Midterm Exam #2
(Close-book, 45 Minutes)

Student ID:___________________ Student Name (Print): ____________________________________

Your paper will not be graded unless you endorse the following statement:
I have neither given nor received inappropriate assistance on this quiz.

Student Signature:________________________________________________________________________

<table>
<thead>
<tr>
<th>Problem Index</th>
<th>Points</th>
<th>Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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**Multiple Choice**: There is ONLY one correct answer in each of the following 6 problems. Write your choice in the Answer box.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Statement</th>
<th>Answers</th>
<th>Correct Answer</th>
</tr>
</thead>
</table>
| 1. | Select the **operator that compares** if the two integer variables \(a\) and \(b\) are holding the same value or not | A. =  
  B. /=  
  C. ==  
  D. None of the above. | C or B |
| 2. | Select the **valid logical expression** given the following declaration statements:  
  integer::a=1  
  real::b=2  
  character::c='3' | A. \((a < b)\)  
  B. \((b < c)\)  
  C. \((a+b < c)\)  
  D. None of the above. | A |
| 3. | Select the logical expression that returns **true** logical value given the following declaration statements:  
  integer::a=1  
  real::b=-2 | A. \((a > 0 \ .AND. \ b > 0)\)  
  B. \((a < 0 \ .OR. \ b < 0)\)  
  C. \((a > abs(b))\)  
  D. None of the above. | B |
| 4. | Select the number of iterations from the following **Do-While loop construct**:  
  INTEGER::i=0  
  DO WHILE ( i <= 10 )  
  i = i + 2  
  END DO | A. 4  
  B. 6  
  C. 8  
  D. 10 | B |
| 5. | Select the Fortran 95/2003 **keyword** that can terminate a loop construct:  
  A. CASE  
  B. EXIT  
  C. STOP  
  D. RETURN | B |
6. Select the phrase that summarize the correct **control construct** of the following pseudocode:

\[
\begin{align*}
\text{DO } & i = 1, 10, 2 \\
\text{DO } & j = i, 10 \\
\text{result } = & \text{ result } + i \times 10 + j \\
\text{END DO} \\
\text{END DO}
\end{align*}
\]

A. A single loop  
B. A single branch  
C. An inner loop nested inside an outer loop  
D. An inner branch nested inside an outer branch

<p>| | | | | | |</p>
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7. **Block-IF Branch Construct**: Fill up the partial Fortran 95/2009 source code to implement an algorithm illustrated in the following flowchart:

```
character(32):: eval=''
real:: temp=104.0

if ( temp < 97.5 ) then
    eval = "below normal"
else if ( temp < 9 ) then
    eval = "normal"
else if ( temp < 103.5 ) then
    eval = "slightly high"
else
    eval = "too high"
end if
```

![Flowchart](image-url)
8. **Do-While Loop** The following Fortran 95/2003 program compiles and runs. Suppose a user entered an input number of 4.6 during runtime. Please list the runtime values for the variables involved in the Do-While loop construct in the following table:

```fortran
PROGRAM main
    IMPLICIT NONE
    INTEGER::i, sum
    REAL::x

    !get user input
    WRITE(*,*) "Enter an input value of x":
    READ(*,*) x

    !start the calculation
    i = 0
    sum = 0
    DO WHILE ( i <= x+0.5 )
        sum = sum + i
        i = i + 1
    END DO

    !display the result
    WRITE(*,*) "sum = ", sum
END PROGRAM main
```

<table>
<thead>
<tr>
<th>Iteration#</th>
<th>value of $i^-$</th>
<th>value of $sum^-$</th>
<th>value of $i^+$</th>
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**Note:**

- The superscript of '-' refers to the value at the beginning of a loop iteration;
- The superscript of '+' refers to the value at the end of a loop iteration;
- The number of rows in the table is more than the number of iterations in this setting.
9. **Nesting**: Read the following partial code written in Fortran 95/2003, and finish the flowchart below to describe the algorithm implemented in the source code. Note that you need to fill the blanks, and add missing flow connectors in between blocks.

```fortran
PROGRAM main
  IMPLICIT NONE
  INTEGER::i=0, j=0, n=0
  CHARACTER(256)::inputStr=""
  CHARACTER(256)::outputStr=""
  DO
    !get user input
    WRITE(*,*) "Input: "
    !The format descriptor '(A256)' ! force the each line of user
    ! input assigned to inputStr
    READ(*,'(A256)') inputStr
    !get the length of input string
    n = LEN(TRIM(inputStr))
    IF ( n < 1 ) THEN
      EXIT
    END IF
    !process the input
    outputStr=''
    DO i = 1, n
      j = n+1-i
      outputStr(i:i) = inputStr(j:j)
    END DO
    WRITE(*,*) "Output: "
    WRITE(*,*) trim(outputStr)
  END DO
END PROGRAM main
```

Suppose in the first iteration, the user entered the following word

esiotrot

What is the corresponding output string that matches the above input string?

tortoise
10. **Debugging logical errors**: The following program compiles and runs. However, the results are not correct for some user input values as shown in the testing runs. There is a logical bug in the source code.

**Testing runs**

```
C:\csci251\mid2>p10.exe
enter an integer(\(\geq 0\))
10
10 !!= 10x 8x 6x 4x 2= 3840
C:\csci251\mid2>p10.exe
enter an integer(\(\geq 0\))
15
15 !!= 15x 13x 11x 9x 7x 5x 3x 1= 2027025
C:\csci251\mid2>p10.exe
enter an integer(\(\geq 0\))
20
20 !!= 20x 18x 16x 14x 12x 10x 8x 6x 4x 2= -579070996
C:\csci251\mid2>p10.exe
5
```

Write your prediction of the program output for the above user input value of 5.

```
5 !!= 5x 3x 1= 15
```

Please explain why the result for the input value of 20 is a negative number even though the multipliers inside the loop are all correct.

```
Because the result of 20!! is out of the range that a 4-byte two's complements integer variable can hold.
```

How can you fix this logical error?

```
Change the data type of output from integer to real.
```

11. **Problem Solving in Fortran 95/2003**

Develop a Fortran 95/2003 program to implement the following natural logarithm approximation function:

\[
\ln(1 + x) \approx \sum_{i=1}^{20} (-1)^{i+1} \frac{x^i}{i} \quad \text{for} -1 < x \leq 1
\]

Your program takes a user input value \(x\) in real type. If the user input is not in the valid range, the program should output "Invalid input" and stop.
range, the program should give an error message and terminate. For valid inputs, the program should give the result of the function above.

**Implementation in Fortran 95/03**

Program main

```fortran
Implicit none

real :: inputVal, outputVal
!declare both input and output variables above

integer :: i
!declare other variables required above
write(*,*) "Enter a real value in the range (-1,1]"

read(*,*) inputVal
!get user input value above
!Start the user input validation from here

if ( inputVal <= -1 .or. inputVal > 1 ) then
    write(*,*) "Invalid input value"
    stop
end if
!Start the computation from here

outputVal = 0

do i = 1, 20
    outputVal = outputVal + (-1)**(i+1)*inputVal**i/i
end do

write(*,*) "The result is ", outputVal
!display result above
End Program
```