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63/2 (SEM-3) PHY 302, 303

2021

(held in 2022)

PHYSICS

(Theory Paper)

Paper Code : PHY 302 (New)

(Computational Physics)

Full Marks – 40

Time – Two hours

The figures in the margin indicate full marks for the questions.

1. Answer any *five* of the following questions : 2×5=10

(a) Why numerical method is believed to be an important technique ? Write one limitation of numerical method.

(b) Briefly explain the bisection method.

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- (c) What is meant by interpolation? Write one advantage of Lagrange interpolation over Newton's interpolation.
- (d) Outline the fundamental difference between Trapezoidal rule and Simpson's 1/3 rule.
- (e) Three approximate values of the number 1/3 are given as 0.30, 0.33 and 0.34. Which of these three values is the best approximation?
- (f) Discuss how one can estimate the value of π using Montecarlo method.
- (g) Mention the advantage and disadvantage of Newton-Raphson method.

2. Answer any six of the following questions :

$$5 \times 6 = 30$$

- (a) Find the real root of the equation $x - 2 + \ln x = 0$ using Newton-Raphson method. Perform three iterations.
- (b) The table below gives the values of $\tan x$ for $0.01 \leq x \leq 0.30$: Find the value of

x	0.10	0.15	0.20	0.25	0.30
y = tan x	0.1003	0.1511	0.2027	0.2553	0.3093

$\tan 0.12$ using Newton's interpolation method.

- (c) Using the method of least squares, fit a curve of the form $y = \frac{x}{a + bx}$ to the following data :
(3, 7.148), (5, 10.231), (8, 13.509),
(12, 16.434)

- (d) Solve the initial value problem defined by

$$\frac{dy}{dx} = \frac{3x + y}{x + 2y}, \quad y(1) = 1$$

and find $y(1.2)$ and $y(1.4)$ by the Runge-Kutta fourth order method.

- (e) Approximate the area under the curve $y = 3^x$ between $x = -2$ and $x = 2$ using Simpson's 1/3 Rule with $n = 4$ subintervals.
- (f) Find in 9.2 with $n = 3$, using Lagrange's interpolation formula with the given table :

x	9.0	9.5	10.0	11.0
ln x	2.197	2.251	2.302	2.397

- (g) Solve the system of equations using Gauss elimination method :

$$\begin{aligned} 1.2x_1 + 2.1x_2 - 1.1x_3 &= 1.8776 \\ -1.1x_1 + 2.0x_2 + 3.1x_3 &= -0.1159 \\ -2.1x_1 - 2.2x_2 + 3.7x_3 &= -4.2882. \end{aligned}$$

PHYSICS

(Theory Paper)

Paper Code : PHY 303 (Old)

(Numerical Methods and Computation)

Full Marks – 40

Time – Two hours

The figures in the margin indicate full marks for the questions.

1. Answer any *five* of the following questions :
2×5=10

(a) Why numerical method is believed to be an important technique? Write one limitation of numerical method.

(b) Briefly explain the *regula-falsi* method.

(c) Write down the formula for Newton's forward and backward interpolation. Under what circumstance Newton's forward difference interpolation works better than Newton's backward difference interpolation?

(d) Outline the fundamental difference between Trapezoidal rule and Simpson's 1/3 rule.

(e) Three approximate values of the number $1/3$ are given as 0.30, 0.33 and 0.34. Which of these three values is the best approximation?

(f) Discuss how one can estimate the value of π using Montecarlo method.

(g) Mention the advantage and disadvantage of Newton-Raphson method.

2. Answer any *six* of the following questions :
5×6=30

(a) Find the real root of the equation $x^3 - x + 1 = 0$ using bisection method. Perform three iterations.

(b) The table below gives the values of $\tan x$ for $0.01 \leq x \leq 0.30$: Find the value of

x	0.10	0.15	0.20	0.25	0.30
y = tan x	0.1003	0.1511	0.2027	0.2553	0.3093

$\tan 0.12$ using Newton's interpolation method.

(c) Using the method of least squares, fit a straight line to the following data :

(1, 0.6), (2, 2.4), (3, 3.5), (4, 4.8) (5, 5.7)

- (d) Solve the initial value problem defined by

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}, \quad y(0) = 1$$

and find $y(0.2)$ and $y(0.4)$ by the Runge-Kutta fourth order method.

- (e) Approximate the area under the curve $y = 3^x$ between $x = -2$ and $x = 2$ using Simpson's 1/3 Rule with $n = 4$ subintervals.

- (f) Find $\ln 9.2$ with $n = 3$, using Lagrange's interpolation formula with the given table :

x	9.0	9.5	10.0	11.0
ln x	2.197	2.251	2.302	2.397

- (g) Solve the system of equations using Gauss elimination method :

$$1.2x_1 + 2.1x_2 - 1.1x_3 = 1.8776$$

$$-1.1x_1 + 2.0x_2 + 3.1x_3 = -0.1159$$

$$-2.1x_1 - 2.2x_2 + 3.7x_3 = -4.2882.$$