

Simulations in Physics

Week 0

1. Write a FORTRAN program to evaluate the following expressions: (ALL the quantities are real)

$$(i) \frac{a^b}{b(b-a)} ; \text{ for } a = 3.0, b = 4.0$$

$$(ii) \log_{10}(x) + \cos(a) + |x^2 + y^2| + 2\sqrt{xy} ; \text{ for } x = 1.0, y = 2.0, a = 15^\circ$$

$$(iii) \frac{1}{a\sqrt{2\pi}} e^{\sqrt{2a(x-m)^3}} ; \text{ for } x = 2.0, m = 1.0, a = 2.0$$

Compare your numerical result with the corresponding exact result for each case.

2. Write a FORTRAN program to code the following function using IF-THEN-ELSE statement:

$$\begin{aligned} f(x) &= 5x^2 + 3x + 2 & \text{for } x < 2 \\ &= 0 & \text{for } x = 2 \\ &= 5x^2 - 3x + 1 & \text{for } x > 2 \end{aligned}$$

Hence, print the value of the function at $x = -0.5, 0.1$ and 2.5 .

3. Single and double factorial of an integer N is defined as

$$\begin{aligned} N! &= N \times (N-1) \times (N-2) \dots \times 3 \times 2 \times 1 \\ N!! &= N \times (N-2) \times (N-4) \dots \times 3 \times 1 \quad (\text{for } N\text{-odd}) \end{aligned}$$

Using the concept of do-loop, calculate the factorial and double factorial of a given number. Make sure, N is an odd integer for double factorial evaluation.

4. Use the DO loop to calculate the summations of the following series for given values of x and n

$$(i) 4 - 4/3 + 4/5 - 4/7 + \dots \text{ n-th term,}$$

$$(ii) 1 + x/1! + x^2/2! + x^3/3! + \dots + x^n/n!$$

$$(iii) 1 - x^2/2! + x^4/4! + \dots + (x^2)^n/(2n)!$$

Also compare the result with (i) constant π , (ii) e^x (iii) $\cos(x)$ respectively.