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Mid Term Examinations - October 2026

Date: 09/10/2026 **Time:** 11:45 AM - 01:15 PM

Course Code: ECE2503 **Course Name:** Digital Communication

Semester: Fifth Semester **Max. Marks:** 50 **Weightage:** 50%

CO - Levels	CO1	CO2	CO3
Marks	4	42	44

PART A: Answer Following Questions. 10 M

Q.N.	Questions	M	CO	BT
1	A band-pass signal occupies the frequency range 40–50 kHz. Determine a possible range of sampling frequencies for which the signal can be sampled using band-pass sampling without spectral overlap.	2	CO1	BT2
2	Define the Hilbert Transform of a signal. What is the phase shift introduced by the Hilbert Transform for positive- and negative-frequency components?	2	CO1	BT2
3	In a PCM system, a message signal has a bandwidth of 4 kHz and is quantized using 8 bits/sample. Determine the minimum sampling rate and PCM bit rate.	2	CO2	BT3
4	A delta modulator has a step size of 0.1 V and sampling frequency of 20 kHz. Determine the maximum amplitude of a 2-kHz sinusoidal input that can be tracked without slope-overload distortion.	2	CO3	BT4
5	Three independent signals having bandwidths of 2 kHz, 3 kHz and 4 kHz are multiplexed using TDM. Each signal is sampled at its Nyquist rate. Determine the TDM frame rate	2	CO3	BT4

PART B : Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
6	A continuous-time signal is given by $x(t)=4\cos(2\pi\ 3000t) + 3\sin(2\pi\ 7000t)$ It is sampled using an impulse-train sampler at fs=10 kHz. (i) Sketch the spectrum of the sampled signal from -20 kHz to +20 kHz. (ii) Identify all frequency components appearing in the sampled spectrum. (iii) Determine the frequencies that will appear in the reconstructed signal when an ideal LPF with cutoff frequency 4 kHz is used. (iv) State whether aliasing occurs and identify the aliased components.	10	CO2	BT3
7	**The signal $x(t) = 4\cos(200\pi t) \times 3\sin(600\pi t)$ is sampled at fs=400 Hz.** **(i) Determine its highest frequency.** **(ii) Determine the Nyquist rate.** **(iii) Determine the frequencies appearing after sampling in the baseband $0 \le f \le 200$ Hz.** **(iv) State whether the sampling rate is sufficient for perfect reconstruction.**	10	CO2	BT3

PART C: Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
8	A practical sampling system uses rectangular sampling pulses of width T, period Ts and amplitude A. (i) Derive the spectrum of a naturally sampled signal (ii) Explain the effect of reducing the duty cycle T/Ts on the spectral replicas. (iii) Compare ideal impulse sampling with natural sampling	10	CO2	BT3
9	**A band-pass signal has a spectrum centered at fc=10 kHz with bandwidth W=1 kHz.** **(i) Explain the principle of quadrature sampling** **(ii) Derive the in-phase (I) and quadrature (Q) components** **(iii) Explain how the original band-pass signal can be reconstructed using the I/Q components.**	10	CO2	BT3

PART D: Answer Any 1 Following Questions. 10 M				
Q.N.	**Questions**	**M**	**CO**	**BT**
10	An analog message is band-limited to 3 kHz and has a peak-to-peak amplitude of 5 V. It is converted into PCM using a uniform quantizer. The maximum permissible quantization error is ±0.1% of the peak-to-peak amplitude. (i) Determine the minimum sampling frequency. (ii) Determine the required number of quantization levels. (iii) Determine the number of bits/sample. (iv) Calculate the PCM bit rate.	10	CO3	BT4
11	**Three independent analog signals have bandwidths W1=1 kHz, W2=2 kHz, W3=3 kHz. They are time division multiplexed.** **(i) Determine the minimum sampling frequency for each signal.** **(ii) Determine the total sampling rate of the TDM system.** **(iii) Determine the minimum transmission bandwidth** **(iv) Give the commutator arrangement**	10	CO3	BT4

PART E: Answer Any 1 Following Questions. 10 M				
Q.N.	**Questions**	**M**	**CO**	**BT**
12	Explain how DPCM predicts future values and derive the expressions for prediction error and reconstructed signal.	10	CO3	BT4
13	**Explain the principle of bit-rate reduction in DPCM. Using one cycle of a level-shifted sine wave as the analog input, demonstrate how prediction reduces the dynamic range of the signal to be quantized and hence the number of bits required.**	10	CO3	BT4