7 Hoare Logic (MOM)

(a) Briefly explain the concepts: mechanised program verification and verification conditions (VCs). [4 marks]

(b) Consider three consecutive assignments:

\[
\{ P \} V_1 := E_1; \quad V_2 := E_2; \quad V_3 := E_3 \quad \{ Q \}
\]

Write down the VCs that are generated for such a program. Give a detailed proof which shows that, if the VCs are true, then the specification above is provable in Hoare Logic. [6 marks]

(c) Write down the VCs for the following annotated program. For this part, do not attempt to define Inv. [4 marks]

\[
\{ T \}
I := 0;
X := 0;
Y := 1;
\text{WHILE} (I \neq N) \text{ DO} \{ \text{Inv} \}
I := I + 1;
X := X + Y;
Y := X + Y
\text{OD}
\{ X = \text{fib}(2 \times N) \}
\]

Here \( \text{fib}(0) = 0, \text{fib}(1) = 1 \) and \( \text{fib}(n + 2) = \text{fib}(n) + \text{fib}(n + 1) \) for \( n \in \mathbb{N} \).

(d) Provide a definition of \( \text{Inv} \) such that the VCs are provable. Sketch a proof of the VCs. [6 marks]