is to operate in the frequency range 500 kHz to 1600 kHz, with intermediate frequency of 450 kHz..Let R= $\frac{C_{max}}{C_{min}}$ represent the required capacitance ratio of the local oscillator and I represents the image frequency (in kHz) of the incoming signal.Then what will be R_____ and I _____?

f) A Signal has a bandwidth of 1 MHz. It is sampled at a rate 50% higher than the Nyquist rate and quantized into 256 level using a μ-law quantizer with μ = 2 5. The signal-to-quantization-noise ratio will be _____

g) A TDM link has 20 signal channels and each channel is sampled 8000 times/sec. Each sample is represented by seven binary bits and contains an additional bit for synchronization. The total bit rate for the TDM link is _____ kbps.

h) A speech signal has a total duration of 20 sec. It is sampled at the rate of 8 kHz and then PCM encoded. The signal-to-quantization noise ratio is required to be 40 dB. The minimum storage capacity needed to accommodate this signal is _____ Kbytes.

i) Two signals bandlimited to 3 to 5 kHz are to be time division multiplexed. The maximum permissible interval between two successive samples _____.

j) Ten telemetry signals, each of bandwidth 2 kHz, are to be transmittedsimultaneously by binary PCM. The maximum tolerable error in sampleamplitudes is 0.2% of the peak signal amplitude. The signals must besampled at least 20% above the Nyquist rate. Framing and synchronizingrequires an additional 1% extra bits.The minimum transmission bandwidth is
(i) 218.16 kHz (ii) 468.32 kHz
(iii) 136.32 kHz (iv) None of the above

Q2 **Answer the following questions: *Short answer type :*** **(2 x 10)**

a) Write Dirichlet sufficient conditions for the existence of theFourier series expansion.

b) What is companding? What is its significance?

c) Draw the neat labeled diagram for the spectral characteristics of black-and-white television signal.

d) Suppose that the message signal is given as $m(t) = 8 + 4\cos 2\pi t + 8\cos 4\pi t + 8\cos 20\pi t$ .Specify the frequency-response characteristic of a VSB filter that passes the upper sideband and the first frequency component of the lower sideband.

e) The output signal from an AM modulator is: $u(t) = 5\cos(1800\pi t) + 20\cos(2000\pi t) + 5\cos(2200\pi t)$. Determine the modulation index.

f) Why flat top PAM preferred over natural PAM?

g) What are the significances of eye pattern taken by a CRO?

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

i) Differentiate between FDM and TDM.

j) Differentiate between SSB and VSB modulations.

Part – B (Answer any four questions)

Q3 **a)** Explain all the basic Properties of the Fourier Transform. **(10)**

b) What is quadrature carrier multiplexing? Explain with neat block diagram. **(5)**

Q4 **a)** An analog signal is to be converted into a PCM signal that is a binary polar NRZ line code. The signal is transmitted over a channel that is absolutely bandlimited to 4 kHz. Assume that the PCM quantizer has 16 steps and that the overall equivalent system transfer function is of the raised cosine-rolloff type with r = 0.5. **(10)**

(a) Find the maximum PCM bit rate that can be supported by this system without introducing ISI.

(b) Find the maximum bandwidth that can be permitted for the analog signal.

b) Show that "the time-average autocorrelation function of a periodic signal is itself periodic with the same period as the original signal, and its Fourier series coefficients are magnitude squares of the Fourier series coefficients of the original signal". **(5)**

Q5 **a)** (i) 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? **(10)**

(ii) An audio signal with a bandwidth of 10 kHz is transmitted over an AM transmitter with a carrier frequency of 1.0 MHz. The AM signal is received on a super-heterodyne receiver with an envelope detector. What is the constraint on the RC time constant for the envelope detector?

b) Describe the pulse modulation scheme of PAM,PPM & PWM. Does these modulation scheme comes under digital modulation technique? Justify the answer. **(5)**

Q6 **a)** (i) Draw a block diagram of a super-heterodyne FM receiver that is designed to receive FM signals over a band from 144 to 148 MHz. Assume that the receiver is of the dual-conversion type (i.e., a mixer and an IF amplifier, followed by another mixer and a second IF amplifier), where the first IF is 10.7 MHz and the second is 455 kHz. Indicate the frequencies of the signals at different points on the diagram, and, in particular, show the frequencies involved when a signal at 146.82 MHz is being received. **(10)**

(ii) Replace the first oscillator by a frequency synthesizer such that the receiver can be tuned in 5-kHz steps from 144.000 to 148.000 MHz. Show the diagram of your synthesizer design and the frequencies involved.

b) Derive the time domain representation of a SSB AM signal. **(5)**

Q7 **a)** Design a TDM PCM system that will accommodate four 300-bits (synchronous) digital inputs and one analog input that has a bandwidth of 500 Hz. Assume that the analog samples will be encoded into 4-bit PCM words. Draw a block diagram for your design, indicating the data rates at the various points on the diagram. Explain how your design works. **(10)**

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

Q8 **a)** 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, **(10)**

(a) What is the baud rate?
(b) What is the equivalent bit rate?
(c) What is the null bandwidth?
(d) Repeat (a) to (c) for the unipolar NRZ line code.

b) With neat sketch, explain the generation of DM signals. **(5)**

Q9 **a)** A DM system is tested with a 10-kHz sinusoidal signal, 1 V peak to peak, at the input. The signal is sampled at 10 times the Nyquist rate. **(10)**

(a) What is the step size required to prevent slope overload and to minimize granular noise?
(b) What is the PSD for the granular noise?
(c) If the receiver input is bandlimited to 200 kHz, what is the average signal–quantizing noise power ratio?

b) Draw various line code formats for the information {1 0 1 1 0 1} **(5)**