Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination [C]
June, 2018

Level : B.Sc.
Year : IV

Course : PHYS 405
Semester : I

Exam Roll No. :

Time : 30 mins.

F. M. : 15

Registration No.:

Date JUN 11 2018

SECTION "A"
[15Q × 1 = 15 marks]

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

1. The syntax `A=triu(B,+1)` extracts
   [a] the upper triangular part of the matrix B from the first upper diagonal and assign to A
   [b] the upper triangular part of the matrix B from the first lower diagonal and assign to A
   [c] the lower triangular part of the matrix B from the first upper diagonal and assign to A
   [d] the lower triangular part of the matrix B from the first lower diagonal and assign to A

2. The differential equation for studying the effect of quadratic air drag is $m\frac{d^2\vec{r}}{dt^2}+bv^2\hat{v}+mg\hat{j}=0$, with $\vec{v}=\frac{d\vec{r}}{dt}$. This equation can be converted in the form of $\frac{dS}{dt}=F(t,\mathrm{S})$. If $S=(x,\mathrm{y},v_x,v_y)$, then $F(t,\mathrm{S})$ is

   [a] $\left(S(2),\mathrm{S}(4),-\frac{b}{m}\frac{S(2)}{\sqrt{S(2)^2+S(4)^2}},-\frac{b}{m}\frac{S(4)}{\sqrt{S(2)^2+S(4)^2}}-g\right)$

   [b] $\left(S(2),\mathrm{S}(4),-\frac{b}{m}S(2)\sqrt{S(2)^2+S(4)^2},-\frac{b}{m}S(4)\sqrt{S(2)^2+S(4)^2}-g\right)$

   [c] $\left(S(2),\mathrm{S}(4),-\frac{b}{m}S(2)^2-\mathrm{g},-\frac{b}{m}S(4)^2-g\right)$

   [d] $\left(S(2),-\frac{b}{m}S(2)-\mathrm{g},\mathrm{S}(4),-\frac{b}{m}S(4)\right)$

3. If E_x, E_y and E_z are the components of electric field at any point (x,y,z), then the appropriate syntax for plotting the field vector is
   [a] `plot3d(x,y,z,Ex,Ey,Ez)`
   [b] `quiver3(x,Ex,y,Ey,z,Ez)`
   [c] `quiver3(x,y,z,Ex,Ey,Ez)`
   [d] `quiver3d(Ex,Ey,Ez,x,y,z)`

4. The initial conditions for solving time independent Schrodinger's equation for even parity using shooting and matching method are
   [a] $\psi(0)=0$ and $\left.\frac{d\psi}{dx}\right|_{x=0}=1$
   [b] $\psi(0)=1$ and $\left.\frac{d\psi}{dx}\right|_{x=0}=0$
   [c] $\psi(0)=0$ and $\left.\frac{d\psi}{dx}\right|_{x=0}=0$
   [d] $\psi(0)=1$ and $\left.\frac{d\psi}{dx}\right|_{x=0}=1$

5. Let c be the speed of a wave, h_x and δt are the step size for the position and time respectively for solving the one-dimensional wave equation using finite difference method. For the stability of the solution

[a] $c\delta t > h_x 1$ [b] $h_x > c\delta t$ [c] $ch_x > \delta t$ [d] $h_x \delta t > c$

6. In finite difference approximation of $\frac{d^2\psi}{dx^2}$ is (with step size h)

[a] $\frac{\psi(x-h)-\psi(x)+\psi(x+h)}{2h^2}$ [b] $\frac{\psi(x-h)-2\psi(x)+\psi(x+h)}{h^2}$

[c] $\frac{\psi(x-h)-\psi(x)+\psi(x+h)}{h^2}$ [d] $\frac{\psi(x-h)+2\psi(x)-\psi(x+h)}{h^2}$

7. A and B are two arrays of same length of random numbers between 0 and 1. The syntax `C=B(A>x & A<y)` creates another array C, which contains the random numbers of

[a] B with respective indices of A whose random numbers lie between x and y
[b] A with respective indices of B whose random numbers lie between x and y
[c] B lie between x and y
[d] A lie between x and y

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

[a] `x(i)>x(i-1)&&x(i)>x(i+1)` [b] `x(i)<x(i-1)&&x(i)<x(i+1)`
[c] `y(i)<y(i-1)&&y(i)<y(i+1)` [d] `y(i)>y(i-1)&&y(i)>y(i+1)`

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

9. The expression of average intensity of light of electric field E after superposition which can be used for writing the code is ....

10. The appropriate syntax to eliminate all the negative elements from a vector V is .....

11. The x-component of electric field used for writing the code and drawing the field vector around the straight wire carrying total charge Q along x-direction is .....

12. The one line syntax to find the sum $S = \sin^2 x + \frac{1}{3^2}\sin^2 3x + \frac{1}{5^2}\sin^2 5x + \ldots$ to N terms for a given value of x is .....

13. The syntax for updating the k-values in RK method with $F(t,s)$ as the function and h as the step size is .....

14. The random walk in which the walker dies as it encounters with the previously visited site is called .....

15. The program which display the animation of progressive wave for given wavelength and speed is ....

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SECTION "B"
[5Q ×3 = 15 marks]

1. Explain the fourth order classic RK method for solving ordinary differential equations.

2. Write a program to study the motion of a projectile of mass m projected with an angle of projection and initial velocity as the input under the linear velocity drag. The force of gravity is given by $\vec{F} = -mg\hat{j}$.

   OR

   Write a program to find the beat period and frequency when two waves of slightly different frequencies are superposed.

3. Write a program to study the intensity distribution in diffraction through single-slit.

4. Explain a method for solving the one dimensional time-dependent Schrodinger's equation.

   OR

   Explain the shooting and matching method for solving the 1-D time-independent Schrodinger's equation.

5. What do you mean by Monte Carlo technique for finding area/volume of an object? Using the technique, write a program to estimate the volume of an ellipsoid.

SECTION "C"
[5Q × 5 = 25 marks]

6. Write a program to animate the simple pendulum for any angle of oscillation. Your program should compute the time period for different angles 10°, 20°, 30°, etc. and compare this with theoretical value.

7. Write a program to study the motion of a satellite revolving round the Earth.

   OR

   Write a program to study the precession of perihelion of the Mercury while revolving round the Sun.

8. Show that the probability in random walk obeys the diffusion equation. Write a program to animate the diffusion of cane-sugar block in water.

9. Write a program for plotting the magnetic vector fields due to a ring of radius R carrying a steady current I.

   OR

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

10. What is meant by SOR technique for solving the PDEs using finite difference method? Write a program for solving the two dimensional Laplace's equation with given boundary condition.