

THE OPEN UNIVERSITY OF SRI LANKA
 B.Sc/B.Ed Degree Programme/Continuing Education Programme
 APPLIED MATHEMATICS - LEVEL 04
 PSU2180/ PSE4180 / ^{PEU2140} Computing for Scientific Studies using FORTRAN
 FINAL EXAMINATION 2010/2011



DURATION: TWO HOURS.

DATE: 28.06.2011

TIME: 1.30pm - 3.30pm

Answer ALL Questions in Section A and only TWO questions in Section B.
 Marks allocation: 40 marks for Section A and 60 marks for Section B.

Non programmable calculators are permitted.

- State whether each of the following is acceptable as an integer variable, a real variable or neither. If you decide as the last category, give reasons.
 a) INCOME b) PREMIUM c) POLICY d) N-DAYS e) YEAR1S
- The only type declaration statement a program has is
 IMPLICIT CHARACTER*4 (A-E), CHARACTER*5 (L)
 In the above program, state whether or not each of the following is acceptable as a character variable, If you decide as not acceptable, give reasons.
 a) AGE b) NAME c) LEAVE1 d) IDNO e) ABCDE
- Write down FORTRAN expressions for each of the following mathematical expressions given in the usual notation.
 a) $(a+b)^2 - 2c$ b) $(x^2 + y^2)^3 - \frac{x}{3}$ c) $\sqrt{|(x-2)|}$ d) $x^a \sin(ax+b)$ e) $\frac{1}{2x} \log_e(y) + 4y$
- Write down equivalent mathematical expressions for the following FORTRAN expressions.
 a) EXP(2*FLOAT(X)) b) 2.0*X*X+X/Y c) (2.0+X/Y)**(a+1.0)
 d) ATAN(X)+1/X/2.0 e) (X+Y)**3+2*X+3.0
- A program has the following statements. State whether each of the following is acceptable to fill in the blank-labelled as bb. If not, give reasons.
 REAL MARK
 MARK = bb
 a) 10 b) 23.5 c) 1.0E-02 d) 2E3.0 e) 103

6. A program has the following statements. State whether each of the statements labelled as (a), (b),(c),(d),(e) is correct or not. If the statement is not correct, state how you would correct it.

```
INTEGER LENGTH, WIDTH
REAL ANGLE, PERIM
```

- (a) ANGLE=LENGTH/WIDTH
- (b) PERIM .EQ. (LENGTH+WIDTH)
- (c) IF (LENGTH .LT. WIDTH) GOTO STATEMENT 10
- (d) PRINT*, 'PERIM IS', PERIM
- (e) PRINT *,(LENGTH+WIDTH)

```
10 STOP
END
```

7. A program has the following statements. Write down the values assigned for the variables labelled X1,X2,X3,X4 and X5. If no value is assigned due to an error in the statement, clearly state what the error is.

```
INTEGER I,J,K,SUM
REAL A,TEMP
REAL X1,X2,X3,X4,X5
```

```
A=6.8
TEMP = 20.0
I=3
J=I+1
K=J+1
```

```
X1=I+J
X2=J/A
X3=NINT(A)
X4=INT(A)/A+TEMP
X5=A**I
```

```
STOP
END
```

8. Assuming that A, B and C are logical variables determine the values of the following logical expressions for all possible values of A, B and C.
- a) A .OR. (B .AND. C)
 - b) A .AND. ((.NOT. B) ,OR, C)
 - c) (A .AND. B). AND. (.NOT. C)
 - d) (A .AND. B) .OR. C
 - e) .NOT. (A .OR. B .OR. C)

9. Let A, B, C be real variables and I be an integer variable. Write FORTRAN statements to execute the following instructions.
- If the value of A is greater than or equal to the value of B, print the error message that " the input values are wrong".
 - To assign the maximum of the values of A and B to the variable C.
 - To multiply A by B and add the value of I to the product and assign the answer to C.
 - To assign the absolute value of the difference between A and B to the variable C.
10. An input line contains the following data, starting from column 1.
241300123
Write statements to read this line of data and make the assignments given in each of the following statements.
- input the value 24.13 to the variable A and the value 123 to the variable I.
 - input the value 24.13001 to the variable A and the value 3 to the variable I.
 - input the value 241.3 to the variable A and the value 12 to the variable I.

Section B

Answer any TWO questions from this section

1. Suppose 45 students followed the course PSU2180 last year. Suppose the faculty wishes to give a cash prize of Rs 5000/- for the best student provided he or she has scored a mark greater than or equal to 70. If two or more students have scored identical marks greater than or equal to 70 and have scored the highest, the prize is to be equally shared among them. Suppose the marks of the 45 students are recorded in a file with 45 lines each with 6 columns; the first three columns have the identification number (a number from 101 to 145) and the next three columns have the mark.

For example the data line 142023 indicates that the student with identification number 142 has the mark 23.

Write a FORTRAN program to read the data, assign the identification number to the integer variable I, the mark to the integer variable MARK and print the identification numbers of students who will receive the prize and the amount of the cash prize to be given. If no students satisfy the award criteria, the program should print the message "no prize will be awarded".

2. The iterative scheme $x_{k+1} = x_k - \frac{x_k^5 - 3}{5x_k^4}$ based on the Newton Raphson method can be used to solve the equation $x^5 - 3 = 0$. Here x_k is the value of x at the k^{th} iteration and x_{k+1} is the approximate value computed at the $(k+1)^{\text{th}}$ iteration. Suppose the value x_0 is to be given as the initial value.

For instance, if the initial value is 1.4, at the first iteration, the approximate value will be $x_1 = 1.4 - \frac{1.4^5 - 3}{5 \times 1.4^4} = 1.276185$. Then, we substitute this value to obtain x_2 and so on.

The program is to be stopped when the values of two successive iterations differ by a value less than 0.001 (i.e. when $|x_{k+1} - x_k| < 0.001$) or when the number of iterations exceeds 20 without satisfying this condition. In the former case, the value of the approximation at the last iteration is to be printed and in the latter case, the error message "solution can not be found" is to be printed.

Write a FORTRAN program to carry out the above instructions using the initial value 1.4.

3. Write a FORTRAN program and a subroutine that carry out the following instructions.

The main program should print the 15 values of $|x^2 - 7x + 3|$ when x varies from 1 to 15 in steps of 1. Here x is an integer variable. The subroutine should compute the value of $|x^2 - 7x + 3|$ when the input value of x is given from the main program

4. Write a FORTRAN program to compute the following four partial sums and print each one of them together with the identification number. The program should be written in general terms so that by a simple change in the input values we should be able to use the program to compute the partial sum for any identification number n . If the value of any of the sums is greater than 1.2, the program should also print that the sum is greater than 1.2.

Identification number	partial sum
1	$1 + \frac{1}{4} - \frac{1}{4^3} + \frac{1}{4^5}$
2	$1 + \frac{1}{4} - \frac{1}{4^3} + \frac{1}{4^5} - \frac{1}{4^7}$
3	$1 + \frac{1}{4} - \frac{1}{4^3} + \frac{1}{4^5} - \frac{1}{4^7} + \frac{1}{4^9}$
4	$1 + \frac{1}{4} - \frac{1}{4^3} + \frac{1}{4^5} - \frac{1}{4^7} + \frac{1}{4^9} - \frac{1}{4^{11}}$

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