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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

04752

June, 2019

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) Use of calculator is allowed during examination.

*(ii) Question no. **1** is **compulsory.** Attempt any **three** questions from questions no. **2** to **5**.*

1. (a) Find the sum of two floating-point numbers $x = 0{\cdot}6239 \times 10^6$ and $y = 0{\cdot}5163 \times 10^4$. *2*

(b) Find the product of x and y where the value of x and y are given in part (a) of this question. *2*

(c) What is 'underflow' ? Give an example of multiplication due to which underflow occurs. *3*

(d) Write the following system of linear equations in matrix form : 2

$$3x + 5y + 8z = 0$$

$$3y + 2z = 7$$

$$2x - 3z = -6$$

(e) Solve the following system of linear equations using the Gauss elimination method : 4

$$13x - 7y = 2$$

$$5x + 3y = 15$$

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

$$2x^2 - 11x + 14 = 0$$

(g) Show two iterations of Newton-Raphson method for finding approximate root of the equation

$x^2 + x - 6 = 0$ starting with $x_0 = 1$. 3

(h) Write the notation and formula for the following operators : 3

(i) Central difference operator

(ii) Shift operator

(iii) Forward difference operator

(i) Write ∇ and δ in terms of E. *3*

(j) Define the term interpolation with the help of an example. State the Newton's backward difference formula for interpolation. *2+2=4*

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

x	4	6	8	10
f(x)	9	15	29	31

(l) From the Newton's backward difference formula asked in part (j), derive a rule/formula for finding the derivative of a function f(x) at $x = x_0$. *3*

(m) State trapezoidal rule for finding the approximate value of integral

$$\int_a^b f(x)\,dx\,.$$

Also show it geometrically. *3*

(n) Define the following terms and give one example for each of the following in the context of differential equations : 4

(i) Order

(ii) Degree

(iii) Initial conditions

(iv) Boundary conditions

2. (a) Assuming an 8-decimal digit floating point representation (with 4 digits for mantissa, two digits for exponent and one each for sign of mantissa and exponent), represent the following numbers in normalised floating point form (use chopping, if required). 3

(i) 23563255

(ii) – 63·27832

(iii) – 0·0000235

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

(c) Obtain the approximate value of smallest positive root of the equation

$$x^3 + 4x - 12 = 0,$$

by using three iterations of bisection method. 6

(d) Find the Maclaurin's series of $f(x) = e^x$, around $x = 0$. (Please note $\frac{d}{dx} e^x = e^x$)

Calculate the approximate value of e using first four terms of this series. 5

3. (a) Solve the following system of linear equations with pivotal condensation Gaussian elimination method : 10

$$2x + 3y - z = 11$$
$$x - 5y + 7z = 0$$
$$3x - y - 3z = 4$$

(b) Solve the following system of linear equations using Gauss-Jacobi iterative method. Perform only three iterations.

$$5x - 7y + 3z = 15$$
$$x - 5x - 2z = 4$$
$$3x + 2y + z = 2$$

Take initial estimates as $x = 0$, $y = 0$ and $z = 0$. 6

(c) Define the following with the help of an example : 4

(i) Ill conditioned problem

(ii) Rounding off errors

(iii) Algebraic equations

(iv) Transcendental equations

4. (a) Find the Newton's forward-difference interpolating polynomial for the following data :

x	1	2	3	4	5	6
f(x)	12	22	44	84	148	242

Hence, obtain the value of f(x) at x = 1·5 and x = 2·5. *8*

(b) Estimate the missing term (represented by '?') in the following data, if it represents a valid interpolating polynomial of degree 3. *6*

x	1	2	3	4	5
f(x)	5	24	?	128	225

(c) Given the following data for interpolation :

x	0	1	5	15
f(x)	20	60	120	200

To find the value of f(x) at x = 2, which of the following methods will be used by you ?

- Bessel's interpolation formula
- Newton's FD formula
- Lagrange's interpolation method

Give reasons in support of your answer. *3*

(d) What is inverse interpolation ? Explain with the help of an example. 3

5. Attempt any ***two*** of the following parts : $2 \times 10 = 20$

(a) Find the approximate value of the integral

$$I = \int_{0.2}^{1.0} \frac{dx}{\sqrt{1+x^2}}$$

by Simpson's $\frac{1}{3}$rd rule dividing the interval [0·2, 1·0] to 4 equal sub-intervals. Compute up to four places of decimal only.

(b) Find the value of $f'(x)$ or y' and $f''(x)$ or y'' at $x = 1{\cdot}25$ for the values of $y = x^{2/3}$ given in the following table :

x	1·0	1·5	2·0	2·5	3·0
$y = f(x) = x^{2/3}$	1	1·310	1·587	1·842	2·080

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

$$y' = 1 - 2xy, \text{ assume that } y(0) = 1.$$

Find the solution in the interval [0, 0·8] with $h = 0{\cdot}2$.