Show all work for full credit, use correct notation, and clearly mark your answer.

1. Using ILT actuarial assumptions and the claims acceleration approach, determine the expectation of the present value random variable for an insurance on independent lives (30) and (40), with death benefit payable at moment of death as follows:

   if (30) dies first, 30 is paid when (30) dies and 40 is paid when (40) dies
   if (40) dies first, 20 is paid when (30) dies and 50 is paid when (40) dies

   \[ EPV = 30 \, A_{30:40} + 40 \, A_{30:40}^2 + 20 \, A_{30:40} + 50 \, A_{30:40}^1 \]
   \[ = 20 \, A_{30} + 10 \, A_{30:40} + 40 \, A_{40} + 10 \, A_{30:40}^1 \]
   \[ = 20 \, A_{30} + 40 \, A_{40} + 10 \, A_{30:40} + \frac{CAA}{e^{0.06}} \cdot \sqrt{1.06} \left( 20 \, A_{30} + 40 \, A_{40} + 10 \, A_{30:40} \right) \]

   \[ ILT \Rightarrow A_{30} = 1.10748 \]
   \[ A_{40} = 1.16132 \]
   \[ A_{30:40} = 1.19584 \]

   \[ \therefore EPV = 10.77 \]

2. Determine the actuarial present value of a 10-year deferred whole life insurance issued to (30) with a benefit of 5000 payable at the moment of death, using ILT actuarial assumptions and the UDD assumption between integer ages.

   \[ APV = 5000 \cdot 10 \, A_{30} = 5000 \cdot 10 \cdot E_{30} \cdot A_{40} \]

   \[ UDD = 5000 \cdot 10 \cdot E_{30} \cdot \frac{1}{s} \cdot A_{40} \]

   \[ ILT = 5000 \cdot (0.54733) \cdot (1.02971) \cdot (1.16132) \]

   \[ \therefore EPV = 454.59 \]
3. Using ILT actuarial assumptions, determine the expected present value of a 20-year deferred whole life annuity immediate issued to (35) with annual payments of 1000.

\[
EPV = 1000 \cdot 20 \cdot t_{35} \cdot a_{35} = 1000 \cdot 20 \cdot E_{35} \cdot a_{35} = 1000 \cdot 20 \cdot E_{35} \left( a_{35} - 1 \right)
\]

\[
\implies 1000 \cdot (0.286)(12.3758 - 1)
\]

\[
\therefore EPV = 3224.88
\]

4. Using ILT actuarial assumptions, determine the actuarial present value of a 30-year temporary life annuity due issued to (30) with annual payments of 5000.

\[
APV = 5000 \cdot a_{30:301} = 5000 \left( \ddot{a}_{30} - 30 \cdot e_{30} \cdot \ddot{a}_{60} \right)
\]

\[
\therefore 10 \cdot E_{30} = 200 \cdot E_{30} \cdot 10 \cdot E_{50} \quad \text{or} \quad 10 \cdot E_{30} \cdot 20 \cdot E_{40} \quad \text{or} \quad 10 \cdot E_{30} \cdot 20 \cdot E_{40} \quad \text{or} \quad \frac{30}{30} \cdot \frac{60}{60}
\]

\[
\implies 0.1500
\]

\[
\therefore APV = 5000 \cdot (16.8561 - 0.15(11.1454)) \approx 70920
\]

5. Using ILT actuarial assumptions, determine the expected present value of a 12-year certain-and-life annuity due issued to (40) with annual payments of 2000.

\[
EPV = 2000 \cdot a_{40:421} = 2000 \left( \ddot{a}_{12} + 12 \cdot E_{40} \cdot \ddot{a}_{52} \right)
\]

\[
12 \cdot E_{40} = 2^{12} \cdot \frac{k_{52}}{k_{40}} \implies 0.47176
\]

\[
\therefore EPV = 2000 \left( 8.8869 + 0.47176(12.8879) \right) = 29935
\]