

Advanced Digital Communication  
(ECEN 5101) 14

Time Allotted : 3 hrs

Full Marks : 70

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following: 10 x 1=10

- (i) For two independent events A and B the joint probability  $P(AB)$  is given by  
(a)  $P(A)P(B)$  (b)  $P(A)/P(B)$   
(c)  $P(B)/P(A)$  (d)  $P(A)+P(B)$ .
- (ii) Total probability of any Random variable between the limits  $-\infty$  to  $+\infty$  is  
(a) infinite (b) zero  
(c) one (d) a fraction.
- (iii) For uniform quantization the quantization noise power is proportional to (where S is the quantization Step size)  
(a) S (b)  $S^2$  (c)  $S^3$  (d)  $S^4$ .
- (iv) Delta modulation is considered as  
(a) carrier modulation (b) amplitude modulation  
(c) phase modulation (d) 1 bit PCM.
- (v) Phase change between two consecutive level of QPSK signal is  
(a) zero degree (b) 90 degree  
(c) 180 degree (d) 230 degree.
- (vi) In a TDM system 10 channels each of output bit rate of 3.5 Kbps are multiplexed. Bit rate of the multiplexed signal is  
(a) 350 kbps (b) 400 kbps  
(c) 35 kbps (d) 3.5 kbps.
- (vii) OFDM signal generation requires a  
(a) multiple carrier frequency (b) single carrier frequency  
(c) fewer message bits (d) large no. of message bits.
- (viii) For n no. of Flip Flops of a PN sequence generator the sequence length is  
(a)  $2^{n-1}$  (b)  $2^n$   
(c) n (d)  $2^{n+1}$ .

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- (ix) In CDMA multiple access to communication resource is based on  
(a) time division (b) frequency division  
(c) polarization (d) code division.
- (x) Decision region in signal space is used for finding  
(a) inter symbol interference (b) minimum error probability  
(c) bandwidth efficiency (d) code rate.

**Group - B**

- 2.(a) Explain probability density and cumulative distribution function that describe the statistical behaviour of a random variable. Write the mathematical relation between the two.
- (b) Give the mathematical definition of  $n$ th order moment of random variable  $x$ . Hence derive the expression of expected value  $\bar{x}$  and variance  $\sigma^2$  of random variable  $x$ . Prove that  $\sigma^2 = \bar{x^2} - (\bar{x})^2$ .
- 3.(a) Find an expression for signal to noise ratio after an analog signal is uniformly quantized. What is the effect of PCM signal bandwidth on S/N ratio of the above quantized signal?
- (b) What are different types of Delta Modulation noise? Explain each type. Show the variation of signal to noise ratio with the quantized step size and explain such variation with step size.

**5 + 7 = 12**

**6 + 6 = 12**

**Group - C**

- 4.(a) Draw the wave form of the BASK and QPSK modulated signal. Draw the PSD of QPSK and find the bandwidth efficiency.
- (b) Describe with block diagram the BPSK Demodulator. Is it synchronous or Envelope Detection?
- 5.(a) What is called bit error probability? Find an expression for BER for unipolar baseband digital signal.
- (b) Find an expression for optimum threshold voltage for minimum BER. What will be the value of threshold voltage for polar signal(+V for bit 1 and -V for bit )?

**6 + 6 = 12**

**6 + 6 = 12**

**Group - D**

6.(a) Explain the difference between multiplexing and multiple access for digital signal. Elucidate with example.

(b) Describe FDM and FDMA with example. Indicate the difference between TDMA and FDMA.

**6+ 6= 12**

7.(a) Elaborate the basic principle of Spread Spectrum technique. What are the application areas of Spread Spectrum technique?

(b) Draw a schematic diagram of Direct Sequence Spread Spectrum (DSSS) modulation and demodulation and explain their operation.

**6+ 6= 12**

**Group - E**

8.(a) Introduce the concept of decision region for Optimum Detection of signal in presence of noise.

(b) Draw the block diagram of a M ary optimum receiver using correlators. What is the function of a correlator ? What way is it useful for optimum detection?

**4 + 8 = 12**

9.(a) Draw the diagram of signal constellation in geometric space for equiprobable 16 QAM signal.

(b) Find an expression for probability of minimum error for 16 QAM signal transmission considering decision region approach.

**6 + 6 = 12**