[This question paper contains 2 printed pages.]

S. No.	:	**8120**
Name of the Course	:	B.Sc. Hons. (Physics)_NEP: UGCF-2022
Name of the Paper	:	Digital Signal Processing
Semester	:	VIII- Semester (DSE Paper)
Unique Paper Code	:	2223010040
Duration	:	2 hours
Maximum Marks	:	60 Marks

Write your Roll No. on the top immediately on receipt of this question paper.
*Attempt **FOUR** questions in all. Question number **one** is compulsory.*

1. Attempt any **five** parts. All questions carry equal marks (3x5=15)

   (a) Determine the fundamental period of the discrete signal
   $$x(n) = \cos(\pi/3)\,n + \cos(3\pi/4)\,n$$

   (b) If $x(n) = \{1, 2, \underset{\uparrow}{-3}, 2, -1\}$, plot $x(n)$ and $x(n/3)$.

   (c) Give the cascade realization for the FIR filter described by the system function
   $$H(z) = \left(1 + \tfrac{1}{2}z^{-1} + z^{-2}\right)\left(2 + \tfrac{1}{3}z^{-1} + 0.4\,z^{-2}\right)$$

   (d) DFT of real signal is $X(k) = \{1, \mathbf{A}, -1, \mathbf{B}, 0, -j2, \mathbf{C}, -1+j\}$. Find A,B,C.

   (e) Give three advantages of Digital Filters.

   (f) Using discrete-time plots, show $\delta(n) = u(n) - u(n-1)$.

2. (a) Determine energy and power for the signal $x(n) = (\frac{1}{3})^n\,u(n)$. Find whether the signal is classified as power signal or energy signal. (5)

   (b) Determine the transfer function $H(e^{j\omega})$, the magnitude $|H(e^{j\omega})|$ and the phase $\angle H(e^{j\omega})$ for the linear time-invariant system given by
   $$y(n) = \frac{1}{2}\left[x(n) + y(n-2)\right] \quad (5)$$

   (c) Using appropriate property of DTFT determine the Discrete-Time Fourier transform of the following signal
   $$x(n) = n\left(\frac{1}{2}\right)^n u(n) \quad (5)$$

3. (a) Find the z-transform and ROC of the given sequence

$$x(n) = \cos n\theta \, u(n)$$ (7)

(b) Find the pole zero plot of the system

$$y(n) - \frac{3}{4} y(n-1) + \frac{1}{8} y(n-2) = x(n) - x(n-1)$$ (8)

4. (a) Find the Inverse z-transform of the causal sequence given by

$$X(z) = \frac{1+\frac{1}{2} z^{-1}}{1+3 z^{-1}+2 z^{-2}}$$ (5)

(b) Find IDFT of X(k)= { 4, -j2, 0, j2 } using linear transformation. (5)

(c) State Parseval's theorem for DFT and prove the theorem for the sequence x(n) ={2, 4, 2, 4} (5)

5. (a) Compute the linear convolution of the sequences $x(n) = \{1, 0, 2\}$ and $h(n) = \{1, 1\}$ using (i) circular convolution (matrix method), and (ii) the tabular method. (8)

(b) Determine the impulse response h(n) for an ideal low pass filter with a linear phase response given by

$$H(e^{j\omega}) = \begin{cases} e^{-j\omega\alpha} & 0 \le |\omega| \le \omega_c \\ 0 & \omega_c \le |\omega| \le \pi \end{cases}$$ (7)