MM-153

March-2019

M.Sc., Sem.-IV

508 : Physics

(Numerical Techniques and C Programming)

Time : 2:30 Hours]   **[Max. Marks : 70**

Instructions :   (1)   Attempt **all** questions.

              (2)   Symbols carry their usual meanings.

              (3)   Scientific calculators are allowed

1.   (A)   (i)   In a given electrical network, the equations for the currents i_1, i_2, i_3 are   7

            $3i_1 + i_2 + i_3 = 8$

            $2i_1 - 3i_2 - 2i_3 = -5$

            $7i_1 + 2i_2 - 5i_3 = 0$

            Obtain i_1, i_2, and i_3 by matrix inversion method.

        (ii)   Solve the following set of simultaneous equations by Relaxation method :   7

            $10x - 2y - 2z = 6$

            $-x + 10y - 2z = 7$

            $-x - y + 10z = 8$

OR

        (i)   Explain Jacobi iterative method for finding the solution of simultaneous equations. What are the limitations of this method ?

            How Gauss-Seidal method is different from Jacobi's method ?

        (ii)   What are ill-conditioned equations ?

            Explain how to improve accuracy of an ill-conditioned system.

(B) Attempt any **four** from the following :   **4**

    (i)   In the Gauss elimination method for solving a system of linear algebraic equations, triangularzation leads to

        (A)   Diagonal matrix   (B)   Lower triangular matrix

        (C)   Upper triangular matrix   (D)   Singular matrix

    (ii)   In the Jacobi's iteration method, in the absence of any better estimates for x0, y0, z0, these may each be taken as _____ .

        (A) ∞ (B)   1

        (C)   zero   (D)   –1

    (iii) Which method of the following for solving linear simultaneous equations is said to be a direct method ?

        (A)   Matrix Inversion   (B)   Jacobi's method

        (C)   Gauss-Seidal method   (D)   Relaxation method

    (iv) $A = \begin{bmatrix} 3 & 2 & 7 \\ 7 & 6 & 6 \\ 3 & 4 & 1 \end{bmatrix}$

        The upper triangular matrix coefficient U_{23} for the above matrix A is __

        (A)   1   (B)   2

        (C)   3   (D)   4

    (v)   Which one of the following method is the iterative method of solving the linear simultaneous equations ?

        (A)   Cramer's rule.   (B)   Gauss elimination method.

        (C)   Relaxation method.   (D)   Doolittle method.

    (vi) $A = \begin{bmatrix} 3 & 1 & 2 \\ 2 & -3 & -1 \\ 1 & 2 & 1 \end{bmatrix}$

        The cofactor B_2 of the determinant of the above matrix A is _____

        (A)   –3   (B)   3

        (C)   1   (D)   –1

2.   (A) (i)   Using appropriate scale in your answer-book, find graphically the values of
a and b which obeys the law $y = ax + b \log_{10} x^{1/2}$ for the following data.   7

x	2.85	2.88	4.66	5.69	6.65	7.77	8.67
y	16.7	26.4	35.1	47.5	60.6	77.5	93.4

(ii) The observed values of an event are given as under :   7

x	87.5	84	77.8	63.7	46.7	36.9
y	292	283	270	235	197	181

Fit a parabola of the form $y = a + bx + c\,x^2$, by the method of group averages.

OR

(i)   Explain how one can obtain three constants (a, b, and c) from the any given set of data for the relations :

(A) $y = a + bx + cx^2$

(B) $y = a + bx^c$

(C) $y = a + b\exp(cx)$

(ii) Explain how to fit the following curves by method of group averages.

(i) $y = a\,x^b$, a and b are constants.

(ii) $y = a\exp(bx)$, a and b are constants.

(iii) $xy^a = b$, a and b are constants.

(B) Attempt any **three** from the following :   3

(i)   Let (x_1, y_1), (x_2, y_2), (x_3, y_3), ... (x_n, y_n) be the set of n observations such that $x_2 - x_1 = x_3 - x_2 = ... = h$

Then the second moment is defined as

(A) $h\Sigma x$ (B) $h\Sigma y$

(C) $h\Sigma xy$ (D) $h\Sigma x^2 y$

(ii) Which of the (x_1, x_2, x_3) follow the arithmetic progression ?

x	1	2	5	8	11
y	18	17.7	17.5	17	15.8

(A) (1, 2, 5) and (5, 8, 11)   (B) (1, 2, 5) and (2, 5, 8)

(C) (1, 2, 5) and (5, 8, 11)   (D) (2, 5, 8) and (5, 8, 11)

(iii) In the method of group averages.

(A) sum of the errors in each group is a minimum.

(B) sum of squares of the errors in each group is a minimum.

(C) sum of square roots of the errors in each group is a minimum.

(D) sum of root mean squares of the errors in each group is a minimum.

(iv) Four arbitrary points (x_1, y_1), (x_2, y_2), (x_3, y_3), (x_4, y_4) are given in the x, y-plane. Using the method of least squares, if regressing y upon x gives the fitted line y = ax + b; and regressing x upon y gives the fitted line x = cy + d, then

(A) Two fitted lines must coincide

(B) Two fitted lines need not coincide

(C) It is possible that ac = 0

(D) a must be 1/c

(v) Convert y = b/[x (x-a)] to its linear form. Here a and b are constants.

3. (A) (i) Discuss the need for user defined functions. Write a program to read 100 values, using a function sort the series in descending order. Program should print both original series and sorted series.   7

(ii) What is a pointer ? What are the advantages of using pointers in programs? Write a program to read two values, call a function exchange the two values. Program should print original values and exchanged values from main().   7

<center>**OR**</center>

(i) Write a program to read 100 values, using a function calculate the standard of the series.

$$std = \sqrt{\frac{1}{n}\left(\sum_{1=1}^{n}(xi - avg)^2\right)}$$

Program should print value of standard deviation from main( ).

(ii) Write a program to define a structure named student with name, subject, roll number and marks out of 50 as its members. Read information about 75 students and print details of all students who have scored more than average mark.

(B) Attempt any **four** from the following :   4

(i) What is meant by prototype of a function ?

(ii) When a pointer variable is declared as double, what does it mean ?

(iii) Distinguish between call by value and call by reference.

(iv) Give an example for definition of union.

(v) What will be size of the structure variable y

```
struct x
{      float a;
       char b [6];
}y[10];
```

(vi) Write output of the following program segment

```
float x[5] = { 1,4, 7, 10}, *px = x;
printf("%d %d", *px+2, *(px+2));
```

4.   (A)   (i)   Write a program to read content of a user specified file, convert all lower case letters to upper case letter and write into another user specified file. Program should check error in opening the files.   **7**

(ii)   Explain the concept of Trapezoidal method for integrating a function. Write a program to integrate the following function within the user specified limits based on trapezoidal method.   **7**

$$\frac{3x}{x^2 + 2x + 1}$$

OR

(i)   Values of resistance in KΩ and capacitance in μF are stored in a file in the following format

1	10	0.047
2	22	0.15
.	.	.
.	.	.

Write a program to read the file, calculate frequencies of phase shift oscillator and astable multivibrator corresponding to each pairs of resistance and capacitance using the following equations.

$$f_{ps} = \frac{1}{2\pi RC\sqrt{6}} \qquad f_{am} = \frac{1}{1.4RC}$$

Program should check error in opening the files and should print contents of original file along with frequencies in another file.

(ii)   Describe concept of Newton-Raphson method to get solution of a polynomial. Write a general program in C language for the same.

(B)   Attempt any **three** from the following :   **3**

(i)   For opening a file, what basic information are to be passed to the compiler ?

(ii)   What will happen when the following statement is executed ?

fseek(fp, –10, 1);

(iii) How the following functions are different

    Getc(),   gets(),   getw()

(iv) Define a macro to get absolute value

(v) In RK4 method for solving ordinary differential equations, the symbol k represents what ?   [k=(l/6)(k1+2k2+2k3+k4]).

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