

Con. 5277-09.

M.E. (ETRX) Sem I (R)  
 Communication Theory  
 (3 Hours)

BB-6122

04/01/10

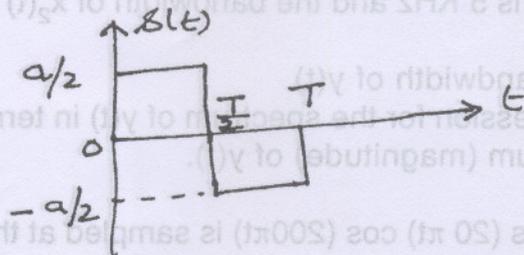
[Total Marks : 100]

10.30 to 1.30

- N. B. : (1) Question No. 1 is **compulsory**.  
 (2) Attempt any **four** questions out of remaining **six** questions.  
 (3) Assume **suitable** data, if **required**, stating them **clearly**.
1. (a) Distinguish between simple AGC and delayed AGC. Explain with characteristics. 5  
 (b) Distinguish between single conversion and double conversion receivers. 5  
 (c) Justify the use of compander in PCM system. Sketch and explain compander characteristics. 5  
 (d) MSK is called shaped QPSK. Justify giving expressions for QPSK and MSK. 5
  2. (a) A modulating signal given by  $e_m(t) = 2 \sin(2\pi 10^4 t)$  is used to amplitude modulate a carrier  $e_c(t) = 10 \sin(2\pi 10^6 t)$ . The modulated wave is developed across a 50 ohm load resistor. 8  
 (i) Give the expression for the modulated wave  
 (ii) Calculate the rms current in load.  
 (iii) Calculate the total average power.  
 (iv) Calculate the power in carrier and side bands.  
 (b) For a receiver with IF and RF frequencies of 455 KHz and 900 KHz respectively, determine : 6  
 (i) Image frequency  
 (ii) Local oscillator frequency  
 (iii) Image frequency rejection ratio for a preselector Q of 80.  
 (c) Explain 'Sensitivity' and 'Selectivity' with respect to a radio receiver. How can these parameters be improved ? 6
  3. (a) A 100 KHz signal, frequency modulates a 500 MHz carrier, with a modulation index of 2. What are the maximum and minimum values of the instantaneous frequency of the modulated signal ? 4  
 (b) Explain "Noise triangle" in FM. Hence explain the need for pre-emphasis and de-emphasis circuits in an FM system. 8  
 (c) In a communication system, two baseband signals  $x_1(t)$  and  $x_2(t)$  are transmitted simultaneously by generating the RF signal.  $y(t) = x_1(t) \cos \omega_o t + x_2(t) \sin \omega_o t$ . The bandwidth of  $x_1(t)$  is 5 KHz and the bandwidth of  $x_2(t)$  is 10 KHz. The carrier frequency is 12 MHz. 8  
 (i) Evaluate the bandwidth of  $y(t)$   
 (ii) Derive the expression for the spectrum of  $y(t)$  in terms of  $X_1(F)$  and  $X_2(F)$ . Plot the spectrum (magnitude) of  $y(t)$ .
  4. (a) The signal  $g(t) = 10 \cos(20\pi t) \cos(200\pi t)$  is sampled at the rate of 250 samples per second. 6  
 (i) Determine the spectrum of the resulting sampled signal.  
 (ii) Specify the frequency of the ideal reconstruction filter so as to recover  $g(t)$  from its sampled version.  
 (iii) What is the Nyquist rate for  $g(t)$  ?

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- (b) Six independent message sources of bandwidth  $W$ ,  $W$ ,  $2W$ ,  $2W$ ,  $3W$  and  $3W$  Hertz are to be transmitted on a time division multiplexed basis using a common communication channel. 8
- (i) Set up a scheme for accomplishing this multiplexing requirement, with each message sampled at its Nyquist rate.
  - (ii) What should be the speed of the commutator ?
  - (iii) Determine the minimum transmission bandwidth of the channel.
  - (iv) If the commutator output is quantised with  $L = 1024$  levels and is binary coded, what is the output bit rate ?
- (c) In a linear Delta modulation system, explain how slope overload error and quantization error are related to step size. Illustrate with suitable input output waveforms. 6
5. (a) Derive and sketch power spectral density of polar NRZ signal. Hence, sketch the power spectral density of BPSK signal and obtain bandwidth. 10
- (b) For 8-ary PSK system :
- (i) Sketch transmitter and receiver block diagram and explain the working. 4
  - (ii) Give the expression for 8-ary PSK signal. Hence, sketch the power spectral density and explain. Obtain the bandwidth. 4
  - (iii) Compare spectral efficiency of 8-ary PSK and 8-ary FSK system. 2
6. (a) MSK signal is Phase-continuous at even and odd bits intervals. Explain. 8
- (b) Derive the expression for the transfer function of Duobinary encoder. Hence, sketch the amplitude and phase response for  $|f| \leq f_b/2$ . Where  $f_b$  is the signalling rate. 8
- (c) Sketch the block diagram for non-coherent BFSK receiver and explain the working. 4
7. (a) Sketch and explain the working of Integrate and dump circuit as baseband receiver for input signal  $\pm V$ . Derive the expression for probability of error. 10
- (b) In a binary communication channel, the receiver detects binary pulses with an error probability  $P_e$ . What is the probability that out of 100 received digits, not more than 3 digits are in error. 5
- (c) Consider the signal  $s(t)$  shown below :— 5



- (i) Determine and plot the impulse response of a filter matched to this signal.
- (ii) Plot the matched filter output as a function of time.