

RAN-2303080102040004
M. Sc. (Sem. - II) Examination September - 2025
Physics (Paper - PH-424-Elective-3) Numerical Techniques and Fortran Programming
Time: 3 Hours]
[Total Marks: 70
સૂચના : / Instructions

- (1) ઉપરોક્ત દર્શાવેલ વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the above details on your answer book.
- (2) Symbols used have their usual meaning.
- (3) Figures to the right indicate full marks.

Seat No.:

Student's Signature

Q. 1. Attempt any two questions out of the (a), (b) and (c) below.

- a. i. Use the method of least squares to fit the straight line $Y = a + bx$ to the data: **(04)**

x	0	1	2	3
y	2	5	8	11
w	1	1	1	1
- ii. Obtain the normal equations for the fitting of a straight line using the method of least squares. **(04)**
- b. i. Find the best values of a_0 and a_1 if the straight line is $y = a_0 + a_1x$ is fitted to data (x_i, y_i) . Also find the correlation coefficient. **(04)**
(1, 06), (2, 2.4), (3, 3.5), (4, 4.8), (5, 5.8)
- ii. Explain the method of least squares fitting of a **(04)**
 $y = a_0 + a_1x + a_2x^2 + \dots + a_nx^n$
- c. i. Fit a second-degree parabola of $y = a_0 + a_1x + a_2x^2$ to the data **(04)**
 $(x_i, y_i) : (1, 0.63), (3, 2.05), (4, 4.08), (6, 10.78)$
- ii. Explain the weighted least squares approximation and discuss the linear weighted least square approximation. **(04)**

Q. 2. Attempt any two questions out of the (a), (b) and (c) below.

- a. i. Obtain the $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ for $x = 1.6$ using the following data: **(05)**

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250
- ii. Obtain the general formula for integration. By using the general formula obtain the formula of Trapezoidal rule. **(04)**
- b. i. Evaluate the integral $\int_0^5 e^{-x^2} dx$ using the Trapezoidal rule with 11 points. **(05)**
- ii. Obtain the Euler-Maclaurin Formula. **(04)**
- c. i. Evaluate the integral $\int_0^1 e^{x+1} dx$ using Simpson -1/3 rule by dividing the interval of integration in eight equal parts. **(05)**

- ii. Discuss Gaussian Integration. (04)

Q. 3. Attempt any two questions out of the (a), (b) and (c) below.

- a. i. Write down the rules for defining declaration of variable names and identifiers in FORTRAN 90. Also, Pick the incorrect type declarations and identifiers from the following list. Explain why they are incorrect: (05)

Declarations:

- i. REAL, servo, mass, iota
- ii. INTEGER :: servo, digit, count
- iii. INTEGER :: rs, ps, unsigned
- iv. REAL :: real, root, big

Identifiers:

- i. roll, no
- ii. lambda
- iii. lab man
- iv. parameter

- ii. Write Fortran 90 statement for each of the following expressions: (04)

- i. $\ln x + \sin 45^\circ + |x^2 - y^2| + 3\sqrt{x}$
- ii. $ae^{kt/2}$
- iii. $\frac{1}{a\sqrt{2\pi}} e^{\sqrt{2a(x-m^2)}}$
- iv. $T + z \log_{10}(V_{OC} - p(r + n_e) + 5)$

- b. i. Write a FORTRAN program that will calculate the answer of math problem given below. (05)

$$\sum_0^{10} x^3$$

- ii. Discuss Mixed Mode of expression in Fortran 90 with suitable example. (04)

- c. i. Write the precedence rules for Logical Operators. Also, explain how the following expression are evaluated in Fortran 90. (05)

- i. $a > b * 4.2 .AND. d == COS(X)$
- ii. $a + 5.2 > b * 4.8 .AND. c + 5.2 > d$

- ii. Discuss the rules for the DO Loop construct of FORTRAN 90. (04)

Q. 4. Attempt any two questions out of the (a), (b) and (c) below.

- a. i. Write a FORTRAN 90 program of the least square fitting for the equation $y = ax^b$. (05)

- ii. Write a syntax of a FUNCTION statement and explain how the FUNCTION statement in FORTRAN 90 is executed. (04)

- b. i. Discuss the SUBROUTINE statement. (05)

- ii. Discuss the format description of integer type format specification for read statement. (04)

- c. i. Discuss FOR ALL statement. (05)

- ii. Define generic functions. (04)