Name: Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2022

Course: Digital Signal Processing — **Semester** : 5th
Program: B.Tech. Electronics and Communication — **Time** : 03 hrs.
Course Code: ECEG 3046 — **Max. Marks: 100**

Instructions:

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	State all properties of DFT.	**4M**	**CO3**
Q 2	What are the advantages of DSP processors in relation to general purpose processors?	**4M**	**CO1**
Q 3	What conditions are to be satisfied by the impulse response of an FIR system in order to have a linear phase?	**4M**	**CO4**
Q 4	Sketch the block diagram representation of the discrete-time system described by the input-output relation. $$Y(n) = ¼\, y(n-1) + ½\, x(n) + 1/2\, x(n-1)$$ where x(n) is the input and y(n) is the output of the system.	**4M**	**CO1**
Q 5	A digital communication link carries binary-coded words representing samples of an input signal $$x_a(t) = 3cos600\pi t - 2cos1800\pi t$$ The link is operated at 10,000 bits/s and each input sample is quantized into 1034 different voltage Ievels. (a) What is the sampling frequency and the folding frequency? (b) What is the Nvquist rate for the signal x_a(t)? (c) What are the frequencies in the resulting discrete-time signal x(n)? (d) What is the resolution?	**4M**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Distinguish between linear and circular convolutions of two sequences. Check whether the following system is i) Linear, and ii) Time invariant. $$y\,(n+2) + 2y\,(n) = x\,(n+1) + 2$$	**10M**	**CO1**

Q 7	Let X(k) is N DFT of x(n). Given two N/2 length sequences. $g(n) = a_1 x(2n) + a_2 x(2n+1) \quad 0 \le n \le N/2-1$ $h(n) = a_3 x(2n) + a_4 x(2n+1) \quad 0 \le n \le N/2-1$ Where $a_1 a_2 \neq a_3 a_4$. If G(k), H(k) is the N/2 DFT of g(n) and h(n) Find X(k) in terms of G(k) and H(k).	**10M**	**CO3**
Q 8	Develop a 2-multiplier canonic realization for $H_1(z) = \frac{(1+\alpha_1+\alpha_2)(1+z^{-1})^2}{(1+\alpha_1 z^{-1} + \alpha_2 z^{-1})}$ Or Derive the radix-2 decimation-in -time FFT algorithm. Sketch the stages in the computation of an N = 8-point DFT	**10M**	**CO2, CO3**
Q 9	Consider an FIR filter with system function $H(z) = 1 + 2.88z^{-1} + 3.4048z^{-1} + 1.74z^{-1} + 0.4z^{-1}$. Sketch the direct form and lattice realizations of the filter and determine in detail the corresponding input-output equations. Is the system minimum phase?	**10M**	**CO2**
SECTION-C (2Qx20M=40 Marks)			
Q 10	i. Design an FIR Low Pass filter with $\omega_c = 1.4\pi$ /s and N = 7 using Hamming window. Explain Gibb's phenomenon. ii. Given a second-order transfer function $H(z) = \frac{0.5(1-z^{-2})}{1+1.3z^{-1}+0.36z^{-2}}$ Perform the filter realizations and write the difference equations using the following realizations: 1. Direct form I and direct form II. 2. Cascade form via the first-order sections. 3. Parallel form via the first-order sections.	**(10+10) M**	**CO4**
Q 11	i. Sketch the block diagram for the direct-form realization and the frequency-sampling realization of the M = 32, a = 0, linear-phase (symmetric) FIR filter which has frequency samples $H(2\pi * k/32) = 1 \quad k = 0,1,2$ $= ½ \quad k = 3$ $= 0 \quad k = 4, 5, \ldots\ldots 15$	**(10+10) M**	**C02, CO4**

	Compare the computational complexity of these two structures. ii. Compare Chebyshev and Butterworth IIR filters. Define Gibbs phenomenon. OR i. Obtain the 8-point DFT of a given sequence {8,8,8,0,1,4,2,3}. DFT of a sequence x(n) is given as X(K) = {64, 32, 80, 32}. Obtain the inverse DFT x(n). ii. Obtain the linear and circular convolution of the sequences a. {2, 1, 2, 1} and {1, 2, 3, 4}. b. {4, -1, 2, 3} and {2, 1, -3, 3}.		