JUNE 2009

AMIETE – ET (OLD SCHEME)

Code: AE07
Subject: NUMERICAL ANALYSIS & COMPUTER PROGRAMMING
Time: 3 Hours
Max. Marks: 100

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q. 1. must be written in the space provided for it in the answer book supplied and nowhere else.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2 × 10)

a. What is the output of the following C program

```
#include<stdio.h>
void main( )
   {
      int arr[ ]={10, 20, 36, 72, 45, 36};
      int *j, *k;
      j = &arr[4];
      k = (arr + 4);
      if (j = = k)
        printf("1010");
      else
        printf("0101");
   }
```

(A) Error **(B)** 0101
(C) 1010 **(D)** No output

b. Consider the following program

```
#include<stdio.h>
void main( )
   {
      int x, y;
      scanf("%d %d", &x, &y);
      fun(x, y);
   }
void fun(int a, int b)
  {
      a = a + b;
```

```
        b = a – b;
        a = a – b;
    }
```

The above coding can be used for

(A) Addition and subtraction of two numbers.
(B) Exchanging the value of two variables
(C) Finding the Fibonacci series
(D) None of these

c. The convergence of Newton-Raphson method is

(A) linear **(B)** quadratic
(C) cubic **(D)** None of the above

d. If Δ is the Forward Difference operator and E is the shift operator, then $\left(\frac{\Delta^2}{E}\right)x^3$ equal to

(A) 6x **(B)** $3x^2$
(C) $3x^3$ **(D)** None of the above

e. The value of y_6 if $y_0 = -8$, $y_1 = -6$, $y_2 = 22$, $y_3 = 148$, $y_4 = 492$, $y_5 = 1222$ is

(A) 2156 **(B)** 2554
(C) 2618 **(D)** None of the above

f. After Rounding of 37.46235 to four significant figures, the absolute error will be

(A) 0.00235 **(B)** 0.3746
(C) 6.27×10^{-5} **(D)** None of the above

g. If λ is an eigen value of the Matrix A, then the eigen value of A^{-1} is

(A) $\frac{1}{\lambda}$ **(B)** $\frac{1}{\lambda^2}$
(C) $\frac{1}{\lambda^3}$ **(D)** None of the above

h. Let $L = \lfloor \ell_{ij} \rfloor$ and $U = \lfloor u_{ij} \rfloor$ denote the lower and upper triangle matrices respectively. Then which of the following is correct.

(A) product of two lower triangular matrices is a upper triangular matrix
(B) product of two upper triangular matrices is a lower triangular matrix
(C) product of two lower triangular matrices is a lower triangular matrix

(D) All of the above

i. The approximate value of

$$I = \int_0^1 \frac{\sin x}{x} dx$$ by using mid-point rule is

(A) 0.7325 **(B)** 0.9589
(C) 0.6537 **(D)** None of the above

j. For Simpson's $1/3^{rd}$ rule, the interpolating polynomial is of degree
(A) first **(B)** second
(C) third **(D)** fourth

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Find the root of the equation $xe^x = \cos x$ using the Secant Method correct to four decimal places. **(8)**

b. Find a real root of the equation $\cos x = 3x - 1$ correct to three decimal places using Iteration Method. **(8)**

Q.3 a. Solve the equations by using Gauss elimination method.

$$x_1 + x_2 + x_3 = 6$$
$$3x_1 + 3x_2 + 4x_3 = 20$$
$$2x_1 + x_2 + 3x_3 = 13$$

(6)

b. Solve the system of equations by Cholesky method.

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 8 & 22 \\ 3 & 22 & 82 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 5 \\ 6 \\ -10 \end{bmatrix}$$

(10)

Q.4 a. The population of a town in decimal census were given in the following table. **(6)**

Year	: 1921	1931	1941	1951	1961
population in					

thousand	: 46	66	81	93	101

Estimate the population for the year 1955 using Newton's backward formulae.

b. Obtain the least squares polynomial approximation of degree two for $f(x) = x^{1/2}$ on [0,1]. **(10)**

Q.5 a. The following values of the function $f(x) = \sin x + \cos x$, are given **(8)**

x	10°	20°	30°
$f(x)$	1.1585	1.2817	1.3660

construct the quadratic interpolating polynomial that fits the data. Hence find $f(\pi/12)$.

b. Find the approximate value of the integral $I = \int_0^1 \frac{dx}{1+x}$ by using composite trapezoidal rule with 2,3,5,9 nodes and Romberg Integration. **(8)**

Q.6 a. Employ Taylor's method to obtain approximate value of y at x=0.2 for the differential equation $\frac{dy}{dx} = 2y + 3e^x,\ y(0) = 0.$ **(8)**

b. Given $\frac{dy}{dx} = \frac{y-x}{y+x}$ with initial condition y = 1 at x = 0. Find y for x = 0.1 by Euler's method. **(8)**

Q.7 a. Assume that f(x) has a minimum in the interval $x_{n-1} \le x \le x_{n+1}$ where $x_k = x_0 + kh$. Show that the interpolation of f(x) by a polynomial of second degree yields the approximation

$$f_n - \frac{1}{8}\left(\frac{(f_{n+1} - f_{n-1})^2}{f_{n+1} - 2f_n + f_{n-1}}\right),\ (f_k = f(x_k))$$

for the minimum value of f(x). **(8)**

b. Prove with the usual notations, that

(i) $hD = \sinh^{-1}(\mu\delta)$

(ii) $\Delta^3 y_2 = \nabla^3 y_5$ **(8)**

where Δ = forward difference operator

∇ = Backward difference operator

δ = Central difference operator
μ = averaging operator
h = interval of differencing
D = first order difference
$\sinh^{-1} \rightarrow$ sin hyperbolic inverse

Q.8 a. Write a C program to find a simple root of f(x)=0 using Newton-Raphson method. **(10)**

b. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's 3/8 rule. **(6)**

Q.9 a. Differentiate the followings
(i) call by value and call by reference in C program
(ii) Structures and Unions **(8)**

b. Define the following terms
(i) Round-off error
(ii) Truncation error
(iii) Absolute error
(iv) Machine epsilon **(8)**