KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks Scored:

Level : B.Sc.
Year : IV
Course : PHYS 405
Semester : I

Exam Roll No. :
Time: 30 mins.
F. M. : 15

Registration No.:
Date 07 JUN 2019

SECTION "A"
[15Q × 1 = 15 marks]

Choose and encircle the most appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings.

1. If A is a $N \times M$ matrix, then which one of the following statements will be incorrect?
[a] The syntax `A^2` produces the square of A for $N = M$.
[b] The syntax `A^2` produces the 'error massage' for $N \neq M$.
[c] The syntax `A.^2` produces element wise square of the matrix.
[d] The syntax `A.^2` produces the 'error massage' for $N \neq N$.

2. If B_x, B_y and B_z are the components of magnetic field at any point (x, y, z), then the syntax `quiver3(x,y,Bx,By)` produces
[a] a figure of magnetic field vectors on xy-plane.
[b] a figure of magnetic field vectors in 3D space.
[c] an error massage.
[d] a figure of magnetic field lines on yz-plane.

3. The optimal value for the relaxation parameter in the second order difference approximation lies in between
[a] 0 and 1 [b] 0 and 2 [c] 0 and 0.5 [d] 0.5 and 1

4. The random walk in which the walker knows already visited site and choose the safe site to continue its walk is called
[a] self-avoiding walk [b] diffusive random walk
[c] simple random walk. [d] growing self-avoiding walk

5. An anonymous function is declared as
`F=@(x,y)[x(1)*y(1)+x(2)*y(2)+y(3)*x(3),x(2)*y(3)-x(3)*y(2)].`
Then `F([2,1,3],[1,0,-1])` produces a vector
[a] [-1, -1] [b] [1, -1] [c] [-1, 1] [d] [1, 1]

6. If A be a matrix of random numbers between 0 and 1. In order to count the random number less than 0.25 in A the required expression is
[a] `sum(A>0.25)` [b] `sum(sum(A<0.25))`
[c] `sum(sum(A>0.25))` [d] `count(A>0.25)`

7. The operation `B=(A>r1&A<r2)` generates vector B with
[a] the elements of A less than r2.
[b] the elements of A between r1 and r2.
[c] the indices of the elements of A between r1 and r2.
[d] the indices of the elements of A do not lie in between r1 and r2.

8. If $D^0u = \frac{u_{i+1} - u_{i-1}}{2h}$, and $D^+u = \frac{u_{i+1} - u_i}{h}$, then D^0D^+u gives

[a] $\frac{u_{i+1} - 2u_i + u_{i-1}}{h^2}$

[b] $\frac{u_{i+2} - 2u_{i+1} + u_{i-1}}{2h^2}$

[c] $\frac{u_{i+2} + u_{i+1} - u_{i-1} - u_{i-2}}{4h^2}$

[d] $\frac{u_{i+2} - 2u_i + u_{i-2}}{4h^2}$

Fill in the blanks with appropriate answer. The symbols, unless mentioned otherwise, have their usual meanings

9. The terms of matrix w of parameter array for classic RK method are _____.

10. The force law predicted by general relativity which is used to study the precession of perihelion of Mercury is _____.

11. An electric field $E = E_0 \sin \omega t$ incident on a birefringence crystal of thickness D . The optical path difference between the x- and y-components of electric fields after emerging from crystal (with refractive index for s and y direction as μ_x and μ_y) is _____.

12. The conditional statement in if-statement for $y = f(x)$ curve to locate the valley position is _____.

13. The y-component of magnetic field used for writing the code and drawing the field vector around ring, (radius R carries a steady current I), on xy- plane is _____.

14. The initial conditions for solving time independent Schrodinger's equation for even parity using shooting and matching method are _____.

15. Write a program which displays the animation of progressive wave for given wavelength and speed.

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F. M. : 40

SECTION "B"
[5Q. × 3 = 15 marks]

Attempt *ALL* questions.

1. What is Runge-Kutta method for solving ordinary differential equation? Write a general code for this method.

2. A spherical body is projected with initial velocity $\vec{v}_0$ in air. The body experiences a drag force $\vec{F}_{drag} = \frac{1}{2} C\pi\rho r v\vec{v}$, with ρ is the density and r be the radius. Write the program to simulate the motion of the body.

OR

Write a program to visualize the beats. Your program should compute the beat frequency and beat time period.

3. Deriving necessary theory, write a program to study the intensity distribution of diffraction through a single slit.

4. Explain the matrix method for solving the two-dimensional time-independent Schrodinger's equation.

OR

Explain the shooting and matching method for solving the time-independent Schrodinger's equation.

5. What is random walk? Using the random walk, write down a program to study series of the radioactive decay in which the daughter nuclei also takes part in the decay process.

SECTION "C"
[5Q. × 5 = 25 marks]

Attempt *ALL* questions.

6. What is three-body problem? With necessary formalism, write a program to study the effect of Jupiter on Earth.

7. Derive the required formula for magnetic field around the circular loop carrying a steady current and write a program to visualize the distribution of field lines.

OR

What is the Lorentz force? Write a program to simulate the motion of the charged particle under the action of the Lorentz force.

8. Deriving the necessary difference formula, write a program to solve the Poisson's equation with and without boundary condition.

9. Write a program to visualize the oscillation of simple pendulum. Your program should able to compute the amplitude and time period. What will happen on the oscillation, if air resistance takes account on it?

OR

Deriving the necessary theory, write a program to find the radius of the Newton's rings and another program to visualize the ring.

10. What is the Monte Carlo technique for finding the area and volume of irregular bodies? Write a program for computing the volume of ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$. Write another program for calculating the moment of inertia of the ellipsoid about x-, y-, and z-axes respectively.