2000 Paper 11 Question 12

Software Engineering II

Consider this program over integer variables:

```
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`:

```
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]