Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S5 (R,S) (FT/WP) (S3 PT) Examination November 2025 (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		Differentiate between narrow band and wide band FM.	3
2		In an FM system, if the maximum value of deviation is 75KHz and the maximum modulating frequency is 10 KHz, calculate the deviation ratio and bandwidth of the system using Carsons rule.	3
3		State the conditions required for a random process to be a wide sense stationary process	3
4		Explain mutual information.	3
5		State and explain sampling theorem.	3
6		What is slope overload distortion? Explain.	3
7		Explain the properties of matched filter.	3
8		Explain the difference between Likelihood and Log likelihood function	3
9		Explain the basic concept of QAM.	3
10		Draw the signal constellation diagram for BPSK	3

PART B

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

Module -1

11	a)	Derive an expression for amplitude modulated carrier and plot its waveform and spectrum.		8
	b)	A carrier signal, $20\cos 2\pi 10^6 t$ is modulated by message signal having three frequency 5kHz, 10kHz and 20kHz. The corresponding modulation index are 0.4,0.5,0.6. Sketch the spectrum and determine bandwidth, power and efficiency.		6
12	a)	Explain the block diagram for FM super heterodyne receiver.		8
	b)	A 100MHz carrier is frequency modulated by a sinusoidal signal of amplitude 20V and frequency 100KHz. The frequency sensitivity of modulator is 25kHz per volt		6
		(i)	Determine Δf, β and bandwidth.	

(ii) Repeat above calculation when message amplitude is doubled

Module -2

13 a) Explain the properties of autocorrelation function of a stationary random process 4

b) Stationary random process X(t) has the following ACF $R_x(\tau)=\sigma^2 e^{-\mu|\tau|}$ where σ and μ are constants. It is passed through a filter whose impulse response is $h(\tau)= ae^{-\alpha\tau} u(\tau)$, where α is a constant and $u(\tau)$ is a step function. Determine the PSD of output random process 10

14 a) Show that for a finite variance σ^2, the Gaussian random variable has the largest differential entropy attainable by any random variable. 8

b) For the following probability density function 4

$f_X(x) = kx \quad 0 \le x \le 2$

$= k(4-x) \quad 2 \le x \le 4$

$= 0 \quad$ otherwise

(i) Determine the value of k for which $f_X(x)$ is valid pdf

(ii) Determine the mean and variance of X

c) Determine the entropy of a source emitting four equally likely symbols. 2

Module -3

15 a) Explain the block diagram for pulse code modulation 8

b) A television signal having a bandwidth of 4.2 MHz is transmitted by a binary PCM system having a number of quantization levels as 512. 6

Determine (i) Codeword length (ii) Transmission bandwidth (iii) Final bit rate

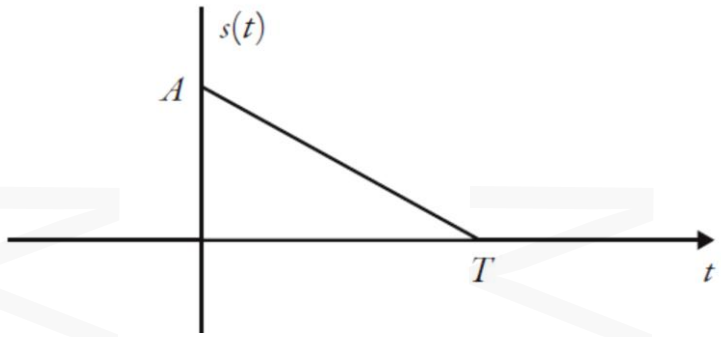
16 a) Explain the format of output code in an 8 bit (15 level) μ–Law compander with μ=255. 5

The input sample in a practical 8-bit (15 level) μ–Law compander is +242. Find the sign, segment value and quantized level.

b) Explain delta modulation with relevant equations and diagrams, also explain its limitations. 9

Module -4

17 a) For a finite energy signal $s(t)$ 4

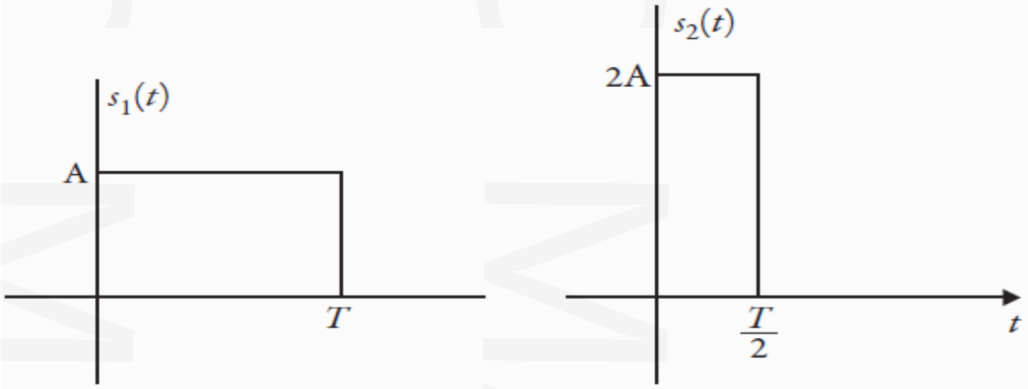


(a) Sketch the impulse response $h_{opt}(t)$ of optimum filter matched to signal $s(t)$.
(b) Also, determine the value of the output signal at $t = T$ assuming noise is zero and input is $s(t)$.

b) Derive the impulse response of duobinary encoder. 8

c) Discuss the importance of raised cosine spectrum. 2

18 Two functions $s_1(t)$ and $s_2(t)$ are given in Fig. 14



(i) Using the Gram–Schmidt orthogonalization procedure, express these functions in terms of orthonormal functions.
(ii) Sketch the basis functions $\phi_1(t)$ and $\phi_2(t)$.

Module -5

19 a) Derive the bit error rate for QPSK. 10

b) Explain the block diagram for QPSK generation. 4

20 a) Draw the block diagram of a BPSK generation and detection system. Explain the system with relevant equations. 10

b) Draw the signal constellation diagram of QAM and explain it briefly. 4

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