Time Series Analysis - Test 2

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Instructions:
All questions carry **three marks**. Question 1 is compulsory.
Answer **any one** question from Questions 2 and 3.
Time limit is 50 minutes.

Recall that the *impulse response* is the output $\{x_t\}$ when the input $u_0 = 1$ and $u_t = 0$ for $t \neq 0$.

1. Use differentiation of the geometric series to derive a power–series representation for $\dfrac{1}{(1-x)^2}$ valid for $|x| < 1$.

2. Consider the difference equation

$$x_t - 2x_{t-1} + x_{t-2} = u_t + u_{t-1}.$$

   Using lag–operator inversion, compute the impulse response x_t and calculate x_{50}.

3. For the difference equation

$$x_t - x_{t-1} - x_{t-2} + x_{t-3} = u_t,$$

   determine the impulse response using lag–operator inversion and partial fraction decomposition, and hence find the value of x_{50}. [Hint: To factor the polynomial, try simple values like ± 1 as roots.]