ATTEMPT ALL THE QUESTIONS:

1. A radioactive isotope remains unused in a lab for 10 years, after which it is found to contain only 80% of the original mass. Find
   i) The half-life of the isotope
   ii) How many additional years it will take until only 15% of the original amount is left?

2. Find the complete (general) solution of
   i) \( \frac{dy}{dx} + 9y = 5e^{3x} \)
   ii) \( (D^2 - 3D + 2)y = 2x^2 + 3e^{2x} \)

3. Solve the Bernoulli’s equation \( x\frac{dy}{dx} + y = y^3 \ln x \)

4. Finding the particular solution of the differential equation \( x^2 \frac{d^2y}{dx^2} - 4x \frac{dy}{dx} + 4y = 4x^2 - 16x^3 \) given \( y(2) = 4, y'(2) = -1 \)

5. Using the transformation
   i) \( 3x + 2 = e^z \) solve the non-homogeneous equation
      \( (3x + 2)^2 \frac{d^2y}{dx^2} + 3(3x + 2) \frac{dy}{dx} - 36y = 3x^2 + 4x + 1 \)
   ii) \( z = 2x + 3y \) solve the differential equation by separation of variable methods
      \( \frac{dy}{dx} = \frac{4x + 6y + 5}{2x + 3y + 4} \)

6. find power series solution by Taylor’s series expansion method
   \((x-1) \frac{d^2y}{dx^2} - (3x-2) \frac{dy}{dx} + 2xy = 0 \)