

Bago University
Department of Physics
Second Semester Examination, September 2019

Second Year (BSc)
(Physics Specialization)

Phys 2102
Computational Physics
Time Allowed: (3) Hours

Answer any Six questions.

- 1 (a) (i) Evaluate, in Mathematica, $\left[10 \times \left(\frac{10.8 \times 10^3}{300} \right)^{\frac{1}{2}} + 4 \right]^{\frac{1}{3}}$.
- (ii) Determine, in Mathematica, a unit vector perpendicular to the plane of $\vec{A} = 2\hat{i} - 6\hat{j} - 3\hat{k}$ and $\vec{B} = 4\hat{i} + 3\hat{j} - \hat{k}$.
- (iii) Solve the equation, in Mathematica, $x^7 + x^5 + 2x^3 + x^2 + 1 = 0$.
- (b) If $\vec{A} = 2xy\hat{i} - 3xy^2\hat{j} - yz\hat{k}$, find, in Mathematica, the divergence of curl of \vec{A} at (0,-2,1).
- 2 (a) (i) Evaluate the expression $\sqrt{\frac{(1.1 \times 10^{-23})(6.8 \times 10^{-2})}{1.4 \times 10^{-24}}}$, and express the result in scientific notation. (ii) The following forces act on a particle: $\vec{F}_1 = 2\hat{i} + 3\hat{j} - 5\hat{k}$, $\vec{F}_2 = -5\hat{i} + \hat{j} + 3\hat{k}$, $\vec{F}_3 = \hat{i} + 2\hat{j} - \hat{k}$. Find, in Mathematica, the resultant of the forces and a unit vector parallel to the resultant force.
- (b) Given the matrix C, determine its inverse in Mathematica. $C = \begin{pmatrix} -2 & 1 & 3 \\ 0 & -1 & 1 \\ 1 & 2 & 0 \end{pmatrix}$. Then multiply C with its inverse. Express the results in matrix form and clear the variables used.
- 3 (a) Evaluate the integral, in Mathematica, $\int \frac{x}{a^3 + x^3} dx$ and $\int_0^2 \sin \sqrt{1 + x^4 + \sin(x^3)} dx$. Determine the real and imaginary parts of the expression $\frac{4+i}{2+3i}$.
- (b) What is the greatest rate of increase of $u = xyz^2$ at (1,0,3), in Mathematica?
- 4 (a) Write a program in C++, to find rest mass energy of electron and proton and display the results.
- (b) An object moves with an initial velocity 'v₀' m/s. After 't' seconds, its velocity becomes 'v' m/s. Write a C++ program to find acceleration 'a' m/s² of the object and distance travelled 's'.
- 5 (a) Write a program in C++ to read any two numbers from keyboard and to display the smaller value of them.
- (b) A stone is thrown with a speed of 20 meter per second. Write a program in C++ to find the maximum height reached for the angles above the horizontal from 10 degree to 80 degree in 2 degree steps.
- 6 (a) Write a program in C++ to find two velocity values. The displacements and time intervals will be entered from the keyboard. Also find the larger velocity value and display the velocities and the larger value.
- (b) Write a C++ program to find the magnitude of Coulomb's force between two charges for the distance between the charges ranging from 1cm to 10cm in 0.2cm steps. The values of charges will be given from the keyboard.

- 7 (a) Distinguish between analog computing and digital computing.
- (b) Express a flow chart to find the sum of two given numbers 'A' and 'B', and to print the result. The numbers 'A' and 'B' will be given from the keyboard.
- 8 (a) Discuss procedure oriented language.
- (b) Express a flow chart to find the voltage across the resistor $100\ \Omega$ if the current increases from 10A to 20A in 2A steps.
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