ROLL NO. ______________

Code: AE07 Subject: NUMERICAL ANALYSIS & COMPUTER PROGRAMMING

AMIETE – ET (OLD SCHEME)

Time: 3 Hours **OCTOBER 2012** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

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.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 Minutes of the commencement of the examination.**
- **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. Consider the following statements:
(i) A switch expression can be of any type.
(ii) The default case is optional in the switch statement.
Which of the following statements are correct?

(A) (i) only **(B)** (ii) only
(C) Both (i) & (ii) **(D)** None of these

b. The error quantity which must be added to the finite representation of a computed number in order to make it the true representation of that number is called.

(A) relative error **(B)** absolute error
(C) round-off error **(D)** truncation error

c. Consider the following statements.
(i) C is a free-form language
(ii) In a C program, # define is a preprocessor compiler directive

Which of the following statements are correct?

(A) (i) only **(B)** (ii) only
(C) (i) and (ii) both **(D)** none the these

d. In bisection method, if the permissible error is $\in$, then the approximate number of iteration may be determined from the formula. [It is assumed that a root of $f(x)=0$ lies in the interval (a_0, b_0) and n denotes the number of iterations]

(A) $n \geq \frac{\log(b_0 - a_0) - \log \in}{\log 2}$ **(B)** $n \leq \frac{\log(b_0 - a_0) - \log \in}{\log 2}$

(C) $n \geq \frac{\log(b_0 + a_0) - \log \in}{\log 2}$ **(D)** $n \leq \frac{\log(b_0 + a_0) - \log \in}{\log 2}$

e. Consider the following statements:
(i) If a matrix A is diagonally dominant then no pivoting is necessary
(ii) If a matrix A is real, symmetric and positive definite then no pivoting is necessary
Which of the above statements are correct?

(A) (i) only **(B)** (ii) only
(C) Both (i) & (ii) **(D)** None of these

f. The Cholesky factorisation of a symmetric matrix A is $A = LL^T$

If $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 8 & 22 \\ 3 & 22 & 82 \end{bmatrix}$ and $L = \begin{bmatrix} 1 & 0 & 0 \\ 2 & a & 0 \\ 3 & b & c \end{bmatrix}$, $a < 0, c > 0,$
then, the values of (a,b,c) are

(A) (2, 8, 3) **(B)** (2, 4, 3)
(C) (2, -8, -3) **(D)** (2, -4, 3)

g. Netwon's backward difference formula

(A) can be expressed in terms of forward differences
(B) is more suitable when we have to interpolate at a point nearer to the initial point
(C) is more suitable when we have to interpolate at a point nearer to the end point
(D) does not give identical polynomial as obtained by using Netwon's forward difference formula

h. Consider the following values for the function $f(x) = x^4$.

X	f(x)
0.4	0.0256
0.6	0.1296
0.8	0.4096

The approximate value of $f'(0.8)$ using the method based on quadratic interpolation is

(A) 1.84 **(B)** 2.048
(C) 1.82 **(D)** 4.4

i. Find the approximate value of
$$I = \int_0^1 \frac{dx}{1+x}$$
Using Simpson's rule

(A) 0.75 **(B)** 0.7050
(C) 0.6915 **(D)** 0.6944

j. Which of the method use a weighted average of slopes on the given interval instead of a single slope?

(A) Taylor's method **(B)** Runge-Kutta method
(C) Euler's Method **(D)** None of these

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

Q.2 a. Write a C program to calculate the real roots of the equation $e^x - 3x^2 = 0$ using bisection method. Use an error tolerance of $\in = 10^{-5}$, maximum number of iterations 40 and [0,1] as the interval containg the root. **(8)**

b. Find the iterative methods based on Newton – Raphson method for finding $N^{1/k}$, where N is a positive real number. Hence, estimate N=18 for K=3, correct to two decimal places. **(8)**

Q.3 a. Give the applications of linked lists with suitable examples. **(8)**

b. Determine the inverse of the matrix

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}$$

using partition method. Hence solve the system of equation Ax =b, where b= $[1, 6, 4]^T$ **(8)**

Q.4 a. Solve the following system of equations by LU decomposition Method. **(8)**

$$x_1 + x_2 - 2x_3 = 3$$
$$4x_1 - 2x_2 + x_3 = 5$$
$$3x_1 - x_2 + 3x_3 = 8$$

b. Solve the following system of equation using Gauss-Seidel method (show upto 3 iterations),

$$4x_1 + x_2 + 2x_3 = 4$$
$$x_1 + x_2 + 3x_3 = 3$$
$$3x_1 + 5x_2 + x_3 = 7$$

(8)

Q.5 a. Expand ln(1+x) in a Taylor series expansion about x_0 = 1 through terms of degree 4. Obtain a bound on the truncation error when approximating ln(1.2) using this expansion. **(8)**

b. By use of repeated Richardson extrapolation, find $f''(0.3)$ from the following values:

x	f(x)
0.1	17.60519
0.2	17.68164
0.3	17.75128
0.4	17.81342
0.5	17.86742

Apply the approximate formula $f''(x) \approx \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}$

Q.6 a. Obtain the linear least square approximation to $f(x) = e^x$, $-1 \le x \le 1$. **(8)**

b. For the following data, calculate the difference and obtain the forward difference polynomial, using the first four points. Hence interpolate at x=0.25. **(8)**

x	f(x)
0.1	9.9833
0.2	4.9667
0.3	3.2836
0.4	2.4339
0.5	1.9177

Q.7 a. Calculate the n^{th} divided difference of $f(x) = \frac{1}{x}$ **(8)**

b. Evaluate the integral $I = \int_0^{\pi} e^x \cos x dx$ using Gauss – Legendre three point formula. **(8)**

Q.8 a. Evaluate the integral $I = \int_0^1 x^3 \sqrt{x}\, dx$ using Simpson's rule taking eight intervals. Also obtain upper bound of the error. **(8)**

b. Given the following values of $f(x) = \ln x$, find the approximate value of $f''(2.0)$ using quadratic interpolation. Also obtain an upper bound on the error.**(8)**

x	f(x)
2.0	0.69315
2.2	0.78846
2.6	0.95551

Q.9 a. Given $\frac{dy}{dx} = \frac{1}{x+y}$ where y(0) = 1, find y (0.5) and y (1.0) using Runge – Kutta fourth order method, (take h = 0.5). **(8)**

b. Given the following equation x^4-x-10=0, determine the initial approximations for finding the smallest positive root. Use these to find the root correct to three decimal places with Secant method. **(8)**