Software Engineering II

Consider this program over integer variables:

```plaintext
k := K;
x := X;
z := 1;
while k <> 0 do
    begin
        k := k-1;
        z := z*x
    end
```

Given that the loop invariant is \( z \times x^k = X^K \), show that executing this program stores the value of \( X^K \) in the variable \( z \). [5 marks]

It is proposed to insert the following code just before the assignment \( k := k-1 \):

```plaintext
while even(k) do
    begin
        k := k/2;
        x := x*x
    end
```

State the loop invariant of this inner loop and show that the modified program still stores the value of \( X^K \) in \( z \). [7 marks]

Briefly describe formal specification languages, top-down design and fault avoidance techniques, indicating their respective roles in a software development project. [8 marks]