Instructions:

1) **Place all answers in the booklet provided.**
2) **Attempt all questions.**
3) **No aids (specifically no electronic devices) are permitted.**
4) **Answer any 4 of questions 1-5.**
5) **The test totals 20 marks. You have 50 minutes.**

Answer 4 of the following questions.

[5] 1. In the following program, assuming static scope, what values are printed (1 mark)? What values are printed using dynamic scope (1 mark)? When is each of: name-declaration, declaration-reference and reference-value bindings of local variables performed in Java (3 marks)?

```
program Main;
  var x : Integer;
  procedure p1;
    var x : Integer;
    procedure p2;
    begin
      print(x);
    end;
  begin
    x := 1;
    p3;
    p2;
  end;
  procedure p3;
  begin
    x := x+1;
    print(x);
  end;
begin
  x := 2;
  p1;
  p3;
end.
```

[5] 2. Differentiate between strongly-typed, firmly-typed and weakly-typed languages (3 marks). What are the advantages of static typing over dynamic typing (2 marks)?

[5] 3. Explain the concept of encapsulation/information hiding (2 marks). Why is it important in constructing large systems (1 mark)? Describe how packages in Ada support this idea (2 marks).

(over)

[5] 4. It is often undesirable to be required to recompile and entire program when only a small change has been made. Differentiate between independent compilation as in FORTRAN and separate compilation as in Ada and Java (2 marks). Ada separates a package into separate specification and body parts, how does this reduce recompilation (2 marks)? A Java class contains both specification and implementation, how does Java achieve the same level of recompilation as Ada (1 mark)?

[5] 5. Determine the value of the variable x after executing the following program if the parameter are passed using each of call-by-value, call-by-value-result (not the Algol-W version), call-by-reference (3 marks). Java uses call-by-value exclusively, how is it that object parameters may be updated in a method (2 marks)?

```
program Main;
  var x : Integer;
  procedure p(a : Integer);
  begin
    a := a + 2;
    x := a + 1;
    a := a + 2;
  end;
begin
  x := 1;
  p(x);
end.
```