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

# DECEMBER 2010

**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 half an hour 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.**

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

a. Which of the following data type can be treated as a pointer by default:

**(A)** char **(B)** int
**(C)** double **(D)** short int

b. A number $x = 0.36132346 \times 10^7$ is subtracted to another number $y = 0.36143447 \times 10^7$. The floating point representation of $(x - y)$ in normalized form is

**(A)** $.11101 \times 10^4$ **(B)** $1.1101 \times 10^3$
**(C)** $.011101 \times 10^5$ **(D)** $11.101 \times 10^2$

c. Consider the following statements:
(i) Newton-Raphson method has quadratic rate of convergence.
(ii) If the Newton-Raphson method converges then, it is faster than the secant method
Which of the following statements are correct?

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

d. In Bisection method if the permissible errors is $\in$, then the approximate number of iterations required may be determined from relation

**(A)** $\frac{b_o - a_o}{2^n} \le \in$ **(B)** $\frac{b_o - a_o}{2^n} \ge \in$
**(C)** $\frac{b_o - a_o}{n \log 2} \le \in$ **(D)** $\frac{b_o - a_o}{n \log 2} \ge \in$

e. In partial pivoting we interchange the

**(A)** Rows only **(B)** Columns only
**(C)** Both rows and columns **(D)** Neither the rows nor the columns

f. Which of the following statement is / are correct?
   (i) The degree of an interpolating polynomial through 3 points is less than or equal to 2.
   (ii) In linear interpolation we approximate the function by a straight line.

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

g. Newton's forward difference interpolation formula

   **(A)** Is expressed in terms of Backward differences
   **(B)** Can also be applied to the situation when points are unequally spaced
   **(C)** is more suitable when we have to interpolate at a point nearer to the initial point
   **(D)** is more suitable when we have to interpolate at a point nearer to the end point

h. Which of the following statements is / are correct?
   (i) In the method of undetermined coefficients we express $f^r(x)$ as a linear combination of values of $f(x)$ at an arbitrary chosen set of tabular points.
   (ii) We assume that tabular points are equispaced.

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

i. An upper bound of the error in evaluating $\int_0^1 \frac{dx}{1+x}$ using trapezoidal rule is

   **(A)** $1.6\times10^{-1}$  **(B)** $1.6\times10^{-2}$
   **(C)** $2.6\times10^{-1}$  **(D)** $2.6\times10^{-2}$

j. The value of y(0.1) using Euler's method; given that $\frac{dy}{dx} = x^2 + y, y(0) = 1$, (h = 0.1) is

   **(A)** 1.1  **(B)** 1.2
   **(C)** 1.12  **(D)** 1.4

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

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**Q.2** a. Write a C program to evaluate $\int_0^1 \frac{dx}{1+x^2}$ using simpson's $1/3$ rule. **(8)**

b. Use Newton Raphson method to evaluate square root of 5 correct up to three decimal places. **(8)**

**Q.3** a. Obtain a second degree polynomial approximation to $f(x) = \cos x, x \in [0, \pi/4]$ using the Taylor series expansion about x = 0. Use the expansion to approximate $f\left(\pi/6\right)$ and find a bound of the truncation error. **(8)**

b. Use the secant method to determine the root of the equation $\cos x - xe^{x} = 0$ (3 iterations) **(8)**

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

$$2x + 3y + z = 9$$
$$x + 2y + 3z = 6$$
$$3x + y + 2z = 8$$

b. Solve the following system of equations using Jacobi's method. (show upto 5 iterations) **(8)**

$$10x + 2y + z = 9$$
$$2x + 20y - 2z = -44$$
$$-2x + 3y + 10z = 22$$

**Q.5** a. Why C language is called mid level language. Justify with an example. **(8)**

b. Using sin (0.1) = 0.09983 and sin (0.2) = 0.19867, find an approximate value of sin (0.15) by lagrange interpolation. Obtain a bound on the truncation error. **(8)**

**Q.6** a. For the following data, calculate the differences and obtain the forward difference polynomial. Interpolate at x = 0.25

| | | | | | |
|---|---|---|---|---|---|
| x: | 0.1 | 0.2 | 0.3 | 0.4 | 0.5 |
| *f*(x): | 1.40 | 1.56 | 1.76 | 2.00 | 2.28 |

**(8)**

b. Find the linear least square approximation to $f(x) = e^{x}; x \in [0,1]$. **(8)**

**Q.7** a. Evaluate $\int_{0}^{3} \left(2x - x^{2}\right) dx$ taking six intervals using trapezoidal rule. **(8)**

b. Evaluate the integral $I = \int_{0}^{1} \frac{dx}{1 + x}$ using Gauss-Legendre two point and three point formula. **(4+4 = 8)**

**Q.8** a. use 7-point Simpson's rule with equally spaced points to solve the integral

$$\int_{1.25}^{3.5} f(x)dx \text{ ; where } f(x) = \begin{cases} (x+7)/3, & 1.25 \le x \le 2.0 \\ \left(10 - x^{2}\right)/2, & 2.0 \le x \le 3.5 \end{cases}$$ **(8)**

b. The following table of values is given:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| x: | -1 | 1 | 2 | 3 | 4 | 5 | 7 |
| f(x): | 1 | 1 | 16 | 81 | 256 | 625 | 2401 |

Using the formula $f'(x_1) = \frac{f(x_2) - f(x_0)}{2h}$ and Richardson extrapolation, find $f'(3)$. **(8)**

**Q.9** a. Given $\frac{dy}{dx} = 1 + y^2$, where $y(0) = 0$, find $y(0.4)$ using Runge kutta fourth order formula (Take h = 0.2). **(8)**

b. Using Gaussian Elimination with partial pivoting solve the system

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

**(8)**