

Roll No.

E-514**M. Sc. (Second Semester) (Main/ATKT)****EXAMINATION, May-June, 2021**

PHYSICS

Paper Fourth

(Computational Physics and Computer Programming)*Time : Three Hours]**[Maximum Marks : 80*

Note : Attempt all Sections as directed. Non-programmable scientific calculator may be allowed inside the examination hall.

Section—A

1 each

(Objective/Multiple Choice Questions)**Note :** Attempt all questions.

Choose the correct answer :

1. In the method of solving a set of simultaneous linear equations by Gauss elimination method; choose the correct process-sequence :

p : Triangularization of matrix A

q : Back substitution of values of x_i r : Formation of matrix $AX = B$ equations : Formation of matrix $[A | B]$, extended one.(a) $p \rightarrow q \rightarrow r \rightarrow s$ (b) $r \rightarrow s \rightarrow p \rightarrow q$ (c) $q \rightarrow r \rightarrow s \rightarrow p$ (d) $p \rightarrow r \rightarrow q \rightarrow s$

2. In the Newton-Raphson method for finding the root of a transcendental equation, formula is :

(a) $x_{n+1} = x_n + \frac{f(x_n)}{f'(x_n)}$

(b) $x_{n+1} = x_n + \frac{f'(x_n)}{f(x_n)}$

(c) $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}$

(d) $x_{n+1} = x_n - \frac{f'(x_n)}{f(x_n)}$

3. How many solutions are there of the equation

$$(3x - 2)^2 - \sin(2x - 5) + 2 = 0 ?$$

(a) One

(b) Two

(c) Three

(d) Infinite

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4. Inversion of a matrix is performed by method.
- (a) Newton-Raphson
 - (b) Gauss-Elimination
 - (c) Gauss-Seidel
 - (d) Gauss-Jordan
5. Which one is not a finite difference method ?
- (a) Forward difference
 - (b) Backward difference
 - (c) Divided difference
 - (d) Multiplied difference
6. If $y = a + bx^2$ and n is the number of observations then the first normal equation is $\Sigma y = \dots\dots\dots$
- (a) $na + b\Sigma x^2$
 - (b) $na\Sigma x + b\Sigma x^2$
 - (c) $na + b\Sigma x^3$
 - (d) $na\Sigma y + b\Sigma yx^2$

7. Given :

| y | x |
|-------|-----|
| u_0 | 3 |
| u_1 | 12 |
| u_2 | 81 |
| u_3 | 200 |
| u_4 | 100 |
| u_5 | 8 |

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then $\Delta^3 u_1$ is :

- (a) -10
 - (b) -269
 - (c) 277
 - (d) None of the above
8. Which one is a composite Simpson's $\frac{1}{3}$ rule ?
- (a) $I = \left(\frac{h}{3}\right)[f_0 + f_1 + f_2 + \dots + f_{2n}]$
 - (b) $I = \left(\frac{h}{3}\right)[f_0 + 2(f_1 + f_2 + \dots + f_{2n-1}) + f_{2n}]$
 - (c) $I = \left(\frac{h}{3}\right)[f_0 + 4(f_1 + f_3 + \dots + f_{2n-1}) + 2(f_2 + f_4 + \dots + f_{2n-2}) + f_{2n}]$
 - (d) $I = \left(\frac{h}{3}\right)[f_0 + 4(f_1 + f_2 + \dots + f_{2n})]$
9. For the data :

| x | $f(x)$ |
|-----|--------|
| 2 | 3 |
| 4 | 5 |
| 6 | 6 |
| 8 | 7 |

$\int_2^8 f(x) dx$ is found by the Trapezoidal Rule :

- (a) 32

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- (b) 16
 - (c) 25
 - (d) 18
10. Numerical solution of an Ordinary Differential Equation (ODE) cannot be found by the method of :
- (a) Simpsons $\frac{3}{8}$ rule
 - (b) Runge-Kutta
 - (c) Predictor-Corrector
 - (d) Picard
11. The first widely used higher level language developed in 1957 is :
- (a) C
 - (b) Java
 - (c) FORTRAN
 - (d) COBOL
12. The FORTRAN constant $5.1 \text{ E} + 06$ is equal to algebraic constant :
- (a) 51×10^6
 - (b) 5.1×10^6
 - (c) 0.51×10^6
 - (d) 0.051×10^6

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13. A compiler can check only error.
- (a) Syntax
 - (b) Logical
 - (c) Content
 - (d) All (a), (b) and (c)
14. In a flowchart oval symbol is used for :
- (a) START/STOP
 - (b) READ/WRITE
 - (c) Computation
 - (d) Decision making
15. Floating point arithmetic is applied to :
- (a) Characters
 - (b) Integer numbers
 - (c) Logical values
 - (d) Real numbers
16. Which statement about FORTRAN program is false ?
- (a) GO TO statement transfers the execution of the program to the referred label number
 - (b) GO TO statement must bear a label number like GO TO n .
 - (c) Conditional GO TO statement must precise with condition bearing a LOGICAL expression
 - (d) Excessive usage of GO TO statement increases the efficiency and neatness of the program.

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17. Which one is the false statement about DO Loop ?
- Nesting of DO is permitted
 - Jumping out of DO loop is allowed.
 - Jumping inside the Do loop from the outside is permitted
 - DO Loop is used for iteration
18. Which is not a valid operation with a file ?
- OPEN
 - CLOSE
 - READ/WRITE
 - None of (a), (b) and (c)
19. Which is an invalid function type in FORTRAN ?
- Recursive function
 - Library function
 - Statement function
 - User defined function
20. Which of the statement given below is false about DIMENSION ?
- It is a non-executable statement.
 - Several DIMENSION statements may appear in a program.
 - INTEGER and REAL both type variables can be declared DIMENSION.
 - It can be converted into executable statement at the time of program executions.

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Section—B

2 each

(Very Short Answer Type Questions)

Note : Attempt all the questions.

1. Evaluate the following expression :

$$9.6 - (3.0 * 2/3 - 14.0/7.0) + 14.0 * 0.1$$

2. What is printed by following program segment ?

```

100 | INTEGER NUM (10), SUM (10)
    | DO 100 I = 1, 5
    | NUM (I) = 100 - I * 10
    | CONTINUE
    | DO 10 J = 1, 5
    | SUM (J) = NUM (6 - I)
    | WRITE (*, *) NUM (4), SUM (5)
    | STOP

```

3. Invert the matrix $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.
4. What is made least in least square fit method ? Explain.
5. Explain the terms-overflow and underflow in floating point arithmetic.
6. Define flowchart and show its various symbols with their meanings.
7. What is the value of $(1 + \Delta)(1 - \nabla)$.
8. Define built in/library functions. What are its importance in programming ?

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Section—C

3 each

(Short Answer Type Questions)

Note : Attempt all questions.

1. The function
- $f(x)$
- is given below :

| x | $f(x) = y$ |
|-----|------------|
| 0.0 | 1 |
| 0.1 | 1.2 |
| 0.2 | 1.2 |
| 0.3 | 1.6 |
| 0.4 | 1.8 |
| 0.5 | 2.0 |

Calculate $I = \int_0^{0.5} y \, dx$ with the help of Trapezoidal rule.

2. Given $\frac{dy}{dx} = xy$ with $y(1) = 5$. Calculate y at $x = 2.0$ taking $h = 0.25$ with the help of Euler's method.
3. Fit a straight line to the given data by least square regression :

| X | Y |
|---|------|
| 1 | 1200 |
| 2 | 900 |
| 3 | 600 |
| 4 | 200 |
| 5 | 110 |
| 6 | 50 |

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4. Given the following table of values as :

| X | Y (X) |
|------|-------|
| 2.0 | 9.00 |
| 2.25 | 10.06 |
| 2.50 | 11.25 |
| 2.75 | 12.56 |
| 3.00 | 14.00 |

Find $Y(2.35)$ with the help of Newton's forward difference table.

5. Construct the difference table for data :

| x | $f(x)$ |
|-----|--------|
| 0 | 1.0 |
| 1 | 1.5 |
| 2 | 2.2 |
| 3 | 3.1 |
| 4 | 4.6 |

and evaluate $\Delta^3 f(2)$.

6. Draw a flowchart and write a FORTRAN program to find the roots of the quadratic equation
- $Ax^2 + Bx + C = 0$
- .

7. Write a computer program to compute the standard deviation in N data x_i ; where $i = 1, N$. Read N and x_i from the Keyboard and compute the standard deviation :

$$= \sqrt{\sum_{i=1}^N (x_i - A_V)^2 / N}$$

$$\text{where } A_V = \frac{\left(\sum_{i=1}^N x_i \right)}{N}.$$

8. Distinguish between subroutine and FUNCTION in FORTRAN.

Section—D

5 each

(Long Answer Type Questions)

Note : Attempt all questions.

1. Solve the following set of linear simultaneous equations with help of either Gauss-Elimination or Gauss-Jordan method :

$$x_1 + x_2 + 2x_3 = 9$$

$$2x_1 + 7x_2 + 3x_3 = 25$$

$$4x_1 + 2x_2 + 4x_3 = 20$$

2. Solve the equation $x^2 - 2 = 0$ by Newton-Raphson method for +ve root taking initially $x_0 = 1.0$ find the root accurate upto 3 digits of decimal point.

Or

Given $\frac{dy}{dx} = x + y$ with initial values of $x_0 = 0$ and $y(x_0) = 1$; find the solution of diff. equation by Runge-Kutta method of 2nd order at $x_n = 0.6$ with $h = 0.2$.

3. Draw a flowchart and write a FORTRAN program to find smallest of given N numbers.
4. Draw a flowchart and write a FORTRAN program to find if a square matrix is symmetric.

Or

Write a FORTRAN program for the sum of the following series :

$$S = 1 - \frac{x^2}{|2|} + \frac{x^4}{|4|} - \frac{x^6}{|6|} + \frac{x^8}{|8|} - \dots - \frac{x^{18}}{|18|}$$