

7. (a) Distinguish between natural sampling and flat top sampling? What is the function of sample and hold circuit? What is an aliasing error? What is Nyquist rate?
- (b) What are the advantages of using PCM over other types of pulse modulations? Compare between FDM and TDM.
- (2 + 2 + 1 + 1) + (2 + 4) = 12**

Group - E

8. (a) A total of 33 MHz bandwidth is allocated to a FDD cellular system with two 25 KHz simplex channels to provide full duplex voice and control channels. Compute the number of channels available per cell if the system uses (i) 4-cell, (ii) 7-cell and (iii) 8-cell reuse technique. Assume 1 MHz of spectrum is allocated to control channels. Give a distribution of voice and control channels.
- (b) What is SDMA technique? What are the types of SDMA techniques?
- (c) Differentiate between co-channel interference and adjacent channel interference.
- 5 + (2 + 1) + 4 = 12**
9. (a) What is the difference between hard handoff and soft handoff? What are the factors influencing the entire handoff process?
- (b) Calculate the orbital velocity for geosynchronous satellite. What are the different advantages and disadvantages of geosynchronous satellite? What is the visibility condition of a satellite?
- (1 + 3) + (2 + 3 + 3) = 12**

**COMMUNICATION TECHNIQUES
(AEIE 3101)****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 alternative for the following: **10 × 1 = 10**
- (i) For a message signal $m(t) = \cos(2\pi f_m t)$ and carrier of frequency f_c , which of the following represents a single side-band (SSB) signal?
 (a) $\cos(2\pi f_m t)\cos(2\pi f_c t)$ (b) $\cos(2\pi f_c t)$
 (c) $\cos[2\pi(f_c + f_m)t]$ (d) $[1 + \cos(2\pi f_m t)]\cos(2\pi f_c t)$
- (ii) A signal has frequency components from 300 Hz to 1.8 KHz. The minimum possible rate at which the signal has to be sampled is
 (a) 600 Hz (b) 1200 Hz (c) 1800 Hz (d) 3600 Hz.
- (iii) The characteristics of compressor in μ -law companding are
 (a) discrete in nature (b) logarithmic in nature
 (c) linear in nature (d) continuous in nature.
- (iv) Compression in PCM refers to relative compression of
 (a) higher signal amplitudes (b) lower signal amplitudes
 (c) lower signal frequencies (d) higher signal frequencies.
- (v) In the physical layer Bluetooth uses
 (a) FHSS (b) DSSS (c) THSS (d) OFDM.
- (vi) Maxwell's equations are based on _____ law(s).
 (a) Faraday's (b) Gauss's (c) Ampere's (d) all of these.
- (vii) For a bit-rate of 8 kbps, the best possible values of the transmitted frequencies in a coherent binary FSK system are
 (a) 16 KHz and 20 KHz (b) 20 KHz and 32 KHz
 (c) 20 KHz and 40 KHz (d) 32 KHz and 40 KHz.

- (viii) The signal to quantization noise ratio in an n-bit PCM system
 (a) depends upon the sampling frequency employed
 (b) is independent of the value of 'n'
 (c) increases with increasing value of 'n'
 (d) decreases with increasing value of 'n'.
- (ix) The line code that has zero dc component for pulse transmission of random binary data is
 (a) non-return to zero (NRZ) (b) return to zero (RZ)
 (c) alternate mark inversion (AMI) (d) both (a) and (b).
- (x) An analog voltage in the range 0 to 8 V is divided in 16 equal intervals for conversion to 4-bit digital output. The maximum quantization error (in V) is
 (a) 2 V (b) 0.5 V (c) 1 V (d) 0.25 V.

Group - B

2. (a) Explain the square law modulator with a neat block diagram and derive an expression for the output.
 (b) An FM transmitter with a carrier frequency of 80 MHz has deviation sensitivity of 4 kHz/V. Determine the frequency deviation for a modulating signal $f_m(t) = 12 \sin(2\pi 2000t)$. Also find the modulation index.
 (c) A phase modulator produces 1.5 rad of phase deviation for a 6 V modulating signal. Determine the deviation sensitivity. How much phase deviation will be produced for a 3 V modulating signal?
(4 + 2) + (2 + 2) + (1 + 1) = 12
3. (a) State Carson's rule for determining the bandwidth of an angle modulated wave. How do you get FM from PM and vice versa?
 (b) An angle modulated wave with a carrier frequency $\omega_c = \pi \times 10^5$ rad/s is given as $f(t) = 5 \cos(\omega_c t + 3 \sin 2000t + 5 \sin 2000\pi t)$
 Find:
 (i) frequency deviation
 (ii) deviation ratio
 (iii) phase deviation and
 (iv) the bandwidth.
 (c) Draw the block diagram of a phase locked loop.
(1 + 2 + 2) + 4 + 3 = 12

Group - C

4. (a) What are slope overload distortion and granular noise in delta modulation? How are these avoided in adaptive delta modulation? Given a sine wave of frequency f_m and amplitude A_m applied to a delta modulator having step size Δ and sampling period of T_s . Show that the slope overload distortion will occur if $A_m > \frac{\Delta}{2\pi f_m T_s}$.
 (b) A delta modulator system is designed to operate at five times the Nyquist rate for a signal having a bandwidth equal to 3 kHz. Calculate the maximum amplitude of a 2 kHz input sinusoidal signal for which the delta modulator does not have slope overload, assuming the quantizing step size to be 250 mV.
 (c) List the applications and limitations of ASK and FSK techniques.
5 + 3 + 4 = 12
5. (a) Briefly explain spread spectrum modulation techniques. Compare among DSSS, FHSS and THSS techniques.
 (b) Define chip rate and processing gain for spread spectrum modulation techniques.
 (c) A 16 PSK system operates with a bit rate of 48kbps. Find the baud rate, minimum bandwidth and bandwidth efficiency.
(4 + 3) + 2 + 3 = 12

Group - D

6. (a) What is the need for bandlimiting a signal before sampling? What is the difference between PPM and PWM? Briefly mention the methods used to reduce inter symbol interference.
 (b) A signal bandlimited to 3.5 kHz is sampled at 30% higher than the Nyquist rate. The maximum accepted error in the sampled amplitude due to quantization must not exceed 0.2% of the peak amplitude E. The quantized samples use binary coding. Find the required sampling rate, the number of bits required to encode each sample and the bit rate of the resulting PCM signal.
(1 + 2 + 3) + 6 = 12