Third Semester Examination-2018

M.Sc. PHYSICS

Paper Code:MTM306 (CBCS)

Full Marks : 40 **Time: 2 Hours**

(Numerical Methods and Computer Programming)

Answer Question no 1 and any One from the rest.

1. Answer any four questions out of eight questions :
   $4 \times 2 = 8$
   a) Write the formula for 4th order Runge-Kutta Method to solve $\frac{dy}{dx} = f(x, y), y(x_0) = y_0$.
   b) Write the error term for Trapezoidal's and Simpson's 1/3rd rule.
   c) Find the iteration formula to find the solution of $x^3 + x - 1 = 0$ using Newton-Raphson method.
   d) Form the divided difference table to approximate $f(x) = x^3 - 1$ based on the four point x = -1, 0, 1, 3.
   e) Write the iteration formula of Gauss-Seidal method to solve $3x + 4y + 8z = 3$, $5x + y + z = 5$ and $3x + 8y - z = 3$ so that the equation converges to the true solution.
   f) How is a numeric array converted into a cell array.
   g) What is the relationship between a stream pointer and a buffer area.
   h) What is pointer variable.
2. Answer any four questions out of eight questions.
   $4 \times 4 = 16$
   a) State and prove the existence and uniqueness property of interpolation.
   b) Derive the Simpson's 1/3rd formula for the integration $\int_a^b f(x)dx$ by taking three points with spacing h.
   c) Using composite Trapezoidal rule, approximate $\int_{-4}^{4} |x + 1| dx$ with h = 1.
   d) Approximate $5^{\frac{1}{4}}$ using Newton-Raphson method of a nonlinear equation with initial approximation as 1. Do five iterations.
   e) Find the value of y(2, 1) as solution of $(x^3 + y^3)dx = xy^2dy$, $y(2) = 2.55$ using Euler's method with h = 0.1
   f) Prove the following relation
   i) $1 + \delta^2\mu^2 = \left(1 + \frac{\delta^2}{2}\right)^2$
   ii) $hD = \sinh^{-1} \mu\delta$

g) Prove that the rate of convergence of Newton-Raphson method is quadratic.

h) Write a C program to solve an ordinary differential equation by fourth order Runge-Kutta method.

3. Answer any two questions out of four questions.
$2 \times 8 = 16$

a) i) $P_2(x) = x^2 + x + 1$ interpolates f(x) at x = -3, -1 and 0. Prepare the divided difference table. Now f(2) = 15 is added to the data, find $P_2(x)$ which interpolates f(x) at x = -3, -1, 0 and 2 by adding term to $P_2(x)$.

ii) Write a program to solve $\frac{dy}{dx} = f(x, y), y(x_0) = y_0$ using Runge-Kutta of order two.

b) i) Find a root of $x^3 + x - 1 = 0$ in [0, 1] using Bisection method. Do four iterations.

ii) Write a program to calculate $\int_a^b f(x)dx$ using Simpson's 1/3rd rule.

c) i) Find the value of y(1.2) as solution of $x\,dy = (1 + y^2)\,dx$, y(1) = 2 using Runge-Kutta method of 4th order with h = 0.2.

ii) Write recursion relation to find the roots of quadratic equation. Using any loop write a C program for finding the roots of a quadratic equation.

d) i) Write down an iteration scheme for finding square root of a positive number N. Hene find the square-root of the number 2.

ii) Discuss the stability of 2nd order Runge-Kutta method.

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