Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech Degree S5 (S,FE) (FT/WP/S3PT) Examinations June 2026 (2019 Scheme)

## Course Code: ECT305
## Course Name: ANALOG AND DIGITAL COMMUNICATION

Max. Marks: 100 Duration: 3 Hours

### PART A

*(Answer all questions; each question carries 3 marks)* Marks

| | | | |
|---|---|---|---|
| 1 | | Explain the need for modulation | 3 |
| 2 | | Derive an expression for amplitude modulated carrier. | 3 |
| 3 | | Define (i) Entropy (ii) Mutual Information | 3 |
| 4 | | Define ergodic process. | 3 |
| 5 | | What is companding? Explain. | 3 |
| 6 | | An audio signal $g(t) = 10\cos(2\pi 500t)$ is quantized using 12-bit PCM. Determine SQNR. | 3 |
| 7 | | What is raised cosine spectrum? | 3 |
| 8 | | Distinguish between MAP rule and ML rule | 3 |
| 9 | | Draw the signal constellation diagram for QPSK. | 3 |
| 10 | | Compare BPSK and QPSK systems. | 3 |

### PART B

*(Answer one full question from each module, each question carries 14 marks)*

#### Module -1

| | | | |
|---|---|---|---|
| 11 | a) | Explain Armstrong method for FM generation with suitable equation and block diagram | 10 |
| | b) | The antenna current of AM broadcast transmitter is 10A when it is modulated to a depth of 30% by an audio signal. It increases to 11A when another signal modulates the carrier signal. What will be the modulation index due to second signal. | 4 |
| 12 | a) | Derive an expression for frequency modulated carrier. | 6 |
| | b) | A carrier signal is frequency modulated with a sinusoidal signal of 2kHz resulting in a maximum frequency deviation of 5kHz. | 8 |
| | | (i) Find bandwidth of the modulated signal | |

(ii) The amplitude of the modulating signal is increased by a factor of 3 and frequency is lowered to 1kHz. Determine the maximum frequency deviation and bandwidth of new modulating signal.

**Module -2**

13 a) Consider a WSS random process X(t) with zero mean and autocorrelation function $R_{xx}(\tau) = e^{-10|\tau|}$. This random process is modulating the carrier wave $\cos(\omega t+\phi)$ where $\phi$ is uniformly distributed in the interval $(-\pi, \pi)$. The resulting process is given by $Y(t) = X(t) \cos(\omega t+\phi)$. The carrier wave is independent of X(t). Determine whether the process Y(t) is WSS 8

b) Explain Wiener-Khinchin's theorem. State its properties. 6

14 a) Find the differential entropy of a Gaussian random variable having mean 'a' and variance $\sigma^2$ 8

b) Consider a continous random variable with pdf 6

$$f_X(x) = \begin{cases} A\,(3x - x^2), & 0 \le x \le 2 \\ 0, & otherwise \end{cases}$$

(i) Find the value of A

(ii) Find P ($X$>1)

**Module -3**

15 a) Explain DPCM system with relevant equations and diagrams. 10

b) A sinusoidal signal with a frequency of 3.4 kHz and a maximum amplitude of 1 V is applied to a delta modulator. If the bit rate for the delta modulator is 25 kbps, find the appropriate step size for the delta modulator. 4

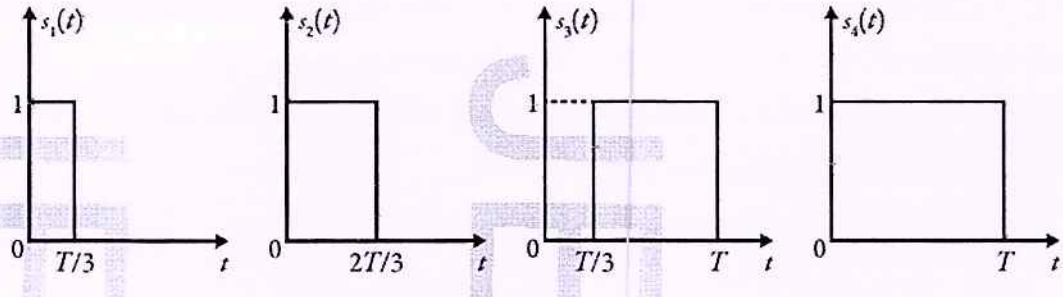
16 a) Explain Delta modulation with relevant equations and diagram. 10

b) Explain the limitations of delta modulation. 4

**Module -4**

17 14

Given the signals $s_1(t)$, $s_2(t)$, $s_3(t)$ and $s_4(t)$ is shown in figure.



(i) Use the Gram–Schmidt orthogonalization procedure to find orthonormal basis functions for the set of signals

(ii) Plot the orthonormal basis functions

18 a) Derive the impulse response of matched filter 7

b) State and prove Nyquist criteria for zero ISI 7

**Module -5**

19 a) Explain QAM system. Obtain the signal space diagram of M-ary QAM for M=16. 8

b) Explain the block diagram for BPSK generation and detection. 6

20 a) Derive the expression for probability of error in QPSK. 10

b) Explain the block diagram for QPSK generation. 4

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