**Answer all the following questions**

**Q1. (15 marks)** One period of A discrete signal $x_1(n)$ and the two sided spectral representation of another discrete signal $x_2(n)$ are given in Fig.1 and Fig.2 respectively.

*Fig.1*

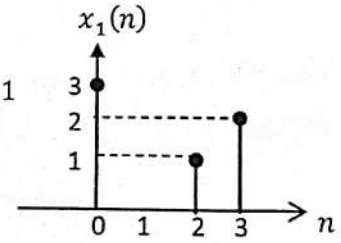
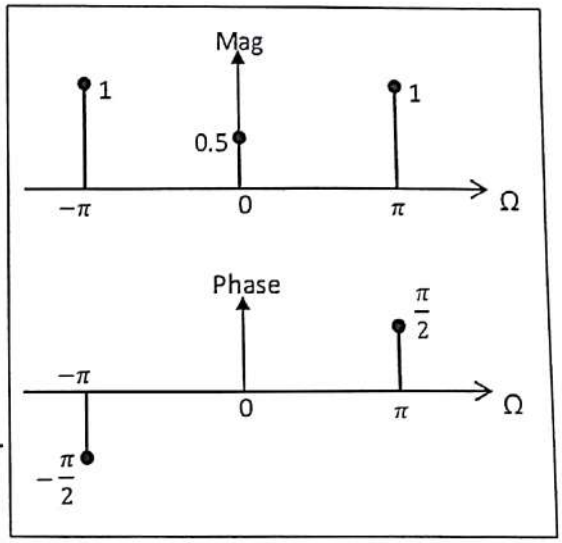



*Fig.2*




(i) Calculate the power of $x_1(n)$
(ii) Find one period of $x_2(n)$.
(iii) Prove the convolution property $x_1(n) * x_2(n) = X_1(z)X_2(z)$.

*Hint: the z − transform of $\delta(n) = 1$*

**Q2. (15 marks)** One period of a discrete signal $x(n)$ is given in the form of:

$$x(n) = u(n) - u(n-2) + 3\delta(n-3)$$

(i) Sketch the discrete signal $x(n)$.
(ii) Represent $x(n)$ as sum of shifted weighted impulse functions.
(iii) Use the DFT general formula or the 4-point radix-2 FFT to compute X(k).



**Q3. (15 marks)** A system function of a discrete system is given:

$$H(z) = \frac{Z^2 + 0.8}{Z - 0.8}$$

(i) Determine the pole-zero diagram.
(ii) Sketch the magnitude of the frequency response $|H(\Omega)|$.

**Q4. (15 marks)** An LTI discrete system (Digital Filter) is described by the difference equation:

$$y(n) = 0.25x(n) + 0.25x(n-1) + 0.25x(n-2) + 0.25x(n-3)$$

(i) Find the system function $H(z)$.
(ii) Draw the implementation structure (Block Diagram) of the Digital filter.