PREVIOUS YEAR QUESTION BANK

EXADEMY

NUMERICAL ANALYSIS & COMPUTER PROGRAMMING

Q1. Fit the natural cubic spline for the data.

x:	0	1	2	3	4
y:	0	0	1	0	0

(Year 1992)
(20 Marks)

Q2. Solve by Runge-Kutta method $\frac{dy}{dx} = x + y$ with the initial conditions $x_0 = 0, y_0 = 1$ correct up to 4 decimal places, by evaluating up to second increment of y (Take $h = 0.1$).

(Year 1992)
(20 Marks)

Q3. Compute to 4 decimal placed by using Newton-Raphson method, the real root of $x^2 + 4\sin x = 0$.

(Year 1992)
(20 Marks)

Q4. Solve $\frac{dy}{dx} = xy$ for $x = 1.4$ by Runge-Kutta method, initially $x = 1, y = 2$ (Take $h = 0.2$)

(Year 1993)
(20 Marks)

Q5. Evaluate approximately $\int_{-3}^{3} x^4\, dx$ Simpson's rule by taking seven equidistant ordinates. Compare it with the value obtained by using the trapezoidal rule and with exact value.

(Year 1993)
(20 Marks)

Q6. Find correct to 3 decimal places the two positive roots of $2e^x - 3x^2 = 2.5644$

(Year 1993)
(20 Marks)

Q7. Find the derivative of $f(x)$ at $x = 0.4$ from the following table:

x	0.1	0.2	0.3	0.4
$y = f(x)$	1.10517	1.22140	1.34986	1.49182

(Year 1994)
(20 Marks)

Q8. Fit the following four points by the cubic splines.

i	0	1	2	3
x_i	1	2	3	4
y_i	1	5	11	8

Use the end conditions Use the end conditions $y''_0 = y''_3 = 0$
Hence compute
(i) $y(1.5)$
(ii) $y'(2)$

(Year 1994)
(20 Marks)

Q9. Find the positive root of the equation $e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6}e^{0.3x}$ correct to five decimal places.

(Year 1994)
(20 Marks)

Q10. Find the positive root of $\log_e x = \cos x$ nearest to five places of decimal by Newton-Raphson method.

(Year 1995)
(20 Marks)

Q11. Find the value of $\int_{1.6}^{3.4} f(x)dx$ from the following data using Simpson's $\frac{3}{8}$ rd rule for the interval (1.6,2.2) and $\frac{1}{8}$ th rule for (2.2,3.4):

x	1.6	1.8	2.0	2.2	2.4
$f(x)$	4.953	6.050	7.389	9.025	11.023

x	2.6	2.8	3.0	3.2	3.4
$f(x)$	13.464	16.445	20.086	24.533	29.964

(Year 1995)
(20 Marks)

Q12. Describe Newton-Raphson method for finding the solutions of the equation $f(x) = 0$ and show that the method has a quadratic convergence.

(Year 1996)
(20 Marks)

Q13. The following are the measurements made on a curve recorded by the oscillograph representing a change of current due to a change in the conditions of an electric current:

t	1.2	2.0	2.5	3.0
i	1.36	0.58	0.34	0.20

Applying an appropriate formula interpolate for the value of i when $t = 1.6$

(Year 1996)
(20 Marks)

Q14. Solve the system of differential equations $\frac{dy}{dx} = xz + 1, \frac{dzz}{dx} = -xy$ for $x = 0.3$ given that $y = 0$ and $z = 1$ when $x = 0$ using Runge-Kutta method of order four.

(Year 1996)
(20 Marks)

Q15. Apply that fourth order Runge-Kutta method to find a value of y correct to four places of decimals at $x = 0.2$, when $y' = \frac{dy}{dx} = x + y, y(0) = 1$

(Year 1997)
(20 Marks)

Q16. Show that the iteration formula for finding the reciprocal of N is

$$x_{n+1} = x_n(2 - N_{xn}), n = 0, 1 \ldots$$

(Year 1997)
(20 Marks)

Q17. Obtain the cubic spline approximation for the function given in the tabular form below:

t	1.2	2.0	2.5	3.0
i	1.36	0.58	0.34	0.20

and $M_0 = 0, M_3 = 0$

(Year 1997)
(20 Marks)

Q18. Evaluate $\int_1^3 \frac{dx}{x}$ by Simpson's rule with 4 strips. Determine the error by direct integration.

(Year 1998)
(20 Marks)

Q19. By the fourth –order Runge-Kutta method. tabulate the solution of the differential equation $\frac{dy}{dx} = \frac{xy+1}{10y^3+4}, y(0) = 0$ in [0,0,4] with step length 0.1 correct to five places of decimals

(Year 1998)
(20 Marks)

Q20. Use Regula-Falsi method to show that the real root of $x \log_{10} x - 12 = 0$ lies between 3 and 2.740646

(Year 1998)
(20 Marks)

Q21. Obtain the Simpson's rule for the integral $I = \int_a^b f(x)dx$ and show that this rule is exact for polynomials of degree $n \leq 3$. In general show that the error of approximation for Simpson's rule is given by $R = -\frac{(b-a)^5}{2880} f^{iv}(\eta), \eta \in (0,2)$. Apply this rule to the integral $\int_0^1 \frac{dx}{1+x}$ and show that $|R| \leq 0.008333$

(Year 1999)
(20 Marks)

Q22. Using fourth order classical Runge-Kutta method for the initial value problem $\frac{du}{dt} = -2tu^2, u(0) = 1$. With $h = 0.2$ on the interval [0,1] calculate $u(0.4)$ correct to six places of decimal.

(Year 1999)
(20 Marks)

Q23. (i) Using Newton-Raphson method, show that the iteration formula for finding the reciprocal of the p^{th} root of N is $x_{i+1} = \frac{x_i(p+1-Nx_i)}{p}$

(ii) Prove De Morgan's Theorem $(p+q)' = p'.q'$

(Year 2000)
(6+6 Marks)

Q24. (i) Evaluate $\int_0^1 \frac{dx}{1+x^2}$, by subdividing the interval (0,1) into 6 equal parts and using Simpson's one-third rule. Hence find the value of π and actual error, correct to five places of decimals.

(ii) Solve the following system of linear equations, using Gauss-elimination method:

$$x_1 + 6x_2 + 3x_3 = 6$$
$$2x_1 + 3x_2 + 3x_3 = 117$$
$$4x_1 + x_2 + 2x_3 = 283$$

(Year 2000)
(15+15 Marks)

Q25. Show that the truncation error associated with linear interpolation of $f(x)$, using ordinates at x_0 and x_1 with $x_0 \le x \le x_1$ is not larger in magnitude than $\frac{1}{8}M_2(x_1 - x_0)^2$ where $M_2 = max|f''(x)|$ in $x_0 \le x \le x_1$. Hence show that if $f(x) = \frac{2}{\sqrt{\pi}}\int_0^{\pi} e^{-t^2}dt$, the truncation error corresponding to linear interpolation of $f(x)$ in $x_0 \le x \le x_1$ cannot exceed $\frac{(x_1-x_0)^2}{2\sqrt{2\pi e}}$

(Year 2001)
(12 Marks)

Q26. (i) Given $A.B' + A'.B = C$ show that $A.C' + A'.C = B$

(ii) Express the area of the triangle having sides of lengths $6\sqrt{2}, 12, 6\sqrt{2}$ units in binary number system.

(Year 2001)
(6+6 Marks)

Q27. Using Gauss Seidel iterative method and the starting solution $x_1 = x_2 = x_3 = 0$ determine the solution of the following system of equations in two iterations

$$10x_1 - x_2 - x_3 = 8$$
$$x_1 + 10x_2 + x_3 = 12$$
$$x_1 - x_2 + 10x_3 = 10$$

Compare the approximate solution with the exact solution

(Year 2001)
(30 Marks)

Q28. Find the values of the two-valued variables A, B, C & D by solving the set of simultaneous equations

$A' + A.B = 0$
$A.B = A.C$
$A.B + A.C' + C.D = C'.D$

(Year 2001)
(15 Marks)

Q29. Find a real root of the equation $f(x) = x^3 - 2x - 5 = 0$ by the method of false position.

(Year 2002)
(12 Marks)

Q30. (i) Convert $(100.85)_{10}$ into its binary equivalent.

(ii) Multiply the binary numbers $(1111.01)_2$ and $(1101.11)_2$ and check with its decimal equivalent.

(Year 2002)
(4+8 Marks)

Q31. (i) Find the cubic polynomial which takes the following values:
$y(0) = 1, y(1) = 0, y(2) = 1$ & $y(3) = 10$. Hence , or otherwise, obtain $y(4)$
(ii) Given: $\frac{dy}{dx} = y - x$ where $y(0) = 2$, using the Runge-Kutta fourth order method, find $y(0.1)$ and $y(0.2)$. Compare the approximate solution with its exact solution. ($e^{0.1} = 1.10517,\ e^{0.2} = 1.2214$)

(Year 2002)
(10+20 Marks)

Q32. Draw a flow chart to examine whether a given number is a prime.

(Year 2002)
(10 Marks)

Q33. Evaluate $\int_0^1 e^{-x^2}\,dx$ by employing three points Gaussian quadrature formula, finding the required weights and residues. Use five decimal places for computation.

(Year 2003)
(12 Marks)

Q34. (i) Convert the following binary number into octal and hexa decimal system:
$$101110010.10010$$
(ii) Find the multiplication of the following binary numbers: 11001.1 and 101.1

(Year 2003)
(6+6 Marks)

Q35. Find the positive root of the equation $2e^{-x} = \frac{1}{x+2} + \frac{1}{x+1}$ using Newton-Raphson method correct to four decimal places. Also show that the following scheme has error of second order: $x_{n+1} = \frac{1}{2}x_n\left(1 + \frac{a}{x_n^2}\right)$

(Year 2003)
(30 Marks)

36. Draw a flow chart and algorithm for Simpson's $\frac{1}{3}^{rd}$ rule for integration $\int_a^b \frac{1}{1+x^2}\,dx$ correct to 10^{-6}

(Year 2003)
(30 Marks)

Q37. How many positive and negative roots of the equation $e^x - 5\sin x = 0$ exist? Find the smallest positive root correct to 3 decimals, using Newton-Raphson method.

(Year 2004)
(10 Marks)

Q38. The velocity of a particle at distance from a pint on it s path is given by the following table:

$S(meters)$	0	10	20	30	40	50	60
$V(m/sec)$	47	58	64	65	61	52	38

Estimate the time taken to travel the first 60 meters using Simpson's $\frac{1}{3}^{rd}$ rule. Compare the result with Simpson's $\frac{3}{8}^{th}$ rule.

(Year 2004)
(12 Marks)

Q39. (i) If $(AB.CD)_{16} = (x)_2 = (y)_8 = (z)_{10}$ then find x, y & z

(ii) In a 4-bit representation, what is the value of 1111 in signed integer form, unsigned integer form, signed 1's complement form and signed 2's complement form?

(Year 2004)
(6+6 Marks)

Q40. Using Gauss-Siedel iterative method, find the solution of the following system:

$$4x - y + 8z = 26$$
$$5x + 2y - z = 6$$
$$x - 10y + 2z = -13$$

up to three iterations.

(Year 2004)
(15 Marks)

Q41. Use appropriate quadrature formulae out of the Trapezoidal and Simpson's rules to numerically integrate $\int_0^1 \frac{dx}{1+x^2}$ with $h = 0.2$. Hence obtain an approximate value of π. Justify the use of particular quadrature formula.

(Year 2005)
(12 Marks)

Q42. Find the hexadecimal equivalent of $(41819)_{10}$ and decimal equivalent of $(111011.10)_2$

(Year 2005)
(12 Marks)

Q43. Find the unique polynomial $P(x)$ of degree 2 or less such that $P(1) = 1, P(3) = 27, P(4) = 64$. Using the Lagrange's interpolation formula and the Newton's divided difference formula, evaluate $P(1.5)$

(Year 2005)
(30 Marks)

Q44. Draw a flow chart and also write algorithm to find one real root of the non-linear equation $x = \emptyset(x)$ by the fixed point iteration method. Illustrate it to find one real root, correct up to four places of decimals, of $x^3 - 2x - 5 = 0$

(Year 2005)
(30 Marks)

Q45. Evaluate $I = \int_0^1 e^{-x^2} dx$ by the Simpson's rule
$\int_a^b f(x)dx \approx \frac{\Delta x}{3}[f(x_0) + 4f(x_1) + 2f(x_2) + 4f(x_3) + \cdots + 2f(x_{2n-2}) + 4f(x_{2n-1}) + f(x_{2n})]$ with $2n = 10, \Delta x = 0.1, x_0 = 0.1, \ldots, x_{10} = 1.0$

(Year 2006)
(12 Marks)

Q46. (i) Given the number 59.625 in decimal system. Write its binary equivalent.
(ii) Given the number 3898 in decimal system. Write its equivalent in system base 8.

(Year 2006)
(6+6 Marks)

Q47. If Q is a polynomial with simple roots $\alpha_1, \alpha_2, \ldots, \alpha_n$ and if P is a polynomial of degree $< n$, show that $\frac{P(x)}{Q(x)} = \sum_{k=1}^{n} \frac{P(\alpha_k)}{(x-\alpha_k)\, Q\prime(\alpha_k)}$. Hence prove that there exists a unique polynomial of degree with given values c_k at the point $\alpha_{k,}\ k = 1,2, \ldots n$

(Year 2006)
(30 Marks)

Q48. Draw a flowchart and algorithm for solving the following system of 3 linear equations in 3 unknowns x_1, x_2 & x_3: $C + X = D$ with $C = \left(x_{ij}\right)^3{}_{i,j-1}, X = \left(x_j\right)^3{}_{j-1}, D = (d_i)^3{}_{i-1}$

(Year 2006)
(30 Marks)

Q49. Use the method of false position to find a real root of $x^3 - 5x - 7 = 0$ lying between 2 and 3 and correct to 3 places of decimals.

(Year 2007)
(12 Marks)

Q50. Convert:
(i) 46655 given to be in the decimal system into one in base 6.
(ii) $(11110.01)_2$ into a number in the decimal system.

(Year 2007)
(6+6 Marks)

Q51. (i) Find from the following table, the area bounded by the axis and the curve between and using the trapezoidal rule:

x	5.34	5.35	5.36	5.37	5.38	5.39	5.40
$f(x)$	1.82	1.85	1.86	1.90	1.95	1.97	2.00

(ii) Apply the second order Runge-Kutta method to find an approximate value of y at $x = 0.2$ taking $h = 0.1$, given that y satisfies the differential equation and the initial condition $y' = x + y, y(0) = 1$

(Year 2007)
(15+15 Marks)

Q52. Find the smallest positive root of equation $xe^x - \cos x = 0$ using Regula-Falsi method. Do three iterations.

(Year 2008)
(12 Marks)

Q53. State the principle of duality

(i) in Boolean algebra and give the dual of the Boolean expressions $(x + y).(\bar{X}.\bar{Z}).(Y + Z)$ and $X\bar{X} = 0$

(ii) Represent $(\bar{A} + \bar{B} + \bar{C})(A + \bar{B} + C)(A + B + \bar{C})$ in NOR to NOR logic network.

(Year 2008)
(6+6 Marks)

Q54. (i) The following values of the function $f(x) = \sin x + \cos x$ are given:

x	$10°$	$20°$	$30°$
$f(x)$	1.1585	1.2817	1.3360

Construct the quadratic interpolating polynomial that fits the data. Hence calculate $f\left(\frac{\pi}{12}\right)$.

Compare with exact value.

(ii) Apply Gauss-Seidel method to calculate x, y, z from the system:

$-x - y + 6z = 42$
$6x - y - z = 11.33$
$-x + 6y - z = 32$

with initial values $(4.67, 7.62, 9.05)$. Carry out computations for two iterations

(Year 2007)
(15+15 Marks)

Q55. Draw a flow chart for solving equation $F(x) = 0$ correct to five decimal places by Newton-Raphson method.

(Year 2008)
(30 Marks)

Q56. (i) The equation $x^2 + ax + b = 0$ has two real roots α and β. Show that the iterative method given by: $x_{k+1} = -\frac{(ax_k+b)}{x_k}, k = 0,1,2,\ldots$ is convergent near $x = \alpha$, if $|\alpha| > |\beta|$

(ii) Find the values of two valued Boolean variables A,B,C,D by solving the following simultaneous equations:

$\bar{A} + AB = 0$

$AB = AC$

$AB + A\bar{C} + CD = \bar{C}D$

where $\bar{x}$ represents the complement of x

(Year 2009)
(6+6 Marks)

Q57. (i) Realize the following expressions by using NAND gates only :

$g = (\bar{a} + \bar{b} + c)\bar{d}(\bar{a} + e)f$ where $\bar{x}$ represents the complement of x

(ii) Find the decimal equivalent of $(357.32)_8$

(Year 2009)
(6+6 Marks)

Q58. Develop an algorithm for Regula-Falsi method to find a root of $f(x) = 0$ starting with two initial iterates x_0 and x_1 to the root such that $sign(f(x_0)) \neq sign(f(x_1))$. Take n as the maximum number of iterations allowed and epsilon be the prescribed error.

(Year 2009)
(30 Marks)

Q59. Using Lagrange interpolation formula, calculate the value of $f(3)$ from the following table of values of x and $f(x)$:

x	0	1	2	4	5	6
$f(x)$	1	14	15	5	6	19

(Year 2009)
(15 Marks)

Q60. Find the value of $y(1.2)$ using Runge-Kutta fourth order method with step size $h = 0.2$ from the initial value problem: $y' = xy, y(1) = 2$

(Year 2009)
(15 Marks)

Q61. Find the positive root of the equation $10xe^{-x^2} - 1 = 0$ correct up to 6 decimal places by using Newton-Raphson method. Carry out computations only for three iterations.

(Year 2010)
(12 Marks)

Q62. (i) Suppose a computer spends 60 per cent of its time handling a particular type of Computation when running a given program and its manufacturers make a change that improves its performance on that type of computation by a factor of 10. If the program takes 100 sec to execute, what will its execution time be after the change?

(ii) If $A \oplus B = AB' + A, B$, find the value of $x \oplus y \oplus z$

(Year 2010)
(6+6 Marks)

Q63. Given the system of equations

$$2x + 3y = 1$$
$$2x + 4y + z = 2$$
$$2y + 6z + Aw = 4$$
$$4z + Bw = C$$

State the solvability and uniqueness conditions for the system. Give the solution when it exists.

(Year 2010)
(20 Marks)

Q64. Find the value of the integral $\int_1^5 \log_{10} x\, dx$ by using Simpson's $\frac{1}{3}^{rd}$ rule correct up to 4 decimal places. Take 8 subintervals in your computation.

(Year 2010)
(20 Marks)

Q65. (i) Find the hexadecimal equivalent of the decimal number $(587632)_{10}$

(ii) For the given set of data points $\left(x_1, f(x_1)\right), \left(x_2, f(x_2)\right), \ldots\ (x_n, f(x_n))$ write an algorithm to find the value of $f(x)$ by using Lagrange's interpolation formula.

(iii) Using Boolean algebra, simplify the following expressions

(a) $a + a'b + a'b'c + a'b'c'd + \cdots$

(b) $x'y'z = yz = xz$ where x' represent the component of x

(Year 2010)
(5+10+5 Marks)

Q66. Draw a flow chart for Lagrange's interpolation formula.

(Year 2011)
(20 Marks)

Q67. Calculate $\int_2^{10} \frac{dx}{1+x}$ (up to 3 places of decimal) by dividing the range into 8 equal parts by Simpson's $\frac{1}{3}^{rd}$ rule.

(Year 2011)
(12 Marks)

Q68. Find the logic circuit that represents the following Boolean function. Find also an equivalent simpler circuit:

x	y	z	$f(x, y, z)$
1	1	1	1
1	1	0	0
1	0	1	0
1	0	0	0
0	1	1	1
0	1	0	0
0	0	1	0
0	0	0	0

(Year 2011)
(20 Marks)

Q69. A solid of revolution is formed by rotating about the x-axis, the area between the x-axis, the line $x = 0$ and $x = 1$ and a curve through the points with the following co-ordinates:

x	0.00	0.25	0.50	0.75	1
y	1	0.9896	0.9589	0.9089	0.8415

Find the volume of the solid.

(Year 2011)
(20 Marks)

Q70. (i) Compute $(3205)_{10}$ to the base 8.
(ii) Let A be an arbitrary but fixed Boolean algebra with operations $\wedge, \vee$ and ‘ and the zero and the unit element denoted by 0 and 1 respectively. Let x, y, z ... be elements of A. If $x, y \in A$ be such that $x \wedge y = 0$ and then prove that $y = x'$ ...

(Year 2011)
(12 Marks)

Q71. Use Newton-Raphson method to find the real root of the equation $3x = \cos x + 1$ correct to four decimal places.

(Year 2012)
(12 Marks)

Q72. Provide a computer algorithm to solve an ordinary differential equation $\frac{dy}{dx} = f(x, y)$ in the interval $[a, b]$ for n number of discrete points, where the initial value$y(a) = \alpha$ is using Euler’s method.

(Year 2012)
(15 Marks)

Q73. Solve the following system of simultaneous equations, using Gauss-Seidel iterative method:

$$3x + 20y - z = -18$$
$$20x + y - 2z = 17$$
$$2x - 3y + 20z = 25$$

(Year 2012)
(20 Marks)

Q74. Find $\frac{dy}{dx}$ at $x = 0.1$ from the following data:

x:	0.1	0.2	0.3	0.4
y:	0.9975	0.9900	0.9776	0.9604

(Year 2012)
(20 Marks)

Q75. In a certain examination, a candidate has to appear for one major & two major subjects. The rules for declaration of results are marks for major are denoted by M_1 and for minors by M_2 and M_3. If the candidate obtains 75% and above marks in each of the three subjects, the candidate is declared to have passed the examination in first class with distinction. If the candidate obtains 60% and above marks in each of the three subjects, the candidate is declared to have passed the examination in first class. If the candidate obtains 50% or above in major, 40% or above in each of the two minors and an average of 50% or above in all the three subjects put together, the candidate is declared to have passed the examination in second class. All those candidates, who have obtained 50% and above in major and 40% or above in minor, are declared to have passed the examination. If the candidate obtains less than 50% in major or less than 40% in anyone of the two minors, the candidate is declared to have failed in the examinations. Draw a flow chart to declare the results for the above.

(Year 2012)
(20 Marks)

Q76. Use Euler's method with step size $h = 0.15$ to compute the approximate value of $y(0.6)$, correct up to five decimal places from the initial value problem.

$y' = x(y + x) - 1, y(0) = 2$

(Year 2013)
(15 Marks)

Q77. Develop an algorithm for Newton-Raphson method to solve $f(x) = 0$ starting with initial iterate x_0, n be the number of iterations allowed, epsilon be the prescribed relative error and delta be the prescribed lower bound for $f'(x)$

(Year 2013)
(20 Marks)

Q78. In an examination, the number of students who obtained marks between certain limits were given in the following table:

Marks	30-40	40-50	50-60	60-70	70-80
No. of student	31	42	51	35	31

Using Newton forward interpolation formula, find the number of students whose marks lie between 45 and 50.

(Year 2013)
(10 Marks)

Q79. The velocity of a train which starts from rest is given in the following table. The time is in minutes and velocity is in km/hour.

t	2	4	6	8	10	12	14	16	18	20
v	16	28.8	40	46.4	51.2	32.0	17.6	8	3.2	0

Estimate approximately the total distance run in 30 minutes by using composite Simpson's $\frac{1}{3}$ rule.

(Year 2013)
(15 Marks)

Q80. Apply Newton-Raphson method to determine a root of the equation $\cos x - xe^x = 0$ correct up to four decimal places.

(Year 2014)
(10 Marks)

Q81. Use five subintervals to integrate $\int_0^1 \frac{dx}{1+x^2}$ using trapezoidal rule.

(Year 2014)
(10 Marks)

Q82. Use only AND and OR logic gates to construct a logic circuit for the Boolean expression $z = xy + uv$

(Year 2014)
(10 Marks)

Q83. Solve the system of equations

$$2x_1 - x_2 = 7$$
$$-x_1 + 2x_2 - x_3 = 1$$
$$-x_2 + 2x_3 = 1$$

using Gauss-Seidel iteration method (perform three iterations)

(Year 2014)
(15 Marks)

Q84. Draw a flowchart for Simpson's one-third rule.

(Year 2014)
(15 Marks)

Q85. Use Runge-Kutta formula of fourth order to find the value of y at $x = 0.8$ where $\frac{dy}{dx} = \sqrt{x+y}$, $y(0.4) = 0..41$. Take the step length $h = 0.2$

(Year 2014)
(20 Marks)

Q86. For any Boolean variables x and y, show that $x + xy = x$

(Year 2014)
(15 Marks)

Q87. Find the principal (or canonical) disjunctive normal form in three variables p, q, r for the Boolean expression $((p \wedge q) \rightarrow r) \vee ((p \wedge q) \rightarrow -r)$. Is the given Boolean expression a contradiction or a tautology?

(Year 2015)
(10 Marks)

Q88. Find the Lagrange interpolating polynomial that fits the following data:

x	-1	2	3	4
$f(x)$	-1	11	31	69

Find $f(1.5)$

(Year 2015)
(20 Marks)

Q89. Solve the initial value problem $\frac{dy}{dx} = x(y - x)$, $y(2) = 3$ in the interval $[2, 2.4]$ using the Runge- Kutta fourth-order method with step size $h = 0.2$

(Year 2015)
(20 Marks)

Q90. Find the solution of the system

$$10x_1 - 2x_2 - x_3 - x_4 = 3$$
$$-2x_1 + 10x_2 - x_3 - x_4 = 15$$
$$-x_1 - x_2 + 10x_3 - 2x_4 = 27$$
$$-x_1 - x_2 - 2x_3 + 10x_4 = -9$$

using Gauss-Seidel method (make four iterations)

(Year 2015)
(15 Marks)

Q91. Convert the following decimal numbers to univalent binary and hexadecimal numbers:

(i) 4096
(ii) 0.4375
(iii) 2048.0625

(Year 2016)
(10 Marks)

Q92. Let $f(x) = e^{2x}\cos 3x$ for $x \in [0,1]$. Estimate the value of $f(0.5)$ Using Lagrange interpolating polynomial of degree 3 over the nodes $x = 0, x = 0.3, x = 0.6$ and $x = 1$.Also compute the error bound over the interval $[0,1]$ and the actual error $E(0.5)$

(Year 2016)
(20 Marks)

Q93. For an integral $\int_{-1}^{1} f(x)dx$ show that the two point Gauss quadrature rule is given by $\int_{-1}^{1} f(x)dx = f\left(\frac{1}{\sqrt{3}}\right) + f\left(-\frac{1}{\sqrt{3}}\right)$ using this rule estimate $\int_{2}^{4} 2xe^{x}dx$

(Year 2016)
(15 Marks)

Q94. Let A, B, C be Boolean variable denote complement $A, A + B$ of is an expression for $A\ OR\ B$ and $B.A$ is an expression for $A\ AND\ B$.Then simplify the following expression and draw a block diagram of the simplified expression using AND and OR gates

$$A.(A + B.C).(\bar{A} + B + C).(A + \bar{B} + C).(A + B + \bar{C})$$

(Year 2016)
(15 Marks)

Q95. Explain the main steps of the Gauss-Jordan method and apply this method to find the inverse of the matrix $\begin{bmatrix} 2 & 6 & 6 \\ 2 & 8 & 6 \\ 2 & 6 & 8 \end{bmatrix}$

(Year 2017)
(10 Marks)

Q96. Write the Boolean expression $z(y + z)(x + y + z)$ in the simplest form using Boolean postulate rules. Mention the rules used during simplification. Verify your result by constructing the truth table for the given expression and for its simplest form.

(Year 2017)
(10 Marks)

Q97. For given equidistant values u_{-1}, u_0, u_1 and u_2 a values is interpolated by Lagrange's formula. Show that it may be written in the form $u_x = yu_0 + \frac{y(y^2-1)}{3!}\Delta^2 u_{-1} + \frac{x(x^2-1)}{3!}\Delta^2 u_0$ where $x + y = 1$

(Year 2017)
(15 Marks)

Q98. Write an algorithm in the form of a flow chart for Newton-Raphson method. Describe the cases of failure of this method.

(Year 2017)
(15 Marks)

Q99. Derive the formula $\int_a^b ydx = \frac{3h}{8}[(y_0 + y_n) + 3(y_1 + y_2 + y_3 + y_4 + \cdots + y_{n-1}) + 2(y_3 + y_6 + y_{n-3})]$ Is there any restriction on n? State that condition. What is the error bounded in the case of Simpson's $\frac{3}{8}$ rule?

(Year 2017)
(20 Marks)

Q100. Using Newton's forward difference formula find the lowest degree polynomial u_x when it is given that $u_1 = 1, u_2 = 9, u_3 = 25, u_4 = 55$ and $u_5 = 105$

(Year 2018)
(10 Marks)

Q101. Starting from rest in the beginning, the speed (in Km/h) of a train at different times (in minutes) is given by the table:

Time(Minutes)	2	4	6	8	10	12	14	16	18	20
Speed(Km/h)	10	18	25	29	32	20	11	5	2	8.5

Using Simpson's $\frac{1}{3}^{rd}$ rule, find the approximate distance travelled (in Km) in 20 minutes from the beginning.

(Year 2018)
(10 Marks)

Q102. Write down the basic algorithm for solving the equation: $xe^x - 1 = 0$ by bisection method, correct to 4 decimal places.

(Year 2018)
(10 Marks)

Q103. Simplify the Boolean expression: $(a + b).\left(\bar{b} + c\right) + b(\bar{a} + \bar{c})$ by using the laws of Boolean algebra. From its truth table, write it in minterm normal form.

(Year 2018)
(15 Marks)

Q104. Find the values of the constants a, b, c such that the quadrature formula $\int_0^f f(x)\,dx = h\left[af(0) + bf\left(\frac{h}{3}\right) + cf(h)\right]$is exact for polynomials of as high degree as possible, and hence find the order of the truncation error.

(Year 2018)
(15 Marks)

Q105. Find the equivalent of numbers given in a specified number system to the system mentioned against them.

(i) $(111011.101)_2$ to decimal system.
(ii) $(1000111110000.00101100)_2$ to hexadecimal system
(iii) $(C4F2)_{16}$ to decimal system.
(iv) $(418)_{10}$ to binary system.

(Year 2018)
(10 Marks)

Q106. Apply Newton-Raphson method, to find a real root of transcendental equation $x \log_{10} x = 1.2$, correct to three decimal places.

(Year 2019)
(10 Marks)

Q107. Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ with $y(0) = 1$ at $x = 0.2$. Use four decimal places for calculation and step length 0.2.

(Year 2019)
(10 Marks)

Q108. Draw a flow chart and write a basic algorithm (in FORTRAN/C/C++) for evaluating $y = \int_0^6 \frac{dx}{1+x^2}$ using Trapezoidal rule.

(Year 2019)
(10 Marks)

Q109. Find the equivalent numbers given in a specified number to the system mentioned against them:

(i) Integer 524 in binary system.
(ii) 101010110101.101101011 to octal system.
(iii) Decimal number 5280 to hexadecimal system
(iv) Find the unknown number $(1101.101)_8 \rightarrow (?)_{10}$

(Year 2019)
(15 Marks)

Q110. Apply Gauss-Seidal iteration method to solve the following system of equations:

$$2x + y - 2z = 17$$
$$3x + 20y - z = -18$$
$$2x - 3y + 20z = 25$$

Correct to three decimal places.

(Year 2019)
(15 Marks)

Q111. Given the Boolean expression

$$X = AB + ABC + A\bar{B}\bar{C} + A\bar{C}$$

(i) Draw the logical diagram for the expression.

(ii) Minimize the expression.

(iii) Draw the logical diagram for the reduced expression.

(Year 2019)
(15 Marks)