**Name:**

**Enrolment No:**

**UPES**

**End Semester Examination, May 2025**

**Programme Name: B.tech (All CSE-H)** **Semester: VI**

**Course Name : Digital Signal Processing** **Time : 03 hrs**

**Course Code : CSEG3042P** **Max. Marks: 100**

**Nos. of page(s) : 2**

**Calculator allowed: Yes**

Instructions: Please attempt according to the time provided and given weightage.

**SECTION A**
**(5Qx4M=20Marks)**

| S. No. | | Marks | CO |
|---|---|---|---|
| Q 1 | Define Signal. Why should we study signals? | **4** | **CO1** |
| Q 2 | Differentiate between analog, discrete and digital signal by giving an example of each. | **4** | **CO1** |
| Q 3 | Explain the types of signals and differentiate them. | **4** | **CO2** |
| Q 4 | Find order of Butterworth filter 'N', given the following filter characteristics:<br><br>$\propto_p$ = 1 dB, $\propto_s$ = 30 dB, $\Omega_p$ = 200 rad/s and $\Omega_s$ = 600 rad/s. | **4** | **CO2** |
| Q 5 | What is windowing technique? Write the name and mathematical representation of different window functions. | **4** | **CO3** |

**SECTION B**
**(4Qx10M= 40 Marks)**

| | | | |
|---|---|---|---|
| Q 6 | Consider the finite sequence of length 7 defined for -3 ≤ n ≥ 3:<br><br>x(n) = {0, 1+j4, -2+j3, 4-j2, -5-j6, -2j, 3}<br>↑<br>(a) Create its conjugate symmetric part<br>(b) Create its conjugate Anti-Symmetric part<br><br>**OR**<br><br>Given x(n) = {0, 1, 4, 5, 2, 3, 6, 7}<br>Find DFT, using DIT-FFT. | **10** | **CO2** |

| | | | |
|---|---|---|---|
| Q 7 | Design an analog Butterworth filter that has a 2 dB passband attenuation at a frequency of 20 rad/s and at least 10 dB stopband attenuation at 30 rad/s. | **10** | **CO2** |
| Q 8 | Determine the direct Forms I and II realizations for a third-order IIR transfer function.<br>$$H(z) = \frac{0.28\,z^2+0.319\,z+0.04}{0.5\,z^3+0.3\,z^2+0.17\,z-0.2}$$ | **10** | **CO3** |
| Q 9 | Design a second order discrete time Butterworth filter, with cut -off frequency of 1 KHz and sampling frequency of 10000 samples/sec by bilinear transformation. | **10** | **CO4** |
| | **SECTION-C**<br>**(2Qx20M=40 Marks)** | | |
| Q 10 | Design an FIR filter for the given characteristics:<br>$H(e^{jw}) = 1$ ; $2 \leq \lvert w \rvert \leq \pi$<br>$= 0$ ; otherwise<br>Use hamming window, for M =7.<br>Further, write the sequence of h'(n) for hamming window. | **20** | **CO5** |
| Q 11 | Using bilinear transformation, design a Butterworth filter which satisfies the following condition:<br>$0.8 \leq \lvert H(w) \rvert \leq 1$ ; $0 \leq w \leq 0.2\,\pi$<br>$\lvert H(w) \rvert \leq 0.2$ ; $0.6\pi \leq w \leq \pi$<br>**OR**<br>Design a digital filter by Impulse invariance method, when analog filter transfer function H(S) is given as:<br>$$H(s) = \frac{4}{(s+0.1)^2+16}$$ | **20** | **CO3, CO4** |