No. of Printed Pages : **4**

BCS-054

02874

BACHELOR IN COMPUTER APPLICATIONS

Term-End Examination

December, 2013

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : **100***

Note : *(i) Simple (but not scientific) calculator is allowed during examination.*

*(ii) Question number **1** is **compulsory.** Attempt **any three** from the next **four** questions.*

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1. (a) Using 8- decimal digit floating-point representation (4 digits for mantissa, 2 digits for exponent and one each for sign of exponent and mantissa), represent the following numbers in normalized floating point form : **3**

(i) -47.65

(ii) 0.00658

(iii) -98674

(use chopping, if required)

(b) Find the sum of two floating numbers $x_1 = 0.3425 \times 10^2$ and $x_2 = 0.5307 \times 10^3$. **2**

(c) Find the product of two numbers in (b) above **2**

(d) What is overflow ? Give an example of multiplication due to which overflow occurs. **3**

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

$$-3x + 5y = 11$$
$$9x + 14y = 3$$

(f) Solve the following system of linear equations using Gauss elimination method : 3

$$2x + 5y = 9$$
$$4x + 3y = 11$$

(g) Find an interval in which, the following equation has a root $x^2 - 5x + 6 = 0$ 2

(h) Write briefly the steps of bisection method to find roots of an equation 3

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

(i) Δ (ii) ∇ (iii) δ

(j) Write ∇ 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	1	3	5	7
$f(x)$	4	6	8	10

(m) From the Newton's Backward formula asked in part k(i) derive rule / formula for finding derivative of a function $f(x)$ at x_0 3

(n) State Simpson's rule for computing 3

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

(o) Define each of the concepts with suitable examples 4

(i) Differential Equation

(ii) Initial value problem

2. (a) Briefly discuss how zero is represented as a floating point number for the 8-decimal digit representation mentioned in Q.No. 1(a). 4

(b) For each of the following numbers find floating point representation, if possible normalized, using rounding , if required. The format is 8-decimal digit as is mentioned under Q.No. 1(a) : 6

(i) 7854302 (ii) $2\frac{2}{3}$

Find absolute error, if any, in each case.

(c) Let $a = 476.9 \times 10^6$, $b = 657.2 \times 10^4$ and $c = -5.342 \times 10^4$ Find out whether '+'is associative for a, b and c ? (i.e, you have to find out whether $(a+b)+c = a+(b+c)$or not ?) 10

3. (a) Solve the following system of linear equations, using partial pivoting : 12

$$2x_1 - 3x_2 + 5x_3 = 4$$
$$x_1 + 5x_2 - 4x_3 = 2$$
$$4x_1 + 3x_2 - 7x_3 = 0$$

(b) For solving a system of three linear equations, how the two iterative methods, viz. Gauss-Jacobi method and Gauss-Seidel method differ from each other. 4

(c) What are the relative advantages of direct methods over iterative methods for solving a system of linear equations ? 4

4. (a) For $f(x)=5x^2+7x+8$, find $\Delta^3 f(x)$. 6

(b) Estimate the missing term the in the following data using FD (Forword Difference) : 8

x	100	101	102	103	104
log (x)	2.000	2.0043	?	2.0128	2.0170

(c) Use Linear Interpolation to find $f(0, 4)$ for $f(x) = 6^x$ **6**

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

(a) Find $f'(x)$ at $x = 0.1$ from the following table of values : **10**

x	0.1	0.2	0.3	0.4	0.5
$f(x)$	1.1051	1.2214	1.3498	1.4918	2.56

(b) Find approximate value of $\int_1^2 \frac{dx}{1+x}$ using trapezoidal rule using n = 1 **10**

(c) Using Euler's method to find the solution of $y' = t + y$, given $y(0) = 1$ find the solution on interval [0, 0.8] with h = 0.2. The independent variable is t. **10**

No. of Printed Pages : 4

BCS-054

BACHELOR IN COMPUTER APPLICATIONS

Term-End Examination

June, 2014

03753

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note : *(i) Simple (but not scientific) calculator is **allowed**.*

*(ii) Question No. **1** is **compulsory**. Attempt **any three** from the next **four** questions.*

---

1. (a) Using 8-decimal digit floating point representation (4 digits for mantissa, 2 for exponent and one each for sign of exponent and mantissa), represent the following numbers in normalised floating point form : **3**

(i) 89.36

(ii) -0.00004375

(iii) 87604

(use chopping, if required)

(b) Find the sum of two floating numbers $x_1 = .5307 \times 10^4$ and $x_2 = .4252 \times 10^3$ **2**

(c) Find the product of the two numbers in (b) above. **2**

(d) What is underflow ? Give an example of multiplication in which underflow occurs. **3**

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

$$5x - 9y = 14$$
$$2x + 5y = 11$$

(f) Solve the following system of linear equations using Gauss elimination method : 3

$$3x + 4y = 11$$
$$x + 3y = 7$$

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

$$x^2 - 7x + 12 = 0$$

(h) Write formula used in Newton - Raphson method for finding the roots of an equation. 3

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

(i) δ (ii) E (iii) μ

(j) Write Δ and δ in terms of E. 2

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

(i) Newton's Forward difference formula

(ii) Stirling's formula

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

x	1	2	3	4
$f(x)$	1	4	9	16

(m) From the Newton's Forward difference formula asked in part k (i) derive formula for finding derivative of a function $f(x)$ at x_o. 3

(n) State Trapezoidal rule for finding the integral $\int_a^b f(x)\,dx$ 3

(o) Define each of the concepts with suitable example. 4

(i) Degree and order of a differential equation

(ii) Initial Value Problem

2. (a) Explain the advantages of normalized floating point number over un-normalized numbers. 4

(b) For each of the following numbers, find floating point representation, if possible normalized, using chopping, if required. The format is 8-digit as is mentioned in Q. No. 1 (a) : 6

(i) $\frac{1}{3}$ (ii) 987668

Find absolute error, if any, in each case.

(c) Let $a = 234.5 \times 10^3$, $b = 4.789 \times 10^3$ and $c = -6.903 \times 10^1$ 10

Find out whether '+' is associative or not for a, b and c ? (i.e. you have to find out whether $(a+b)+c = a+(b+c)$ or not ?

3. (a) Solve the following system of equations, using partial pivoting : 12

$-3x_1 + 5x_2 - x_3 = 1$

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

$x_1 + x_2 - 2x_3 = 0$

(b) For solving a system of linear equations : 4

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

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

$a_{31}\, x_1 + a_{32}\, x_2 + a_{33}\, x_3 = b_3$, by iterative Gauss-Jacobi Method, with initial approximations, $x_1 = 0 = x_2 = x_3$, give formulas for next approximations of x_1, x_2 and x_3.

(c) What are the advantages of iterative methods over direct methods for solving a system of linear equations. 4

4. (a) For $f(x)=7x^2-3x+11$, find $\Delta^3 f(x)$. 6

(b) Construct a difference table and mark the forward differences for the following data : 8

x	1	2	3	4	5
$f(x)$	7	15	20	26	35

(c) Given $f(x)=\sin x$, 6
$f(0.1)=0.09983$ $f(0.2)=0.19867$; use the method of linear interpolation to find $f(0.17)$.

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

(a) The values of $y=\sqrt{x}$ are given below for $x=1.5(0.5)3.5$. **10**

x	1.5	2.0	2.5	3.0	3.5
$\sqrt{x}$	1.2247	1.4142	1.5811	1.7320	1.8708

Find y' at $x=2.20$ using FD formula.

(b) Find approximate value of $\int_2^3 \frac{dx}{1+x^2}$, using trapezoidal rule using $n=1$. **10**

(c) We are given the Initial Value Problem (IVP) $y'=1-2xy$, $y(0.2)=0.1948$ with $h=0.2$, using Euler's Method, find $y(0.4)$. The independent variable is x. **10**

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

01734

December, 2014

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note : *Simple (but not scientific) calculator is allowed. Question number **1** is **compulsory**. Attempt any **three** from the next four questions.*

---

1. (a) 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 rounding, if required) : *3*

(i) 9561

(ii) – 74·794

(iii) – 0·00726

(b) What is an overflow ? Give an example involving addition of numbers in which overflow occurs. 3

(c) Find the sum of two floating-point numbers : 2

$$x_1 = 0{\cdot}4507 \times 10^3 \text{ and } x_2 = 0{\cdot}5671 \times 10^5$$

(d) Find the product of the two numbers given in question. no. 1(c) above. 2

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

$$-8x + 6y = 13$$
$$9x - 5y = 7$$

(f) Solve the following system of linear equations using Gauss Elimination method : 3

$$4x + 3y = 1$$
$$7x - 2y = -20$$

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

$$x^2 - 8x + 11 = 0$$

(h) Write the formula used in Regula-Falsi method for finding the roots of an equation. 3

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

(i) Δ

(ii) δ

(iii) D

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

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

(i) Newton's Backward difference formula

(ii) Stirling's formula

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

x	1	2	3	4
f(x)	2	9	28	65

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

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

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

(i) Degree and order of a differential equation

(ii) Boundary Value Problem

2. (a) Can the number zero (0) be represented as a normalized floating point number ? Why or why not ? Further, under representation of question no. 1(a), how many floating point representations (including all un-normalized representations) are possible for the number zero ? 4

(b) For each of the following numbers, find the floating point representation, if possible normalized, using rounding if required. The format is 8-digit as is mentioned in question no. 1(a) : 6

(i) 2/7

(ii) 896786

Further, find absolute error, if any, in each case.

(c) Find the product of the two numbers : 6

$a = -0{\cdot}5203 \times 10^4$ and $b = -0{\cdot}6251 \times 10^{-5}$.

(d) Find the approximate value of $e = e^1$, by taking first four terms of Maclaurin's series, and also find truncation error. 4

3. (a) Solve the following system of equations, using partial pivoting Gaussian elimination method (compute upto two places of decimal only) : 12

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

$$3x_1 + 5x_2 - 2x_3 = 6$$

$$x_1 - 2x_2 - x_3 = -2$$

(b) Give formula for next approximations of values of x_1, x_2 and x_3 using Gauss-Seidel method for solving a system of linear equations of the form 4

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

$$a_{21}\,x_1 + a_{22}\,x_2 + a_{23}\,x_3 = b_2 \text{ and}$$

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

(c) What are the advantages of Direct methods over Iterative methods for solving a system of linear equations ? 4

4. (a) For $f(x) = 8x^3 - 5x^2 + 12$, find $\Delta^4 f(x)$. *6*

(b) Construct a difference table and mark the backward differences for the following data : *8*

x	1	2	3	4	5	6
f(x)	5	13	18	24	33	40

(c) Estimate the missing term 'A' in the following data, where it represents a polynomial of degree three : *6*

x :	1	2	3	4	5
f(x) :	3	7	A	21	31

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

(a) Given the following values of $f(x) = ln\ (x)$, find the approximate value of $f'(2{\cdot}0)$. *10*

x	2·0	2·2	2·6
f(x)	0.69315	0.78846	0.95551

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

(c) Solve the following IVP using Euler's method : *10*

$y' = 1 - 2xy$, $y(0{\cdot}2) = 0{\cdot}1948$

Find $y(0{\cdot}4)$ with $h = 0{\cdot}2$.

No. of Printed Pages : 7

BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

02083

June, 2015

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note : *Simple (but not scientific) calculator is allowed. Question number **1** is **compulsory**. Attempt any **three** from the next four questions.*

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

(i) 87426

(ii) – 94·27

(iii) – 0·000346

(b) For the following two floating point numbers

$x_1 = 0{\cdot}4527 \times 10^4$ and $x_2 = 0{\cdot}5243 \times 10^3$, find $x_1 - x_2$. 2

(c) Find the product of x_1 and x_2 given in Q. No. 1(b) above. 2

(d) What is underflow ? Explain it with an example of multiplication in which underflow occurs. 3

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

$$6x + 8y = 10$$

$$-5x + 3y = 11$$

(f) Solve the system of linear equations given in Q. No. 1 (e) above. 3

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

$$4x^2 - 4x - 3 = 0$$

(h) Give one example of each of (i) algebraic equation (ii) transcendental equation. 2

(i) Write the expressions, which are obtained by applying each of the operators to f(x), for some h : 4

(i) ∇

(ii) Δ

(iii) E

(iv) δ

(j) Write Δ and δ in terms of E. 2

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

(i) Newton's Backward Difference Formula

(ii) Newton's Forward Difference Formula

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

x	1	2	3	4
f(x)	2	9	28	65

(m) From the Newton's Forward Difference Formula asked in Q. No. 1(k) (ii) above, derive the formula for finding derivative of a function at x_0. 3

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

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

(i) Initial Value Problem

(ii) Degree and order of a differential equation

2. (a) Let min. and max. represent respectively minimum and maximum positive real numbers representable by some floating point number system. Can every real number between max. and min. be representable by such a number system ? Explain the reason for your answer. 4

(b) For each of the following numbers, find the floating point representation, if possible normalized, using chopping, if required. The format is 8-digit as is mentioned in Q. No. 1(a) above :

(i) 3/11

(ii) 74·0365

Further, find the absolute error, if any, in each case. 6

(c) Find a ÷ b (a divided by b) for the floating point numbers : 6

$a = -0{\cdot}4783 \times 10^4$; $b = 0{\cdot}5237 \times 10^{-5}$.

(d) Find the Taylor's series for x^{-1} at a = 1. 4

3. (a) Solve the following system of equations, using partial pivoting Gaussian elimination method (compute upto two places of decimal only) : 12

$$4x_1 - 5x_2 + 6x_3 = 24$$

$$3x_1 - 7x_2 + 2x_3 = 17$$

$$5x_1 + 2x_2 - 4x_3 = -21$$

(b) What are the advantages of Direct methods over Iterative methods for solving a system of linear equations ? 4

(c) For solving the following system of linear equations

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

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

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

with $a_{11} \neq 0 \neq a_{22}$ and $a_{33} \neq 0$, by iterative Gauss-Jacobi Method, with initial approximations as $x_1 = 1 = x_2 = x_3$, find the values of next approximations of x_1, x_2 and x_3. 4

4. (a) Compute the difference table and mark the forward differences for x = 5. 8

x	f(x)
1	4
2	7
3	12
4	19
5	28

(b) For the table given above, find Newton's forward differences interpolating polynomial and find the value f(1·7) using the polynomial. 12

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

(a) If, in the Table of Q. No. 4(a), f(x) represents the distance covered by a particle in x units of time, estimate the velocity and acceleration of the particle at x = 1·5. 10

(b) Evaluate the integral

$$\int_0^5 (2x^2 - 5x + 2)\, dx,$$

using trapezoidal rule, with h = 1·0. *10*

(c) Solve the following IVP using Euler's method : *10*

$y' = f(x, y) = x + y$, given $y(0) = 1$.

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2015

05869

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note : *Simple (but not scientific) calculator is allowed. Question number **1** is **compulsory**. Attempt **any three** from the next **four** questions.*

---

1. (a) Explain, with suitable examples, the advantages of using Normalized form for representing numbers. 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) 8975

(ii) -897.87

(iii) -0.0078456

(c) For two floating point numbers $x_1 = 0.6187 \times 10^4$ and $x_2 = 0.5306 \times 10^3$, find $x_1 - x_2$ in floating point representation. 2

(d) Find the product of the two numbers given in question number 1(c) above. 2

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

$$7x - 5y = 9$$

$$-8x - 4y = -13$$

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

$$-8x + 7y = 15$$

$$5x - 2y = -7$$

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

$$x^2 - 5x + 6 = 0$$

(h) Write the formula used in Newton-Raphson method for finding root of an equation. 3

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

(i) ∇ (ii) E (iii) D

(j) Write each of Δ and μ in terms of E. 2

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

(i) Newton's Forward difference formula

(ii) Stirling's formula

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

x	1	2	3	4
$f(x)$	2	5	10	17

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

(n) State Trapezoidal rule for finding the value of integral $\int_a^b f(x)\,dx$. 3

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

(i) Boundary Value Problem.

(ii) Order of a differential equation.

2. (a) For each of the three numbers of question number 1(b), find relative error in its normalized floating point representation. 6

(b) Find approximate value of e by taking first three terms of Maclausin's series and also find the truncation error. 4

(c) Solve the following system of linear equations using Gaussian elimination method and comment on the nature of solution. 5

$$12x_1 + 18x_2 - 5x_3 = 25$$
$$3x_1 - 5x_2 + 7x_3 = 05$$
$$9x_1 + 23x_2 - 12x_3 = 20$$

(d) Obtain the smallest positive root of the equation $x^3 - 5x + 1 = 0$, by using three iterations of bisection method. 5

3. (a) Solve the following system of linear equations with partial pivoting condensation. Gaussian elimination method. 12

$$x_1 - x_2 + 3x_3 = 3$$
$$2x_1 + x_2 + 4x_3 = 7$$
$$3x_1 + 5x_2 - 2x_3 = 6$$

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

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

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

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

(c) Describe relative merits of each of direct methods and iterative methods of solving system of linear equations, over each other. 4

4. (a) The population of a city in a census taken once in 10 years is given below in thousands. Estimate the value in 1965. 8

Year	1961	1971	1981	1991	2001	2011
Population	35	42	58	84	120	165

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

(c) Find Newton's backward difference form of interpolating polynomial for the data : 7

x	4	6	8	10
$f(x)$	19	40	83	155

Hence evaluate $f(9)$.

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

(a) Find approximate value of $I = \int_1^3 \frac{dx}{4 + 3^x}$ **10**

using Simpson's $\left(\frac{1}{3}\right)$ rule (three points).

(b) The values of $y = \sqrt{x}$ are given below for $x = 1.5(0.5)3.5$ **10**

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 $x = 3.25$ using BD formula.

(c) Solve the following IVP using Euler's method : **10**

$y' = 1 - 2xy$, $y(0.2) = 0.1948$, Find $y(0.4)$ with $h = 0.2$.

No. of Printed Pages : 7

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.*

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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*

No. of Printed Pages : 5

BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2016

05116

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) Calculator, including scientific, is allowed during examination. However, each step of numerical calculation should be explicitly carried out by the examinee.

*(ii) Question no. **1** is **compulsory.** Attempt any **three** from rest of the four questions.*

---

1. (a) Find the sum of two floating point numbers $a = 0{\cdot}5403 \times 10^3$ and $b = 0{\cdot}7182 \times 10^4$. *3*

(b) Find the product of the two numbers a and b given above. *3*

(c) Define what is 'underflow'. Give an example of multiplication due to which underflow occurs. *4*

(d) Write the following system of linear equations in matrix form : 3

$$8x + 11y = 19$$

$$12x + 5y = 17$$

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

$$5x - 3y = 7$$

$$-2x + 9y = 5$$

(f) Find an interval in which the following equation has a root : 3

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

(g) Write briefly the steps of bisection method to find out the roots of an equation. 4

(h) Write the expressions which are obtained by applying each of the following operators to f(x) : 4

(i) δ

(ii) ∇

(i) Write E in terms of each of ∇ and δ separately. 3

(j) Construct the difference table for the following data : 3

x	1	5	9	13
f(x)	5	17	29	41

(k) State the following two formulae for interpolation (for equal intervals) : 4

(i) Newton Forward Difference Formula

(ii) Bessel's Formula

(l) Explain the concept of 'Initial Value Problem' with an example. 2

2. (a) Solve the following system of linear equations, using partial pivoting : 15

$$4x_1 - 5x_2 + 6x_3 = -24$$

$$x_1 + 3x_2 - 5x_3 = 22$$

$$-2x_1 + 8x_2 + x_3 = 11$$

(b) What are the relative advantages of iterative methods over direct methods for solving a system of linear equations ? 5

3. (a) For $f(x) = 3x^3 + 11x - 5$, find $\nabla^3 f(x)$ in terms of h, where h is an equally spaced interval. 8

(b) Estimate the missing term in the following data using backward difference assuming that the data is a valid representation of polynomial of degree 3 : 12

x	1·20	1·40	1·60	1·80	2·00
f(x)	3·3201	4·0552	4·9530	?	7·3891

4. Attempt any ***two*** of (a), (b) and (c) below :

(a) Find $f'(x)$ at $x = 0{\cdot}25$ from the following table of values : *10*

x	0·2	0·3	0·4	0·5	0·6
f(x)	2·1082	2·8706	3·4013	3·9121	4·3012

(b) Find the approximate value of $\int_2^3 \frac{dx}{3+4x}$, using Trapezoidal rule, with 5 equal parts of [2, 3]. *10*

(c) Using Euler's method to find the solution of $dy/dx = 3x + y$, given $y(0) = 3$, find the solution on the interval [0, 0·8] with $h = 0{\cdot}2$, where x is the independent variable and y is the dependent variable. *10*

5. (a) Using the 8-decimal digit floating point representation (4 digits for mantissa, 2 digits for exponent, and one each for sign of exponent and mantissa), represent the following numbers in normalized floating point form : *4*

(i) $-98{\cdot}37$

(ii) 0·000893

(Use chopping, if required)

(b) Using the 8-decimal digit format stated in Q5(a) above, briefly discuss how zero is represented as a floating point number. *6*

(c) Let $a = 476{\cdot}9 \times 10^6$, $b = 657{\cdot}2 \times 10^4$ and $c = -5{\cdot}342 \times 10^4$. Find out whether '+' is associative for a, b and c (i.e., you are required to find out whether $(a + b) + c = a + (b + c)$ or not). *10*

No. of Printed Pages : 5

BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

04872

June, 2017

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) Calculator, including scientific, is allowed during examination. However, each step of numerical calculation should be explicitly carried out by the examinee.

*(ii) Question no. **1** is **compulsory**. Attempt any **three** from the rest of the four questions.*

---

1. (a) Calculate x – y, for the following two floating-point numbers : 3

$$x = 0{\cdot}8706 \times 10^{-3},\ y = 0{\cdot}7604 \times 10^{-2}$$

(b) Find the product of x and y given in (a) above. 3

(c) Explain what is 'overflow', with a suitable example of multiplication. 4

(d) Write the following system of linear equations in matrix form : 3

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

$$12x = 23$$

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

$$-7x + 5y = 3$$

$$2x - 8y = -12$$

(f) Find an interval in which the following equation has a root : 3

$$2x^2 + 6x - 7 = 0$$

(g) Write briefly the steps of the Secant Method to find out the roots of an equation. 4

(h) Write the expressions which are obtained by applying each of the following operators to f(x) : 4

(i) ∇

(ii) Δ

(i) Write Δ in terms of each of (i) E and (ii) δ separately. 3

(j) Construct the difference table for the following data : 3

x	2	7	11	17	23
f(x)	17	32	49	73	143

(k) State the following two formulae for interpolation (for equal intervals) : 4

(i) Stirling's Formula

(ii) Newton's Backward Difference Formula

(l) Explain the concepts of 'order' and 'degree' of a differential equation, with an example. 2

2. (a) Using either Gauss-Jacobi iterative method or Gauss elimination method with partial pivoting, solve the following system of linear equations : 15

$$3x - 5y + 6z = 11$$

$$5x - 11z = -28$$

$$2y + 9z = 31$$

(b) Discuss the merits and demerits of direct approach over iterative approach for solving a system of linear equations. 5

3. (a) For $f(x) = 4x^3 - 3x^2 + 8$, find $\Delta^3 f(x)$ in terms of h, where h is an equally spaced interval. 8

(b) Estimate the missing term in the following data using FD (Forward Difference) assuming that the data is a valid representation of a polynomial of degree 3. 12

x	1·00	1·20	1·40	1·60	1·80
f(x)	2·7183	?	4·0552	4·9530	6·049

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

(a) Approximate the value of $\int_3^4 \frac{dx}{4-3x}$ using the Trapezoidal rule, using five equal parts of the interval [3, 4]. *10*

(b) Using Euler's method, tabulate the solution of the Initial Value Problem (IVP) $y' = -3ty^2$, $y(0) = 1$ in the interval [0, 1], using $h = 0{\cdot}2$. *10*

(c) From the data given in the table below, find $y' = \frac{dy}{dx}$ at $x = 2{\cdot}75$ using Forward Difference. *10*

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

5. (a) Using 8-decimal digit floating-point representation (4 digits for mantissa, 2 digits for exponent, and one each for sign of exponent and mantissa), represent the following numbers (use chopping, if required) : *4*

(i) $-76{\cdot}384$

(ii) $0{\cdot}00079542$

(b) Is '+' associative when $a = 0{\cdot}2134 \times 10^5$; $b = 0{\cdot}2354 \times 10^3$ and $c = -0{\cdot}2142 \times 10^1$ are three floating-point numbers to be added, in this order ? You are required to find out whether $(a + b) + c = a + (b + c)$. *10*

(c) Explain the following two concepts with a suitable example for each : *6*

(i) Chopping error

(ii) Rounding error

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

01091

December, 2017

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) Any calculator is allowed during examination.

*(ii) Question no. 1 is **compulsory.** Attempt any **three** more from the next four questions.*

1. (a) Find the sum of two floating-point numbers $x_1 = 0{\cdot}4325 \times 10^2$ and $x_2 = 0{\cdot}3507 \times 10^3$. 2

(b) Find the product of x_1 and x_2 given above in (a). 2

(c) Explain what is 'Overflow'. Give an example of multiplication due to which overflow occurs. 3

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

$$-8x + 7y = 15$$

$$12x - 8y = 4$$

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

$$5x - 3y = 7$$
$$-7x + 15y = 1$$

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

$$x^2 - 9x + 19 = 0$$

(g) Write the formula of Newton-Raphson method for finding root of an equation. 3

(h) Write the expressions which are obtained by applying each of the following operators : 3

(i) ∇

(ii) δ

(iii) Δ

(i) Write ∇ and δ in terms of E. 3

(j) State the following two formulae for interpolation : 4

(i) Bessel's Formula

(ii) Newton's Forward Difference Formula

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

x	1	4	7	10
f(x)	6	10	14	18

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

(m) State Trapezoidal rule for finding the value of the integral $\int_a^b f(x)\,dx$. 3

(n) Define each of the following concepts with one suitable example for each : 4

(i) Differential Equation

(ii) Initial Value Problem

2. (a) Using 8-decimal digit floating point representation (with four digits for mantissa, two digits 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) 8795

(ii) – 798·78

(iii) – 0·0087456

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

(c) Find the approximate value of 'e' by taking first three terms of Maclaurin's series and also find truncation error. 5

(d) Obtain the smallest positive root of the equation $x^3 - 5x + 1 = 0$, by using three iterations of bisection method. 6

3. (a) Discuss relative merits and demerits of each of (i) direct methods, and (ii) iterative methods of solving a system of linear equations, w.r.t. each other. 4

(b) Solve the following system of linear equations using Gaussian elimination method, and comment on the nature of the solution : 6

$$12x + 18y - 5z = 25$$

$$3x - 5y + 7z = 5$$

$$9x + 23y - 12z = 20$$

(c) Solve the following system of linear equations with partial pivoting condensation Gaussian elimination method : 10

$$x - y + 3z = 3$$

$$2x + y + 4z = 7$$

$$3x + 5y - 2z = 6$$

4. (a) For $f(x) = 6x^2 + 8x + 9$, find $\Delta^3 f(x)$. *6*

(b) Estimate the missing term in the following data, using Forward Difference : *8*

x	100	101	102	103	104
log x	2·000	2·0043	?	2·0128	2·0170

(c) Derive the operators E and Δ in terms of δ. *6*

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

(a) Find the approximate value of $\int_2^3 \frac{dx}{1+x}$ using Trapezoidal rule, with $h = 0{\cdot}25$. *10*

(b) Find $f'(x)$ at $x = 0{\cdot}1$ from the following table of values : *10*

x	0·2	0·3	0·4	0·5	0·6
f(x)	1·2214	1·3498	1·4918	2·56	3·02

(c) Using Euler's method to find the solution of $y' = t + y$ given $y(0) = 1$, find the solution on the interval [0, 0·8] with $h = 0{\cdot}2$. The independent variable is t. *10*

No. of Printed Pages : 7

BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

01075 **Term-End Examination**

June, 2018

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) Any calculator is allowed during examination.

*(ii) Question no. **1** is **compulsory**. Attempt any **three** more from the next four questions.*

1. (a) Explain with suitable example, the advantages of using Normalized form of representing numbers. *3*

(b) For two floating point numbers $x_1 = 0{\cdot}7268 \times 10^5$ and $x_2 = 0{\cdot}6271 \times 10^4$, find $x_1 - x_2$ in floating point representation. *3*

(c) Find the product of two numbers given in question number 1(b) above, in floating point notation. 3

(d) Write the following system of linear equations in matrix form 3

$$-8x + 15y = -1$$

$$7x - 4y = 10$$

(e) Find an interval in which the following equation has a root

$$x^2 - 12x + 30 = 0.$$ 2

(f) Write briefly the steps of bisection method to find roots of an equation. 3

(g) Write E and μ in terms of ∇. 3

(h) Write the expressions, one for each, which is obtained by applying each of the following operators to f(x) for some $h > 0$: 3

(i) D

(ii) E

(iii) ∇

(i) State formulae for each of the following interpolations : 4

(i) Newton's Forward Difference Formula

(ii) Stirling's Formula

(j) Construct a difference table for the following data : 3

x	1	2	3	4
f(x)	8	12	17	25

(k) State Trapezoidal rule for finding the value of integral $\int_a^b f(x)\,dx$. 4

(l) Explain each of the following concepts with a suitable example : 6

(i) Boundary value problem

(ii) Order of a differential equation

(iii) Degree of a differential equation

2. (a) Using 8-decimal digit floating point representation (4 digits for mantissa, 2 for exponent and one each for signs of mantissa and exponent), represent the following numbers in normalized floating point form : *3*

(i) 0·000725

(ii) – 89·6532

(iii) – 98876

(b) Briefly discuss how ZERO is represented as a floating point number for 8-decimal digit representation mentioned above in Q. No. 2(a). *3*

(c) Let $a = 476{\cdot}9 \times 10^6$, $b = 657{\cdot}2 \times 10^4$ and $c = -5{\cdot}342 \times 10^4$. Find out, whether '+' is associative for a, b and c (i.e., you have to find whether $a + (b + c) = (a + b) + c$ or not), using 8-decimal digit representation mentioned in Q. No. 2(a). *14*

3. (a) Solve the following system of linear equations, using Partial Pivoting : 11

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

$$x + 5y - 4z = 2$$

$$4x + 3y - 7z = 0$$

(b) Explain the relative advantages of direct methods over iterative methods for solving a system of linear equations. 4

(c) Solve the following system of linear equations by Gaussian Elimination Method : 5

$$8x - 5y = 11$$

$$3x + 7y = 13$$

4. (a) The population of a city in a census taken once in 10 years is given below in thousands. Estimate the value in 1975. 8

Year	1970	1980	1990	2000	2010
Population	45	52	68	94	130

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

(c) Find Newton's Backward difference form of interpolating polynomial for the data : 7

x	f(x)
6	21
8	42
10	85
12	157

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

(a) Find approximate value of $I = \int_2^4 \frac{dx}{4 + 3^x}$ using Simpson's (1/3) rule taking h = 0·5. 10

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

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

Compute the value of f'(x) at x = 1·0. 10

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

$$y' = 1 - 2xy, \quad y(0{\cdot}2) = 0{\cdot}1948$$

Find $y(0{\cdot}4)$ with $h = 0{\cdot}1$. *10*

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

04473

Term-End Examination

December, 2018

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) Assume that a floating point representation is of eight decimal digits with four digits for mantissa, two digits for exponent and one digit each for sign of exponent and mantissa. Answer the following, using this representation (The numbers should be represented in normalised floating point form. Use chopping, if required).

Represent :

(i) – 235

(ii) – 2576

(iii) + 0·007567 *3*

(b) What are the advantages of representing floating point numbers in normalised form ? 2

(c) If $x_1 = 2{\cdot}98 \times 10^2$ and $x_2 = 1{\cdot}97 \times 10^1$ are two floating point numbers, then find the value of $x_1 - x_2$. You must show all the steps. 2

(d) If $x_3 = 2{\cdot}71 \times 10^4$ and $x_4 = -1{\cdot}53 \times 10^{-5}$ are two floating point numbers, find the value of $x_3 \times x_4$. Show all the steps. 2

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

$$2x + y + z = 5$$

$$x + 3z = 9$$

$$2y + 5z = 11$$

(f) Show one iteration of solving the following system of linear equations using Gauss – Jacobi iterative method. You may assume $x = 1$ and $y = 1$ as initial estimate. 3

$$2x + 3y = 8$$

$$3x + 5y = 13$$

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

$$4x^2 + 4x - 35 = 0$$

(h) Explain how calculation of next estimate differs in Newton – Raphson method and Bisection method of solving non-linear equations. 3

(i) Write the symbol and formula with respect to f(x) and some value of h for the following operators : 3

(i) Forward difference

(ii) Central difference

(iii) Shift operator

(j) Express forward difference and backward difference operators in terms of shift operator. 2

(k) State the Newton's forward difference formula for interpolation. 2

(l) Given the following data :

x	0	2	10	30
y	5	10	40	70

To find the value of y at x = 5, which of the methods will you choose from the Lagrange's method or Newton's backward difference formula ? Give reason in support of your answer. 3

(m) From the forward difference formula for interpolation asked in question 1(k), derive the formula for finding derivative of a function f(x) at $x = x_0$. 3

(n) State and explain the Trapezoidal rule geometrically. 4

(o) Define the following terms in the context of differential equations : 4

(i) Order

(ii) Degree

(iii) Initial condition

(iv) Boundary condition

2. (a) Explain the following terms with the help of an example : 8

(i) Truncation error

(ii) Absolute error

(iii) Overflow

(iv) Unstable problem

(b) Obtain the smallest positive root of the equation

$$x^3 - x - 3 = 0,$$

by using three iterations of Bisection method. 6

(c) What is Maclaurin series ? Find the Maclaurin series of $f(x) = e^x$ around $x = 0$. 6

3. (a) Solve the following system of linear equations using Gaussian elimination method with partial pivoting condensation : *10*

$$x - 2y + z = 1$$

$$3x + y + 3z = 10$$

$$2x + 3y - 5z = 2$$

(b) Using Gauss – Seidel iterative method, show two iterations of solving the following system of linear equations : *6*

$$4x_1 - x_2 + x_3 = 10$$

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

$$x_1 + 2x_2 + x_3 = 7$$

Take initial estimate as $x_1 = x_2 = x_3 = 0$.

(c) Which of the two methods – direct or iterative, will you choose for the following types of problems. Give reasons in support of your answer. *2+2=4*

(i) When the matrix is dense and order of matrix is less than 50.

(ii) When you want small rounding off errors.

4. (a) Estimate the missing term (shown by '?') in the following data, if it represents a valid interpolating polynomial of degree 3 :

x	2	3	4	5	6
f(x)	3	7	?	21	31

Also find the interpolating polynomial using Newton's forward difference formula and find the value of f(x) at x = 2·5. *10*

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

x	2	4	6	8
f(x)	21	41	80	140

Hence, evaluate f(7). *6*

(c) Find the $\Delta^2 f(x)$ and $\Delta^3 f(x)$ for the square function $f(x) = x^2$. *2+2=4*

5. Attempt any two parts of (a), (b) and (c) given below. Each part is of 10 marks. *10+10=20*

(a) The value of $y = x^{3/2}$ are given for $x = 1{\cdot}0\ (0{\cdot}5)\ 3{\cdot}0$.

x	1·0	1·5	2·0	2·5	3·0
$y = x^{3/2}$	1·00	1·84	2·83	3·95	5·20

Find y' and y'' at $x = 1{\cdot}25$ using FD formula.

(b) Evaluate :

$$\int_1^6 (2 + x^2)\, dx$$

using Simpson's $\frac{1}{3}$ rule with 11 points.

(c) Using Euler's method, find the solution of the differential equation

$$y' = t^2 + y, \text{ given } y(0) = 1.$$

Find the solution on the interval [0, 0·8] with $h = 0{\cdot}2$ (Please note t is an independent variable).

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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**.*

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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 :

$y' = 1 - 2xy$, assume that $y(0) = 1$.

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

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2019

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : *Question No. 1 is compulsory. Attempt any* ***three*** *more questions from the questions no.* ***2*** *to* ***5****. Use of any calculator is permitted.*

1. (a) Find the absolute error and relative error in the numbers 432.8 and 0.12584 if four digit mantissa is used and chopping is used for approximation. 4

(b) Round the following numbers to two decimal places : 2

38.21416, 4.3742, 82.375, 2.4869

(c) For the following two floating point numbers : 3

$$x_1 = 0.5527 \times 10^4$$

and $$x_2 = 0.6243 \times 10^3$$

find $x_1 - x_2$. The result should be rounded to four decimal digits.

(d) Find the product of x_1 and x_2 given in Q. No. 1 (c) above. The result should be chopped to four decimal digits. 3

(e) Find the Newton's forward difference interpolating polynomial for the following data. Hence obtain the value of $f(x)$ at $x = 1.5$: 6

x	$f(x)$
1	34
2	60
3	90
4	124
5	162
6	204

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

$$x + 2y + 3z = 14$$
$$x - y = -1$$
$$y + 3z = 11$$

(g) Solve the following system of linear equations using Gauss-Seidel iterative method : 5

$$x + 6y = 13$$
$$4x - y = 2$$

Perform two iterations, taking $x = 0$ and $y = 0$ as the initial values.

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

$$2x^3 + x^2 - 20x + 12 = 0$$

(i) Find Δf for the following functions for some $h > 0$: 3

(i) $f(x) = 3x^2$

(ii) $f(x) = 2x$

(j) Find the approximate value of $I = \int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal rule dividing the interval into five equal parts. 10

2. (a) Using an 8-decimal digit floating point representation (4 digits for mantissa, 2 for exponent and 1 each for sign for exponent and sign for mantissa) represent the following numbers in normalised floating point from (using chopping if required) : 6

(i) 92752

(ii) –93.231

(iii) –0.0012345

(b) Solve the following system of linear equations by using Gaussian elimination method : 8

$$x_1 - x_2 - x_3 = -3$$

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

$$x_1 - 2x_3 + 3x_3 = -11$$

(c) Give *one* example each of the following : 6

(i) Ill conditional problem

(ii) Ordinary differential equation (ODE) of degree 3 and order 2

(iii) A system of inconsistent linear equations in two variables.

3. (a) Consider the initial-value problem : 6

$$y' = 0.2xy,\ y(1) = 1$$

Use Euler's method to obtain an approximation to $y(1.2)$ using $h = 0.1$.

(b) Using Lagrange's interpolation formula, find the form of the function $y(x)$ from the following table. Also compute $f(3)$: 7

x	y
0	6
2	20
5	56

(c) Write the expressions, one for each, which is obtained by applying each of the following operators to $f(x)$ for some $h > 0$: 4

(i) ∇

(ii) δ

(iii) μ

(iv) E

(d) Derive the relation between δ and E. 3

4. (a) Solve the following system of linear equations using partial pivoting : 10

$$x + y - 5z = 0$$

$$5x + 2y - z = 18$$

$$2x - 2y + z = 3$$

(b) Find a real root for the equation $x^3 + x - 5 = 0$.

Using Regula-Falsi method, taking x co-ordinates of initial points as $x = 0$ and $x = 2$. Perform only two iterations of the method. 7

(c) Make the Newton's divided difference table for the following data : 3

x	$f(x)$
1	10
2	20
4	40
8	80

5. (a) Explain the concept of overflow and underflow in the context of decimal floating point number with the help of ***one*** example of each. 6

(b) Find by Newton-Raphson's method, the real root of the equation $x^2 - 3x + 1 = 0$ taking $x = 2$ as the starting value. Show three iterations. 7

(c) Apply Newton's backward difference formula to the data below to obtain a polynomial of degree 4 in x: 7

x	y
1	1
2	−1
3	1
4	−1
5	1

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

June, 2020

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : *(i) Any calculator is allowed during examination.*

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

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1. (a) Write formulas for absolute error and relative error. If the represented value of X_1 is 3.1428 and its actual value is X_1 = 3.14285, find absolute and relative errors. 4

(b) Solve the following system of linear equations using Gauss Elimination method : 5

$$X_1 + X_2 + X_3 = 3$$

$$4X_1 + 3X_2 + 4X_3 = 11$$

$$9X_1 + 3X_2 + 4X_3 = 16$$

(c) Use Newton-Raphson method performing only 2 iterations, to find a root of the equation $x^3 - 2x - 5 = 0$ near the value 2. 5

(d) Prove that : 3

$$\Delta = E - 1$$

(e) Using the data given below find $f(2)$ by using the Lagrange's interpolation method : 6

x	$f(x)$
0	2
1	6
3	8

(f) Calculate the value of the Integral $\int_2^3 x^2 dx$ by using Simpson's 1/3 rule, taking $h = 0.2$. 6

(g) Given that $y' = x^2 + y$ and $y(0) = 1$, determine the value of y when $x = 0.1$, using the Euler's method. 6

(h) Assume that a floating point representation is of eight decimal digits with four digits for normalised mantissa, two digits for exponent and one digit each for sign of exponent and mantissa. Answer the following, using this representation (use chopping if required). 1, 1, 1, 2

(i) – 35678

(ii) + 0.0035622

(iii) Addition of numbers given in (i) and (ii) above

(iv) Multiplication of numbers given in (i) and (ii) above.

2. (a) Solve the following system of equations by using Gauss-Seidel iteration method. Perform only two iterations taking $x = y = z = 0$ as the initial approximation : 8

$$8x - 3y + 2z = 20$$

$$4x + 11y - z = 33$$

$$6x + 3y + 12z = 35$$

(b) Find a root of the equation : 8

$$x^3 - 2 = 0$$

using the Regula-Falsi method. Perform only two iterations.

(c) Define the order and degree of a differential equation. Find the order and the degree of the equation : 4

$$\frac{d^3y}{dx^3} + \left(\frac{dy}{dx}\right)^6 = 0$$

3. (a) Using Newton's forward interpolation formula on the table of values given below, obtain the value of y when $x = 0.4$: 7

x	y
1.1	0.21
1.3	0.69
1.5	1.25
1.7	1.89
1.9	2.61

(b) Evaluate $\int_1^3 \frac{dx}{1+x}$ by subdividing the interval (1, 3) into 8 equal parts and using Trapezoidal rule. 6

(c) Solve the following system of equations by using Gauss-Jacobi's iteration method : 7

$$8x + y + z = 8$$

$$2x + 4y + z = 4$$

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

Perform any two iterations.

4. (a) Apply Newton's backward difference interpolation formula to find $f(x)$ from the following data. Also compute $f(2.5)$: 7

x	$f(x)$
0	4
2	24
4	39

(b) Solve the following system of linear equations using Gaussian elimination method using pivotal condensation : 10

$$3x - 2y + 6z = 17$$

$$6x - y + z = 9$$

$$2x + 12y - z = -12$$

(c) Explain, how the fixed point method for solving non-linear equations is related to Newton-Raphson method. 3

5. (a) Evaluate $\int_0^1 e^{-x^2} dx$, using Rectangle rule by taking $h = 0.5$. 5

(b) Find the smallest positive root of the equation $x^3 - 3x - 5 = 0$ using the Bisection method. Perform only three iterations. 6

(c) Write the symbol and formula with respect to $f(x)$ and h for the following operators : 4

(i) Central difference

(ii) Averaging operator

(d) Explain the concept of overflow and underflow in the context of floating point decimal number representation with the help of *one* example of each. 5

BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

February, 2021

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

(i) Any calculator is allowed during examination.

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

1. (a) Define the terms 'accuracy' and 'precision'. If 0·333 is the approximate value of $\frac{1}{3}$, find absolute and relative errors. *4*

(b) Solve the following system of equations, using Gauss Elimination method. *6*

$x + y + z = 3$; $3x + 2y + 3z = 18$;

$x + 4y + 9z = 16$

(c) Find the root of the equation $x^3 + 2 = 0$, by using Newton-Raphson method, taking initial approximation as –1. Perform only two iterations. *5*

(d) Express the operators (i) Δ (ii) ∇ (iii) δ in terms of operator E. *4*

(e) Find the Lagrange interpolating polynomial that fits the following data : *6*

x :	0	1	2
f(x) :	2	3	12

(f) Evaluate the integral $\int_0^6 (x^2 + x + 2)\, dx$ using Trapezoidal rule, with h = 1·0. *5*

(g) Find the smallest positive root of the equation $x^2 - x - 1 = 0$ by Bisection method. Perform only three iterations. *5*

(h) Assume that a floating point representation is of eight decimal digits with four digits for normalised mantissa, two digits for exponent and one digit each for sign of exponent and mantissa. Answer the following, using this representation. (Use chopping if required) *1+1+1+2=5*

(i) 0·035119

(ii) 42·169

(iii) Addition of numbers given in (i) and (ii) above.

(iv) Multiplication of numbers given in (i) and (ii) above.

2. (a) Find the interpolating polynomial fitting the following data using Newton's backward difference interpolating method. *7*

x :	0	1	2	3	4
f(x) :	10	9	6	1	– 6

Hence, evaluate f(3·5).

(b) Construct the forward difference table and determine the term missing in the following data. You may assume $\Delta^4 y_0 = 0$. *8*

x :	100	101	102	103	104
f(x) :	2·000	2·0043	?	2·0128	2·0170

(c) Using Divided Difference table verify that for $f(x) = x^3$; f[a, b, c] = a + b + c. *5*

3. (a) Evaluate $\int_1^3 \sqrt{x}\, dx$ using Simpson's $\frac{1}{3}$ rule, with h = 0·5. *5*

(b) Solve the following system of equations by using Gauss-Jacobi method. Perform only two iterations, assuming $x_1 = x_2 = x_3 = 0$ as the initial approximation. *6*

$$2x_1 - x_2 + x_3 = -1$$
$$x_1 + 2x_2 - x_3 = 6$$
$$x_1 - x_2 + 2x_3 = -3$$

(c) Solve the following system of linear equations using Gaussian elimination method using pivotal condensation. *9*

$$x + y + 10z = 14$$
$$5x - y + z = 9$$
$$x - 4y + z = -5$$

4. (a) Use Secant method to find the smallest positive root of the equation $f(x) = 2^x - 5x + 2$. Perform only two iterations. *7*

(b) What are the pitfalls of Gauss elimination method ? Discuss with the help of an example for each. *5*

(c) Given that $y' = xy$ and $y(0) = 1$, determine the value of y when x = 0·4, using Euler's method with h = 0·1. *8*

5. (a) Solve the following system of equations by using Gauss-Seidel method. Perform only two iterations, assuming $x_1 = x_2 = x_3 = 0$ as the initial approximation. *7*

$$-4x_1 + x_2 + 10x_3 = 21$$

$$5x_1 - x_2 + x_3 = 14$$

$$2x_1 + 8x_2 - x_3 = -7$$

(b) Write the formula for the following operations for function f(x) and step size h. *6*

(i) Δ

(ii) ∇

(iii) δ

(iv) μ

(v) E

(vi) D

(c) State the following formulae : *4*

(i) Stirling formula for Interpolation

(ii) Bessel's formula for Interpolation

(d) Explain the concept of Boundary Value Problem with suitable example. *3*

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

June, 2021

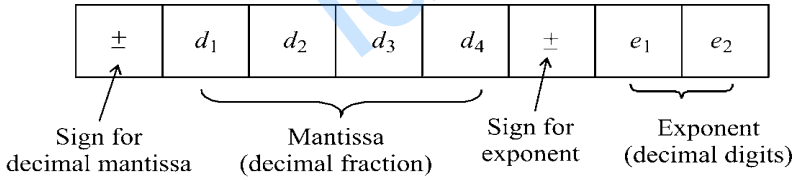
BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : (*i*) *Any calculator is allowed during examination.*

(*ii*) *Question No. **1** is **compulsory**. Attempt any **three** more from the next four questions.*

1. (a) Consider the following decimal floating point representation for a number having base 10 : 3



Which of the following numbers are not in normalised form ? Convert all the numbers to normalised form :

(i)

+	0	1	2	3	–	1	5

(ii)

–	1	2	3	4	+	0	0

(iii)

–	0	0	0	1	+	0	2

(b) Solve the following system of equations using Gauss-elimination method. Does this method produce a solution for this system ? 5

$$6x + 2y + 4z = 6$$

$$3x + 2y + z = 3$$

$$2x + y + z = 0$$

(c) Find the smallest positive root for the equation using bi-section method : 7

$$x^3 + 3x^2 - 6 = 0$$

Show three iterations.

(d) Construct the difference table for the data : 3

x	$f(x)$
1	6
2	12
3	18
4	25

List the forward differences for $f(1)$ and backward differences for $f(4)$.

(e) Write the notation and the formula in terms of $f(x)$ and h for the following : 2

(i) Central difference

(ii) Shift operator

(f) Find the Newton's forward-difference interpolating polynomial which agrees with the table of values given below : 7

x	$f(x)$
1	5
2	14
3	27
4	44
5	65
6	90

Using this polynomial, find the value of $f(1.25)$.

(g) Evaluate the integral $I = \int_0^{0.4} \frac{dx}{(1+2x)^2}$ by using Simpson's 1/3rd rule, by dividing the interval into four equal sub-intervals. 7

(h) Find the order and degree of the following differential equation : 2

$$5\left(\frac{d^3y}{dx^3}\right)^3 + 12\left(\frac{dy}{dx}\right) - 3x\left(\frac{d^2y}{dx^2}\right)^4 = 0$$

(i) Write the formula for finding the numerical differentiation $\left(\frac{dy}{dx} \text{ and } \frac{d^2y}{dx^2}\right)$ using backward difference formula. 4

2. (a) Perform the following floating point operations (assume the maximum mantissa size to be of 4 decimal digits). Use chopping wherever required (answer should be in normalised form) : 6

(i) add 0.2345×10^5 and -0.2205×10^5

(ii) subtract 0.6101×10^2 from 0.2016×10^5

(iii) multiply 0.28×10^{-3} and 0.221×10^4

(b) Using the Gauss-Seidel iterative method, solve the following system of linear equations : 6

$$2x + y = 7$$

$$x + 4y = 14$$

Use the initial values $x_0 = y_0 = 1$. Perform only two iterations.

(c) Using Newton-Raphson method, find the cube root of 10 with initial value as 2. Perform 3 iterations. 8

3. (a) Derive the relationship between E and the following operators : 6

(i) ∇

(ii) δ

(iii) μ

(b) Find the value of α in the following data, if $f(x)$ represents a polynomial of degree 3 : 6

x	$f(x)$
1	7
2	15
3	α
4	73
5	135

(c) Find the Lagrange's interpolating polynomial for the following data : 8

x	$f(x)$
1	4
3	18
7	70

Hence evaluate $f(4)$ using the interpolating polynomial.

4. (a) The values of $y = x^{1.5}$ are given below for $x = 1(1)5$. Find the value of y' and y'' at $x = 1.5$ using F-D formula : 10

x	$f(x) : y = x^{1.5}$
1	1
2	2.8284
3	5.1962
4	8

(b) Using Euler's method, solve the differential equation : 10

$$y' = x^3 + y^2,$$

where $y(0) = 1$. Find the solution on $[0, 0.4]$ with $h = 0.1$.

5. (a) Assuming the decimal floating point representation given in Q. 1 (c), identify what problems will be encountered, if you perform the following operations. Explain the problem and propose solution, if any : 6

   (i) Adding 0.6005×10^{99} with

   $$0.4150 \times 10^{99}$$

   (ii) Adding 0.6705×10^{12}, 0.6685×10^{5} and -0.6705×10^{12}

   (iii) Dividing 0.2003×10^{-53} by

   $$-0.5000 \times 10^{49}$$

   (b) How is truncation error related to Taylor series ? Explain with the help of an example. 4

   (c) For a given value of h, find the values of Δ, Δ^2 and Δ^3, if $f(x) = x^2$. 5

   (d) Derive the formula of Trapezoidal rule using a diagram. 5

BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (Revised)

Term-End Examination

December, 2021

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 hours *Maximum Marks : 100*

Note :

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

(ii) Any calculator is allowed during examination.

1. (a) Assuming a four decimal digit mantissa, two digit exponent and one digit each for sign of mantissa and exponent, perform the following arithmetic operations, indicate overflow, if any. Use chopping, if required. The result should be in normalised form. *6*

(i) Add $0{\cdot}7265 \times 10^{-2}$ and $0{\cdot}7105 \times 10^{1}$

(ii) Subtract $0{\cdot}2516 \times 10^{+2}$ from $0{\cdot}1001 \times 10^{3}$

(iii) Multiply $0{\cdot}5125 \times 10^{50}$ and $0{\cdot}1251 \times 10^{52}$

(b) Solve the following system of equations using Gauss-Jacobi iteration method : *5*

$$5x + 2y = 19$$

$$3x + 5y = 19$$

Take initial estimate as $x_0 = 1$ and $y_0 = 1$. Perform only two iterations.

(c) Write the Newton-Raphson iterative scheme for finding the square root of a positive number n. *4*

(d) Write the name and formula of the following operators : *3*

(i) E

(ii) ∇

(iii) δ

(e) Find the Newton's forward difference interpolating polynomial for the data given below :

x	1	2	3	4	5	6
y = f(x)	1	12	33	64	105	156

Hence, calculate the value of f(x) at x = 1·5. *6*

(f) Construct the Newton's divided difference table for the following data : *4*

x	2	3	5	6
f(x)	5	10	26	37

(g) Using Simpson's $\frac{1}{3}$rd rule, find the approximate value of $I = \int_0^2 \frac{dx}{1+x}$, dividing the interval into four equal sub-intervals. *7*

(h) Define the order and degree of a differential equation. What is the order and degree of the following differential equation ? *3*

$$2\left(\frac{d^4y}{dx^4}\right)^5 + \left(\frac{dy}{dx}\right)^7 + 3x^2\left(\frac{d^2y}{dx^2}\right)^3$$

(i) Write the Newton's backward difference formula for evaluating $\frac{dy}{dx}$. *2*

2. (a) Solve the following equations using Gaussian elimination method with row interchange/pivotal condensation method : *8*

$$y + z = 1$$
$$2x + 3y + 4z = 4$$
$$4x + 2y - 3z = 11$$

(b) Find the first positive root of the equation $x^3 + x^2 - 10 = 0$ by Regula-Falsi method. Show two iterations. *7*

(c) Find the Taylor/Maclaurin series for $f(x) = e^x$ around $x = 0$. *5*

3. (a) Represent the following operators in terms of E : *3*

(i) Δ

(ii) ∇

(iii) δ

(b) Find the missing term (?) in the following data, where f(x) is a polynomial of degree 3 :

x	1	2	3	4	5
f(x)	– 3	10	?	78	145

Also find the interpolating polynomial using backward difference. *10*

(c) Find the interpolating polynomial that fits the data

x	1	2	5
f(x)	4	7	28

using Lagrange's interpolating polynomial method. *7*

4. (a) Given the following values of x and f(x) for $x = 1(0{\cdot}5)^3$:

x	1	1·5	2	2·5	3
y = f(x)	2	4·875	10	18·125	30

Find y′ and y″ at x = 1·25 using FD formula. *10*

(b) Use the Euler's method to find the solution of the differential equation

$$y' = t^4 + y^3 \text{ given that } y(0) = 1.$$

Find the solution of the above in the interval [0, 0·9] with h = 0·3. *10*

5. (a) Explain the formula for Trapezoidal rule with the help of a diagram. Also find the approximate value of

$$I = \int_0^1 \frac{dx}{1+x} \text{ using Trapezoidal rule}$$

with only one interval. *5*

(b) What is an Inverse Interpolation ? Explain with the help of an example. *4*

(c) Explain, whether in arithmetic, with 4 significant digits, the problem of solving the following system of linear equations

$$(2{\cdot}0000)x + (0{\cdot}6667)\,y = 2{\cdot}0000$$

$$(1{\cdot}0000)x + (0{\cdot}3333)y = 1{\cdot}0000$$

is ill-conditioned or not. *5*

(d) Compare and contrast the following methods : *6*

(i) Gauss elimination method and Gauss-Seidel Iterative method

(ii) Bisection method and Regula-Falsi method

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

June, 2022

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : (*i*) *Any calculator is allowed during examination.*

(*ii*) *Question No.* ***1*** *is* ***compulsory****. Attempt any* ***three*** *more from the next four questions.*

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1. (a) Solve the following system of equations using Gauss Elimination method : 6

$$x + 2y + z = 3$$

$$2x + 3y + 3z = 10$$

$$3x - y + 2z = 13$$

(b) Perform two iterations, using Gauss-Seidel iteration method to solve the following system of equations : 6

$$10x - 2y - z - w = 3$$
$$-2x + 10y - z - w = 15$$
$$-x - y + 10z - 2w = 27$$
$$-x - y - 2z + 10w = -9$$

(c) Find the root of the equation $x^3 - x - 1 = 0$, lying between 1 and 2, by using Bisection method (perform three iterations). 6

(d) Verify the relation $\Delta - \nabla = \Delta\nabla$, where Δ and ∇ are forward and backward differencing operations, respectively. 6

(e) Write Stirling's formula of numerical differentiation. Briefly discuss its application with suitable example. 6

(f) Find $f(5)$ by Lagrange's interpolation method, for the following data : 5

x	$f(x)$
1	0
3	18
4	48
6	180
10	900

(g) Compute the integral of function $f(x)$ using Trapezoidal rule, the value of $f(x)$ for values of x between 0 and 1.0 are tabulated below : 5

x	$f(x)$
0	1
0.1	1.2
0.2	1.4
0.3	1.6
0.4	1.8
0.5	2.0
0.6	2.2
0.7	2.4
0.8	2.6
0.9	2.8
1.0	3.0

2. (a) Perform the following conversions : 6

(i) $(-349)_{10}$ to its binary equivalent

(ii) $(-0.3125)_{10}$ to its binary equivalent

(b) Compare direct methods and iterative methods of solving linear algebraic equations. Give merits and demerits of each. Give *one* name of the methods for each category i.e. direct and indirect methods. 6

(c) Explain Newton-Raphson's iterative method for finding the qth root of a positive number N. Also find the cube root of 10 correct upto 3 places of decimal, taking initial estimate as 2.0. 8

3. (a) Verify the following : 6

(i) $\Delta f(x) = 0$ when $f(x) = c$, a constant

(ii) $\Delta^2 f(x) = 0$ when $f(x) = x$, an identity function.

(iii) $E^2x^2 = x^2 + 8x + 16$, when the value of x varies by a constant increment of 2.

(b) Construct a difference table for data given below :

x	$f(x)$
1	7
2	13
3	18
4	25

Now perform the following : 7

(i) Highlight the forward differences for $f(1)$ by drawing circle around the values.

(ii) Highlight the backward differences for f (4) by drawing square around the values.

(iii) Find the highest degree of polynomial that can be generated.

(c) Write short notes on the following in the context of floating point representation :

(i) Precision

(ii) Accuracy

(iii) Significant digit

Give suitable example of each. 3+3+1

4. (a) If $f(x) = x^3$, find the first and second divided difference of f for $x = \{a, b, c\}$. 5

(b) Evaluate the integral $I = \int_0^{0.8} \frac{dx}{\sqrt{1+x}}$ by Simpson's 1/3 rule, divide the interval 0 to 0.8 to 4 equal subintervals. (Compute upto 5 decimal places only). 5

(c) Use modified Euler's method to find the value of y for $x = 0.1$ and 0.2 from the differential equation $\frac{dy}{dx} = x^2 + y^2 - 2$; $y(0) = 1$. (Compute upto 5 places of decimal only). 10

5. (a) Using Runge-Kutta method of order 4, obtain y when $x = 1.1$, given that $y = 1.2$ when $x = 1$, y satisfies the equation $\frac{dy}{dx} = 3x + y^2$. 10

(b) Write formula for Euler's method and use it to find the solution of equation $y' = f(t, y) = t + y$ given $y(0) = 1$. Find the solution on [0, 0.8] interval with step size $h = 0.2$. 10

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

December, 2022

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : (*i*) *Any calculator is allowed during examination.*

(*ii*) *Question No.* ***1*** *is* ***compulsory****. Attempt any* ***three*** *more from the next four questions.*

1. (a) Solve the following system of equations using Gauss Elimination method : 6

$$2x_1 + 8x_2 + 2x_3 = 14$$

$$x_1 + 6x_2 - x_3 = 13$$

$$2x_1 - x_2 + 2x_3 = 5$$

(b) Solve the following system of equations by using Gauss-Seidel iteration method (perform two iterations) : 6

$$8x - 3y + 2z = 20$$

$$6x + 3y + 12z = 35$$

$$4x + 11y - z = 33$$

(c) Determine the value of $\sqrt{12}$ by Newton-Raphson method (perform 3 iterations), taking $x_0 = 3.5$, as initial estimate. 6

(d) Verify the relation $(1 + \Delta)(1 - \nabla) = 1$, where Δ and ∇ are forward and backward differencing operators, respectively. 6

(e) Write Bessel's formula of numerical differentiation. Briefly discuss its application with suitable example. 6

(f) Using the Lagrange's interpolation method, find the interpolating polynomial that fits the data given below : 5

x_k	f_k
0	2
1	3
2	12
5	147

(g) Write Simpson's $\frac{1}{3}$ rule and use it to compute the integral of the function $f(x)$, the respective values of x and $f(x)$ are tabulated below : 5

x	$f(x)$
0	1
0.1	1.01
0.2	1.04
0.3	1.09
0.4	1.16
0.5	1.25
0.6	1.36
0.7	1.49
0.8	1.64
0.9	1.81
1.0	2.0

2. (a) Briefly discuss the terms accuracy, precision and significant digits with suitable example of each. 6

(b) Write formula for Gauss-Jacobi iterative method. Solve the following system of

equations using Gauss-Jacobi method (perform three iterations) : 7

$$-4x_1 + x_2 + 10x_3 = 21$$
$$5x_1 - x_2 + x_3 = 14$$
$$2x_1 + 8x_2 - x_3 = -7$$

(c) Write formula for the Secant method. Use it to perform three iterations for finding roots of the equation $x^3 + 4x^2 - 10 = 0$ near $x = 0$ and $x = 1$ (compute upto two decimal places only). 7

3. (a) Verify the following : 6

(i) $\Delta^3 f(x) = 0$, when $f(x) = x^2$

(ii) $E^n f(x) = e^{x+nh}$, where $f(x) = x^2$

(x varies with constant increment of h)

(b) Find the Newton's forward difference interpolating polynomial which agrees with the following data : 7

x	$f(x)$
1	10
2	19
3	40
4	79
5	142
6	235

Also, obtain the values of $f(x)$ at $x = 1.5$.

(c) Find the Lagrange's interpolating polynomial for the following data : 7

x	$f(x)$
$\frac{1}{4}$	-1
$\frac{1}{3}$	2
1	7

4. (a) If $f(x) = \frac{1}{x}$, show that : 5

$$f(a, b, c) = \frac{+1}{abc}$$

using divided difference table for $x = \{a, b, c\}$.

(b) Evaluate the integral $I = \int_0^1 \frac{dx}{\sqrt{1 + x^2}}$ by Trapezoidal rule, divide the interval [0, 1] into 5 equal parts (compute upto 5 decimal places only). 5

(c) Use Euler's method to find the solution of the IVP given below : 10

$$y' = -2ty^2,\ y(0) = 1$$

take the interval [0, 1] with step size $h = 0.2$.

5. (a) Using Runge-Kutta method of order 4, approximate y, when $x = 0.1$ and $x = 0.2$, given that $x = 0$ when $y = 1$ and $\frac{dy}{dx} = x + y$. (Take $h = 0.1$). 10

(b) Differentiate between the following : 10

(i) Euler's method and modified/improved Euler's method

(ii) Runge-Kutta method (order 2) and Runge-Kutta method (order 4)

Give advantage and disadvantage of each.

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BCS-054

BACHELOR OF COMPUTER APPLICATIONS (BCA) (REVISED)

Term-End Examination

June, 2023

BCS-054 : COMPUTER ORIENTED NUMERICAL TECHNIQUES

Time : 3 Hours *Maximum Marks : 100*

Note : (*i*) *Any calculator is allowed during examination.*

(*ii*) *Question No.* ***1*** *is* ***compulsory****. Attempt any* ***three*** *more from the next four questions.*

1. (a) Use Gauss elimination method to solve the system of linear equations given below : 6

$$x_1 + x_2 + x_3 = 3$$

$$4x_1 + 3x_2 + 4x_3 = 8$$

$$9x_1 + 3x_2 + 4x_3 = 7$$

(b) Use Gauss Jacobi method to solve the system of linear equations given below (results should be correct upto two decimal places only) : 6

$$-4x_1 + x_2 + 10x_3 = 21$$

$$5x_1 - x_2 + x_3 = 14$$

$$2x_1 + 8x_2 - x_3 = -7.$$

(c) Use Bisection method to find positive root of the equation $x^3 + 4x^2 - 10 = 0$, correct upto two places of decimal. 6

(d) Perform the following : 6

(i) Express operator E in terms of operator δ.

(ii) Express operator μ in terms of operator δ.

(e) Determine the Newton's forward difference interpolating polynomial that satisfies the data tabulated ahead : 6

x	$f(x)$
1	1
2	4
3	9
4	16
5	25

Also, find the value of $f(x)$ at $x = 1.7$.

(f) Determine y' and y'' at $x = 2.25$, using Newton's Forward Difference (FD) formula for the data given below : 5

x	$y = \sqrt{x}$
1.5	1.2247
2.0	1.4142
2.5	1.5811
3.0	1.7320
3.5	1.8708

(g) Calculate the value of the integral $\int_4^{5.2} \log x \, dx$, using Trapezoidal rule (assume $h = 0.2$). 5

2. (a) Use Euler method to find the solution of $y' = f(t, y) = t + y$, given $y(0) = 1$, take $h = 0.2$ and find solution on [0, 0.8]. 8

(b) Find Maclaurin's series of $f(x) = e^x$ around $x = 0$. 4

(c) Determine approximate root of the equation : 8

$$\cos x - xe^x = 0$$

using Secant method with two initial approximations as $x_0 = 0$ and $x_1 = 1$. Perform two iterations.

3. (a) Write Newton-Raphson iterative scheme to find inverse of an integer number N. Hence find inverse of 17 correct upto 4 places of decimal starting with 0.05. 8

(b) Write expressions for Δ, ∇, δ and μ operators in terms of operator E. 4

(c) Find Lagrange's interpolating polynomial for the data given below : 8

x	$f(x)$
$\frac{1}{4}$	-1
$\frac{1}{3}$	2
1	7

4. (a) Use Divided difference table to find the value of $f(a,b,c)$, for $f(x) = x^3$. 4

(b) Use Stirling's formula for differentiation on the data given below, to find the value of x for which $f(x)$ attains its maximum value : 10

x	$y = f(x)$
1	7
2	15
3	21
4	19
5	3

(c) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Simpon's rule, subdivide the interval (0, 1) into 6 equal parts. 6

5. (a) Solve the Initial Value Problem (IVP) $y' = -ty^2, y(2) = 1$. Also, find y (2.1) and y (2.2) with $h = 0.1$, using modified Euler's method. 10

(b) Use classical R-K method of order 4 to solve the IVP $y' = 2y + 3e^t, y(0) = 0$; and find y (0.1), $y(0.2)$ and $y(0.3)$. 10