UNIVERSITY OF NORTH BENGAL

B.Sc. Honours 1st Semester Examination, 2019

CC1-PHYSICS (PRACTICAL)

MATHEMATICAL PHYSICS I: LAB

Time Allotted: 3 Hours | Full Marks: 20

The figures in the margin indicate full marks.
Candidates should answer in their own words and adhere to the word limit as practicable.
All symbols are of usual significance.

Answer any *one* question on lottery basis. Program can be written in C/C++/Fortran/Python.

Distribution of Marks: LNB-2; Viva-4; Program-14; Total-20

1. (a) Calculate the sum of the following series with accuracy 0.0001 (for $x>1$).

$$S=1+\frac{1}{x}+\frac{1}{x^3}+\frac{1}{x^5}+\frac{1}{x^7}+\frac{1}{x^9}+\cdots\cdots$$

Program: 4, Output: 2

(b) Compute one root of the equation

$$x^2+x-2=0$$

using Bisection method. The program must print out a massage in case the specified interval does not bracket a root.

Program: 6, Output: 2

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2. (a) Write a program to input a decimal number. Calculate and display the binary equivalent of this number.

Program: 4, Output: 2

(b) Compute one root of the equation

$$x^2-3x+2=0$$

in the vicinity of $x=0$ using Newton-Raphson method.

Program: 6, Output: 2

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3. (a) Write a program to input a list of numbers using a loop. Print the list. Find the largest number and its position in the list.

   Program: 4, Output: 2

   (b) Write a program that implements the Bisection method to solve equation,

   $$x^3 - 2x - 2 = 0$$

   which has a root between $x = -4$ and $x = 2$.

   Program: 6, Output: 2

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4. (a) Write a program to input a binary number. Calculate and display the decimal equivalent of this number.

   Program: 4, Output: 2

   (b) Using Newton-Raphson method find the root of transcendental equation assuming suitable initial guess.

   $$x = \tan(x)$$

   Program: 6, Output: 2

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5. (a) Write a program to compute the integral $\int_{\pi/2}^{2\pi} \sin(x)\,dx$, using Trapezoidal rule.

   Program: 4, Output: 2

   (b) The following table gives the distances(D) of an object at various points in time(t). Find the velocity and acceleration of the object at $t = 5$ second and $t = 10$ second using Forward and Backward difference formula. Assume a suitable value for h.

t (sec.)	0	2	4	6	8	10	12	14	16
D (km)	0	0.25	1	2.2	4	6.5	8.5	11	13

   Program: 6, Output: 2

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6. (a) Write a program to input a list of numbers using a loop. Sort the numbers in an ascending order using decision control statement (e.g. if-else statement) and hence find the average of the numbers.

   Program: 4, Output: 2

   (b) Write a program to find the root of the equation

   $$x^2 - 4x - 10 = 0$$

   using the Secant method with initial estimate $x_1 = 4,\ x_2 = 2$.

   Program: 6, Output: 2

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7. (a) Write a program to compute the sum of square of all odd numbers from the first *n* natural numbers.

   Program: 4, Output: 2

   (b) Write a program to compute the integral $\int_a^b (x^3+1)\,dx$, using Trapezoidal rule for the intervals (i) (1, 2) and (ii) (1, 1.5)

   Program: 6, Output: 2

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8. (a) Write a program to compute the sum of square of all even numbers from the first *n* natural numbers.

   Program: 4, Output: 2

   (b) Write a program to compute the integral $\int_{-1}^{1} e^x\,dx$, using Simpson's $1/3$ rule.

   Program: 6, Output: 2

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9. (a) Calculate the sum of the following series with accuracy 0.0001 (for $x>1$).

$$S = 1+\frac{1}{x^2}+\frac{1}{x^4}+\frac{1}{x^6}+\frac{1}{x^8}+\cdots\cdots$$

   Program: 4, Output: 2

   (b) Write a program to estimate $y(2)$ by solving the following differential equation using Euler method.

$$\frac{dy}{dx} = 3x^2+1, \text{ with } y(1)=2$$

   Use $h = 0.25$.

   Program: 6, Output: 2

10.(a) Calculate the sum of the following series.

$$S = \frac{1}{2}+\frac{2}{3}+\frac{3}{4}+.....+\frac{n}{n+1}$$

   Program: 4, Output: 2

   (b) Write a program to estimate $y(0.4)$ by solving the following differential equation using Runge-Kutta method.

$$\frac{dy}{dx} = x^2+y^2, \text{ with } y(0)=0$$

   Use $h = 0.2$.

   Program: 6, Output: 2

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