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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

June, 2016

04216

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note : *Simple (but not scientific) calculator is allowed. Question no. 1 is* ***compulsory.*** *Attempt any* ***three*** *questions from the next four questions.*

1. (a) Explain the concepts of (i) chopping, (ii) rounding, each with a suitable example. 3

(b) Using 8-decimal digit floating-point representation (with four digits for mantissa, two for exponent and one each for sign of exponent and mantissa), represent the following numbers in normalized floating point form (use chopping, if required) : 3

(i) 89543

(ii) – 89·766

(iii) 0·0007345

(c) For two floating point numbers
$x_1 = 0{\cdot}7108 \times 10^5$ and $x_2 = 0{\cdot}8701 \times 10^4$,
find $x_1 + x_2$. *2*

(d) Find the product of the two numbers given in question no. 1(c) above. *3*

(e) Write the following system of equations in matrix form : *2*

$$-9x - 8y = -4$$
$$3x + 4y = -17$$

(f) Show one iteration of solving the following system of linear equations using any iterative method. You may assume $x = y = 0$ as the initial estimate : *3*

$$-6x + 8y = -2$$
$$4x + 7y = -11$$

(g) Find an interval in which the following equation has a root : *2*

$$x^2 + 9x + 20 = 0$$

(h) Write the formula used in Secant method for finding the root of an equation. *2*

(i) Write the three expressions which are obtained by applying each of the following operators to f(x), for some h : 3

(i) E

(ii) Δ

(iii) ∇

(j) Write each of ∇ and δ in terms of E. 2

(k) State the following two formulae for interpolation : 3

(i) Newton's backward difference formula

(ii) Bessel's formula

(l) Construct a difference table for the following data : 2

x	4	5	6	7
f(x)	13	22	33	46

(m) From the Newton's backward difference formula asked in part k(i) above, derive the formula for finding the derivative of a function at $x = x_0$. 3

(n) State Simpson's $\frac{1}{3}$ rule for finding the value of $\int_a^b f(x)\,dx$. 3

(o) Explain each of the following concepts with a suitable example : 4

(i) Order of a differential equation

(ii) Initial Value Problem

(iii) Degree of a differential equation

(iv) Non-linear differential equation

2. (a) For each of the three numbers of Q.No. 1(b), find relative error in its normalized floating point representation. 6

(b) Using Maclaurin's series expansion, find the value of $(1 - x)^{-1}$, at $x = 0$, by taking the first three terms and find truncation error. 4

(c) Attempt to solve the following system of linear equations using the Gauss elimination method :

$$3x_1 + 2x_2 + x_3 = 3$$

$$2x_1 + x_2 + x_3 = 0$$

$$6x_1 + 2x_2 + 4x_3 = 6$$

Does the solution exist ? If yes, how many ? 5

(d) Starting with $x_0 = 0$, perform two iterations to find an approximate root of the equation $x^3 - 4x + 1 = 0$, using Newton-Raphson method. 5

3. (a) Solve the following system of linear equations using Gaussian elimination method with partial pivoting condensation :

$$3x_2 + 4x_3 = 2$$

$$4x_1 - 2x_2 + x_3 = 18$$

$$3x_1 + 4x_2 + 5x_3 = 11$$

Compute upto two decimals only. 12

(b) Give the formula for next approximation of values of x_1, x_2 and x_3 using Gauss-Jacobi iterative method for solving the following system of linear equations : 4

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = b_1$$

$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = b_2$$

$$a_{31}x_1 + a_{32}x_2 + a_{33}x_3 = b_3$$

(c) Discuss the relative merits and demerits of direct methods over iterative methods for solving a given system of linear equations. 4

4. (a) Construct a difference table for the following data and mark the forward differences by underlying the numbers : *8*

x	1	2	3	4	5	6	7	8
y	7	13	18	25	35	48	62	78

(b) Derive the operators δ and Δ in terms of E. *5*

(c) Find Newton's backward difference form of interpolating polynomial for the following data :

x	3	5	7	9	11	13
f(x)	16	36	64	100	144	196

Hence evaluate f(12). *7*

5. Attempt any ***two*** parts of (a), (b) and (c) given below :

(a) Find the approximate value of $I = \int_0^1 \frac{dx}{2+3x}$ using Simpson's $\frac{1}{3}$ rule (three points). *10*

(b) The values of $y = \sqrt{x}$ are given below for $x = 1{\cdot}5\ (0{\cdot}5)\ 3{\cdot}5$.

x	1·5	2·0	2·5	3·0	3·5
f(x)	1·2247	1·4142	1·5811	1·7320	1·8708

Find y' and y'' at $x = 1{\cdot}75$ using FD formula. *10*

(c) Solve the following IVP using Euler's method :

$$y' = f(t, y) = 1 + y; \quad \text{given } y(0) = 1$$

Find the solution on $[0, 0{\cdot}8]$ with $h = 0{\cdot}2$. *10*