Code : 211404

B.Tech 4th Semester Exam., 2019

NUMERICAL METHODS AND COMPUTATIONAL TECHNIQUE

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer (any *seven*) : 2×7=14

(a) Predict the output of the following program :

```
#include "stdio.h"
int main( )
{
  char arr[100];
  printf("%d", scanf ("%s", arr));
  /* Suppose that input value given
     for above scanf is "GeeksQuiz"*/
  return 1;
}
```

(i) 9 *(ii)* 1

(iii) 10 *(iv)* 100

(b) In C,

(i) parameters are always passed by value

(ii) parameters are always passed by reference

(iii) non-pointer variables are passed by value and pointers are passed by reference

(iv) parameters are always passed by value result

(c) Predict the output of the following program :

```
#include <stdio.h>
#define EVEN 0
#define ODD 1
int main( )
{
  int i = 3;
  switch (i & 1)
  {
    case EVEN: printf("Even");
         break;
    case ODD: printf("Odd");
         break;
    default: printf("Default");
  }
  return 0;
}
```

(i) Even

(ii) Odd

(iii) Default

(iv) Compile-time error

(d) In which of the following methods proper choice of initial value is very important?

(i) Bisection method

(ii) False position

(iii) Newton-Raphson

(iv) None of the above

(e) Errors may occur in performing numerical computation on the computer due to

(i) rounding errors

(ii) power fluctuation

(iii) operator fatigue

(iv) All of the above

(f) Newton-Raphson method is applicable to the solution of

(i) both algebraic and transcendental equations

(ii) both algebraic and transcendental and also used when the roots are complex

(iii) algebraic equations only

(iv) transcendental equations only

(g) The value of $\Delta \tan^{-1} x$ is

(i) $\Delta \tan^{-1}\left(\frac{h}{1+hx+x^2}\right)$

(ii) $\Delta \tan^{-1}\left(\frac{h+2x}{1+hx+x^2}\right)$

(iii) $\Delta \tan^{-1}\left(\frac{h-2x}{1+hx+x^2}\right)$

(iv) $\Delta \tan^{-1}\left(\frac{h+2x}{1-hx-x^2}\right)$

(h) The following x, y data is given :-

x	15	18	22
y	24	37	25

The Newton's divided difference second-order polynomial for the above data is given by

$$f_2(x) = b_0 + b_1(x-15) + b_2(x-15)(x-18)$$

The value of b_1 is most nearly

(i) -1·0480

(ii) 0·14333

(iii) 4·3333

(iv) 24·000

(i) The highest order of polynomial integrands for which Simpson's 1/3rd rule of integration is exact is

(i) first

(ii) second

(iii) third

(iv) fourth

(j) Given

$$3\frac{dy}{dx} + 5y^2 = \sin x, \quad y(0\cdot3) = 5$$

Using a step size of $h = 0\cdot3$, the value of $y(0\cdot9)$ using Euler's method is most nearly

(i) -35·318

(ii) -36·458

(iii) -658·91

(iv) -669·05

2. (a) Write a C/C++ program to calculate and print the multiplication of user defined two matrices. 7

(b) Develop a flowchart to select the largest number of a given set of 100 numbers. 7

3. (a) Find the order (rate) of convergence of Newton-Raphson method. When does the Newton-Raphson method fail? 7

(b) Find the smallest positive root of the equation $x^3 - x - 10 = 0$, using the general iteration method. 7

4. (a) How do we avoid computational errors in Gauss elimination method? 7

(b) Computationally show that Gauss-Seidel method applied to the system of equations

$$3x_1 - 6x_2 + 2x_3 = 23$$
$$-4x_1 + x_2 - x_3 = -8$$
$$x_1 - 3x_2 + 7x_3 = 17$$

diverges. Take the initial approximations as $x_1 = 0\cdot9$, $x_2 = -3\cdot1$, $x_3 = 0\cdot9$. Interchange the first and second equations and solve the resulting system by the Gauss-Seidel method. Again take the initial approximations as $x_1 = 0\cdot9$, $x_2 = -3\cdot1$, $x_3 = 0\cdot9$, and obtain the result correct to two decimal places. 7

5. (a) The following values of the function $f(x) = \sin x + \cos x$ are given :

x	10°	20°	30°
$f(x)$	1·1585	1·2817	1·366

Construct the quadratic Lagrange interpolating polynomial that fits the data. Hence, find $f(\pi/12)$. Compare with the exact value. 7

(b) Derive the Newton's forward difference formula using the operator relations. 7

6. (a) Evaluate $I = \int_1^2 \frac{dx}{5+3x}$ with 4 and 8 sub-intervals using the trapezium rule. Compare with the exact solution and find the absolute errors in the solutions. Comment on the magnitudes of the errors obtained. Find the bound on the errors. 7

(b) What are the disadvantages of the Simpson's 3/8th rule compared with the Simpson's 1/3rd rule? 7

7. (a) Find the best values of a and b if the straight line $y = a + bx$ is fitted to the data

(x_i, y_i) : (1, 0·6) (2, 2·4) (3, 3·5) (4, 4·8) (5, 5·7)

Find also the correlation coefficient. 7

(b) Obtain the least square approximation of the form $f(x) = ae^{bx}$ to the following data : 7

X	:	0·5	1·0	2·0	2·5	3·0
$f(x)$	:	0·57	1·46	5·10	7·65	9·20

8. (a) Solve the initial value problem $yy' = x$, $y(0) = 1$, using the Euler's method in $0 \le x \le 0{\cdot}8$, with $h = 0{\cdot}2$ and $h = 0{\cdot}1$. Compare the results with the exact solution at $x = 0{\cdot}8$. Extrapolate the result. 7

(b) Given $y'' + y' + y = 0$, $y(0) = 1$, $y'(0) = 0$. Find the value of $y(0{\cdot}1)$ by the fourth-order Runge-Kutta method. 7

9. Using the second-order finite difference method, find $y(0{\cdot}25)$, $y(0{\cdot}5)$, $y(0{\cdot}75)$ satisfying the differential equation $y'' - y = x$ and subject to the conditions $y(0) = 0$, $y(1) = 2$. 14

★ ★ ★