Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Computational Physics **Semester: III**

Program: BSc (H) Physics **Time : 03 hrs.**

Course Code: PHYS 2014K **Max. Marks: 100**

Instructions: Use of scientific calculator is allowed

No. of pages: 3

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Draw a flowchart to find solution of quadratic equation.	**4**	**CO1**
Q 2	Write the precedence rules for arithmetic operators in FORTRAN 90 and list the steps in which following expression will be evaluated: a < b * 10.6 .OR. c == tan(x)	**4**	**CO2**
Q 3	An Armstrong number is a number such that the sum of its digits raised to the third power is equal to the number itself. Write a FORTRAN 90 program that generates Armstrong numbers in between 0 and 999.	**4**	**CO2**
Q 4	Elaborate on the following in LaTeX: 1. "In-line math" mode. 2. "Equations" mode. 3. "Equations with no label" mode.	**4**	**CO3**
Q 5	Explain meaning of the following Gnuplot commands: 1. set title "My Plot" 2. unset log y 3. set tic font ",18" 4. set samples 2500	**4**	**CO4**

SECTION B

(4Qx10M= 40 Marks)

Q 6	(a) What is the role of shells in Linux? (b) What is the difference between "binary search" and "linear search (brute force)". What is the computational complexity for determining the minimum for a list of "n" numbers using both searches.	**2+8**	**CO1**
Q 7	A Palindrome is some word or number or a phrase which when read from the opposite end, appears the same (reflection symmetry, example, 34543, symmetry around 5 in the middle). Write a FORTRAN 90 program that checks if a number is Palindrome.	**10**	**CO2**

Q 8	Prepare a LaTeX code to generate the following thermodynamical equations as has been shown below. While writing the LaTeX code you should pay attention to the following items: 1. Use tag with the first equation. 2. Split the second equation in two halves with tag only assigned to the second half. 3. Make use of the "gather" environment for the second equation. $$T_1^{\gamma} P_1^{1-\gamma} = T_2^{\gamma} P_2^{1-\gamma} = constant \quad (1)$$ $$T_1^{\gamma} P_1^{1-\gamma} = T_2^{\gamma} P_2^{1-\gamma} = constant \quad (2)$$ OR Using packages "float" and "graphicx" write a LaTeX code where you have to use a specific command of the "graphicx" package to import an image (Indian_flag.png) while scaling it by 0.50x. Make sure that the image placement is at the center and it has a label "fig:flag" and a caption "The Indian flag". Place a statement in the document "The Indian flag has three colors" making use of the label "fig:flag" assigned to the image.	**10**	**CO3**
Q 9	(a) What role does the "splot" command serve, and what is the significance of creating contour plots in Gnuplot? (b) Write Gnuplot commands for producing a surface plot for the function $(1+x)^2+y^2$ with x and y axis in the range -2 to 2. Then use a higher sampling rate to produce a more accurate plot. After this, enable contour drawing for surfaces (you can set the number of levels to 5) and replot.	**2+8**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10	(a) What does the term "count-controlled 'DO' loop" mean in FORTRAN 90, and what is the mechanism behind its operation? (b) The energy lost from a 10 cm thick slab of steel is 50 W. If the temperature differences are 10.0 K, 20.0 K, 30.0 K, 40.0 K and 50.0 K, write a FORTRAN 90 program to find the corresponding area of the slab in 5 steps using a count controlled do loop. (Thermal conductivity of steel = 45 W/m K). The formula for heat transfer rate is given as: $q = K A (T_h - T_c) / d$ Where "A" is the area of the slab, "$T_h - T_c$" is the temperature difference, and "d" is the thickness of the slab.	**5+15**	**CO2**

	OR (a) What is the definition of allocatable arrays in FORTRAN 90, and what sets them apart from conventional arrays? (b) Write a FORTRAN 90 program which generates the following data entries: $x(i) = (i-1)^2 \times 5.0$ and $y(i) = \cos(x(i)) - i^2$ where i = 1 to 100 and "x" and "y" are arrays of dimensions 100 each. Finally write this data to an output file "pressure.dat" with x(i) entries in first column and y(i) entries in the second column. In the same code you should be able to open the file "pressure.dat", created in the previous step. You should then read its contents and finally print them on the screen.		
Q 11	(a) Provide a detailed explanation of the following attributes of tables in LaTeX: 1. Cross-Referencing 2. Customization 3. Organization (b) You have to create a document using LaTeX that has a table with two columns. The first column should be center justified while for the second column you must force LaTeX to word wrap in individual cells by giving them a fixed width of 2 inch. Also put a line between the columns and a horizontal line under the first row. Following should be the table entries: 1. Entries of the first column should be "S.No.", "1", and "2" 2. Entries of the second column should be "Fact", "Kapil Dev is the youngest captain to lift a World Cup, having been 24 when India stunned the world in 1983", and "India's second World Cup triumph in 2011 made them the first country to win a World Cup on home soil (a feat repeated by Australia in 2015)".	**5+15**	**CO3**