NUMERICAL ANALYSIS

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***BISECTION METHOD**

*NO QUESTIONS SINCE 2010.

1. REGULA-FALSI

1. 8b 2018 IFoS

(b) The equation $x^6 - x^4 - x^3 - 1 = 0$ has one real root between 1·4 and 1·5. Find the root to four places of decimal by regula-falsi method. 10

2. 5b 2010 IFoS

(b) Solve $x\log_{10} x = 1 \cdot 2$ by regula falsi method. 10

2. NEWTON-RAPHSON METHOD

1. 5b 2020

Show that the equation : $f(x) = \cos\frac{\pi(x+1)}{8} + 0\cdot148x - 0\cdot9062 = 0$ has one root in the interval $(-1, 0)$ and one in $(0, 1)$. Calculate the negative root correct to four decimal places using Newton-Raphson method. 10

2. 5b 2020 IFoS

Using Newton-Raphson method, find the value of $(37)^{1/3}$, correct to four decimal places. 8

3. 5b 2019

Apply Newton-Raphson method, to find a real root of transcendental equation $x \log_{10} x = 1\cdot2$, correct to three decimal places. 10

4. 7a 2017 IFoS

7.(a) Find the real root of the equation $x^3 + x^2 + 3x + 4 = 0$ correct up to five places of decimal using Newton-Raphson method. 10

5. 7b 2016 IFoS

7.(b) Find the cube root of 10 up to 5 significant figures by Newton-Raphson method. 10

6. 5b 2014

Apply Newton-Raphson method to determine a root of the equation $\cos x - xe^x = 0$ correct up to four decimal places. 10

7. 5a 2013 IFoS

(a) Use Newton – Raphson method and derive the iteration scheme $x_{n+1} = \frac{1}{2}\left(x_n + \frac{N}{x_n}\right)$ to calculate an approximate value of the square root of a number N. Show that the formula $\sqrt{N} \approx \frac{A+B}{4} + \frac{N}{A+B}$ where AB = N, can easily be obtained if the above scheme is applied two times. Assume A = 1 as an initial guess value and use the formula twice to calculate the value of $\sqrt{2}$ [For 2nd iteration, one may take A = result of the 1st iteration]. *14*

8. 5b 2012

(b) Use Newton-Raphson method to find the real root of the equation $3x = \cos x + 1$ correct to four decimal places. 12

9. 6c 2011 IFoS

(c) Find the smallest positive root of the equation $x^3 - 6x + 4 = 0$ correct to four decimal places using Newton-Raphson method. From this root, determine the positive square root of 3 correct to four decimal places. 12

10. 5c 2010

(c) Find the positive root of the equation

$$10x\,e^{-x^2} - 1 = 0$$

correct up to 6 decimal places by using Newton-Raphson method. Carry out computations only for three iterations. 12

3. GAUSSIAN ELIMINATION (DIRECT)

1. 8c 2020 IFoS

Solve the following system of linear equations using Gaussian elimination method :

$$\begin{aligned} 5x_1 + 2x_2 + x_3 &= -2 \\ 6x_1 + 3x_2 + 2x_3 &= 1 \\ x_1 - x_2 + 2x_3 &= 0 \end{aligned}$$

10

2. 7b 2014 IFoS

(b) Solve the following system of equations : 15

$$\begin{aligned} 2x_1 + x_2 + x_3 - 2x_4 &= -10 \\ 4x_1 + 2x_3 + x_4 &= 8 \\ 3x_1 + 2x_2 + 2x_3 &= 7 \\ x_1 + 3x_2 + 2x_3 - x_4 &= -5 \end{aligned}$$

4. GAUSS JORDON METHOD (DIRECT)

1. 6b 2019 IFoS

(b) Solve the following system of equations by Gauss-Jordan elimination method : *10*

$$x_1 + x_2 + x_3 = 3$$

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

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

2. 5b 2017

Explain the main steps of the Gauss-Jordan method and apply this method to find the inverse of the matrix *10*

$$\begin{bmatrix} 2 & 6 & 6 \\ 2 & 8 & 6 \\ 2 & 6 & 8 \end{bmatrix}.$$

***GAUSS JACOBI METHOD (ITERATIVE)**

1. 5c 2011 IFoS

(c) Solve by Gauss-Jacobi method of iteration the equations

$$27x + 6y - z = 85$$

$$6x + 15y + 2z = 72$$

$$x + y + 54z = 110$$

(correct to two decimal places) 10

5. GAUSS- SEIDEL METHOD (ITERATIVE)

1. 6b 2020

For the solution of the system of equations : $4x + y + 2z = 4$
$3x + 5y + z = 7$
$x + y + 3z = 3$

set up the Gauss-Seidel iterative scheme and iterate three times starting with the initial vector $X^{(0)} = 0$. Also find the exact solutions and compare with the iterated solutions. 15

2. 7b 2019

Apply Gauss-Seidel 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. 15

3. 8b 2015

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). 15

4. 6a 2015 IFoS

Q6. (a) Solve the following system of linear equations correct to two places by Gauss-Seidel method :

$$x + 4y + z = -1, \; 3x - y + z = 6, \; x + y + 2z = 4.$$ *16*

5. 6b 2014

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). 15

6. 6c 2012

(c) Solve the following system of simultaneous equations, using Gauss-Seidel iterative method :

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

20

7. 7b 2012 IFoS

(b) Solve the following system of equations using Gauss-Seidel Method :

$$28x + 4y - z = 32$$

$$2x + 17y + 4z = 35$$

$$x + 3y + 10z = 24$$

correct to three decimal places. 13

6. NEWTON'S (FORWARD AND BACKWARD) INTERPOLATION

1. 5b 2019 IFoS

(b) The following table gives the values of $y = f(x)$ for certain equidistant values of x. Find the value of f(x) when $x = 0{\cdot}612$ using Newton's forward difference interpolation formula. 8

x :	0·61	0·62	0·63	0·64	0·65
y = f(x) :	1·840431	1·858928	1·877610	1·896481	1·915541

2. 5b 2018

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 $u_5 = 105$. 10

3. 5c 2013

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 Students	31	42	51	35	31

Using Newton forward interpolation formula, find the number of students whose marks lie between 45 and 50. 10

*[Newton's divided difference formula]

1. 7a 2012

7. (a) Find $\frac{dy}{dx}$ at $x = 0{\cdot}1$ from the following data :

x :	0·1	0·2	0·3	0·4
y :	0·9975	0·9900	0·9776	0·9604

20

2. 7c 2011 IFoS

(c) The velocity of a particle at time t is as follows :

t (seconds)	:	0	2	4	6	8	10	12
v (m/sec)	:	4	6	16	36	60	94	136

Find its displacement at the 12th second and acceleration at the 2nd second. 12

7. LAGRANGE'S INTERPOLATION

1. 8b 2020

Write the three point Lagrangian interpolating polynomial relative to the points x_0, $x_0+\varepsilon$ and x_1. Then by taking the limit $\varepsilon \to 0$, establish the relation

$$f(x) = \frac{(x_1-x)(x+x_1-2x_0)}{(x_1-x_0)^2} f(x_0) + \frac{(x-x_0)(x_1-x)}{(x_1-x_0)} f'(x_0) + \frac{(x-x_0)^2}{(x_1-x_0)} f(x_1) + E(x)$$

where $E(x) = \frac{1}{6}(x-x_0)^2(x-x_1)f'''(\xi)$

is the error function and $\min.(x_0, x_0+\varepsilon, x_1) < \xi < \max.(x_0, x_0+\varepsilon, x_1)$ 15

2. 6b 2020 IFoS

Find the Lagrange interpolating polynomial that fits the following data values :

x	:	-1	2	3	5
$f(x)$	:	-1	10	25	60

Also, interpolate at $x = 2{\cdot}5$, correct to three decimal places. 15

3. 6b 2017

For given equidistant values u_{-1}, u_0, u_1 and u_2, a value is interpolated by Lagrange's formula. Show that it may be written in the form

$$u_x = yu_0 + xu_1 + \frac{y(y^2-1)}{3!}\Delta^2 u_{-1} + \frac{x(x^2-1)}{3!}\Delta^2 u_0,$$

where $x + y = 1$. *15*

4. 6c 2016

Let $f(x) = e^{2x} \cos 3x$, for $x \in [0, 1]$. Estimate the value of $f(0{\cdot}5)$ using Lagrange interpolating polynomial of degree 3 over the nodes $x = 0$, $x = 0{\cdot}3$, $x = 0{\cdot}6$ and $x = 1$. Also, compute the error bound over the interval $[0, 1]$ and the actual error $E(0{\cdot}5)$. *20*

5. 5d 2016 IFoS

5.(d) Apply Lagrange's interpolation formula to find $f(5)$ and $f(6)$ given that $f(1) = 2$, $f(2) = 4$, $f(3) = 8$, $f(7) = 128$. 8

6. 6c 2015

Find the Lagrange interpolating polynomial that fits the following data :

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

Find $f(1{\cdot}5)$. 20

7. 5b 2015 IFoS

(b) Show that $\sum_{k=1}^{n} l_k(x) = 1$, where $l_k(x)$, k = 1 to n, are Lagrange's fundamental polynomials. 10

8. 5a 2014 IFoS

(a) Use Lagrange's formula to find the form of $f(x)$ from the following table : 8

x	0	2	3	6
$f(x)$	648	704	729	792

9. 6c 2014 IFoS

(c) The values of $f(x)$ for different values of x are given as $f(1) = 4$, $f(2) = 5$, $f(7) = 5$ and $f(8) = 4$. Using Lagrange's interpolation formula, find the value of $f(6)$. Also find the value of x for which $f(x)$ is optimum. 10

10. 5a 2012 IFoS

(a) Using Lagrange's interpolation formula, show that

$$32f(1) = -3f(-4) + 10f(-2) + 30f(2) - 5f(4).$$

10

11. 5b 2011 IFoS

(b) For the data

x	:	0	1	2	5
$f(x)$	:	2	3	12	147

find the cubic function of x. 10

12. 7c(ii) 2010

(ii) For the given set of data points

$(x_1, f(x_1)), (x_2, f(x_2)), \ldots\ldots (x_n, f(x_n))$

write an algorithm to find the value of $f(x)$ by using Lagrange's interpolation formula.

13. 6a 2010 IFoS

6. *(a)* Using Lagrange interpolation, obtain an approximate value of $\sin(0 \cdot 15)$ and a bound on the truncation error for the given data : 12

$$\sin(0 \cdot 1) = 0 \cdot 09983, \ \sin(0 \cdot 2) = 0 \cdot 19867$$

14. 7c 2010 IFoS

(c) Find the interpolating polynomial for $(0, 2)$, $(1, 3)$, $(2, 12)$ and $(5, 147)$. 14

8. TRAPEZOIDAL RULE

1. 8b 2020 IFoS

Evaluate the integral $\int_0^2 \frac{x}{1+x^3}\,dx$, using trapezoidal rule with $h = \frac{1}{4}$, correct to three decimal places. (h is the length of subinterval) 10

*COMPOSITE TRAPEZOIDAL RULE

1. 5d 2017 IFoS

5.(d) Evaluate $\int_0^1 e^{-x^2}\,dx$ using the composite trapezoidal rule with four decimal precision, i.e., with the absolute value of the error not exceeding 5×10^{-5}. 10

9. SIMPSON'S 1/3rd RULE

1. 5c 2019 IFoS

(c) Following values of x_i and the corresponding values of y_i are given. Find $\int_0^3 y\,dx$ using Simpson's one-third rule. 8

x_i :	0·0	0·5	1·0	1·5	2·0	2·5	3·0
y_i :	0·0	0·75	1·0	0·75	0·0	– 1·25	– 3·0

2. 5d 2018

समय (मिनट) Time (Minutes)	2	4	6	8	10	12	14	16	18	20
रफ़्तार (किमी/घं) Speed (Km/h)	10	18	25	29	32	20	11	5	2	8·5

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

Using Simpson's $\frac{1}{3}$rd rule, find the approximate distance travelled (in Km) in 20 minutes from the beginning. 10

3. 7b 2018 IFoS

(b) The velocity v (km/min) of a moped is given at fixed interval of time (min) as below :

t	0·1	0·2	0·3	0·4	0·5	0·6
v	1·00	1·104987	1·219779	1·34385	1·476122	1·615146

t	0·7	0·8	0·9	1·0	1·1
v	1·758819	1·904497	2·049009	2·18874	2·31977

Estimate the distance covered during the time (use Simpson's one-third rule). 10

4. 7b 2017 IFoS

7.(b) A river is 80 metre wide, the depth y, in metre, of the river at a distance x from one bank is given by the following table :

x	0	10	20	30	40	50	60	70	80
y	0	4	7	9	12	15	14	8	3

Find the area of cross-section of the river using Simpson's $\frac{1}{3}$rd rule. 10

5. 7a 2016 IFoS

7.(a) Evaluate $\int_0^{0\cdot 6} \frac{dx}{\sqrt{1-x^2}}$ by Simpson's $\frac{1}{3}$rd rule, by taking 12 equal sub-intervals. 15

6. 7c 2013

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. 15

7. 6c 2012 IFoS

(c) A river is 80 meters wide. The depth d (in meters) of the river at a distance x from one bank of the river is given by the following table :

x	0	10	20	30	40	50	60	70	80
d	0	4	7	9	12	15	14	8	3

Find approximately the area of cross-section of the river. 14

8. 5c 2011

(c) Calculate $\int_2^{10} \frac{dx}{1+x}$ (upto 3 places of decimal) by dividing the range into 8 equal parts by Simpson's $\frac{1}{3}$rd Rule. 12

9. 7a 2011

7. (a) 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	·00	·25	·50	·75	1
y	1	·9896	·9589	·9089	·8415

Find the volume of the solid. 20

10. 7c 2011 IFoS

(c) The velocity of a particle at time t is as follows :

t (seconds) :	0	2	4	6	8	10	12
v (m/sec) :	4	6	16	36	60	94	136

Find its displacement at the 12th second and acceleration at the 2nd second. 12

11. 7b 2010

(b) Find the value of the integral

$$\int_1^5 \log_{10} x \, dx$$

by using Simpson's $\frac{1}{3}$-rule correct up to 4 decimal places. Take 8 subintervals in your computation. 20

10. SIMPSON'S 3/8 RULE

1. 7b 2017

Derive the formula

$$\int_a^b y\,dx = \frac{3h}{8}\left[(y_0 + y_n) + 3\,(y_1 + y_2 + y_4 + y_5 + \ldots + y_{n-1}) + 2\,(y_3 + y_6 + \ldots + y_{n-3})\right].$$

Is there any restriction on n ? State that condition. What is the error bound in the case of Simpson's $\frac{3}{8}$ rule ? *20*

11. GAUSSIAN QUADRATURE FORMULA

1. 7b 2020

Find a quadrature formula

$$\int_0^1 f(x)\frac{dx}{\sqrt{x(1-x)}} = \alpha_1 f(0) + \alpha_2 f\left(\tfrac{1}{2}\right) + \alpha_3 f(1)$$

which is exact for polynomials of highest possible degree. Then use the formula to evaluate $\int_0^1 \frac{dx}{\sqrt{x-x^3}}$ (correct up to three decimal places). 20

2. 8c 2019 IFoS

(c) Use Gauss quadrature formula of point six to evaluate $\int_0^1 \frac{dx}{1+x^2}$

given

$x_1 = -0{\cdot}23861919,\quad w_1 = 0{\cdot}46791393$

$x_2 = -0{\cdot}66120939,\quad w_2 = 0{\cdot}36076157$

$x_3 = -0{\cdot}93246951,\quad w_3 = 0{\cdot}17132449$

$x_4 = -x_1,\ x_5 = -x_2,\ x_6 = -x_3,\ w_4 = w_1,\ w_5 = w_2$ and $w_6 = w_3$. *15*

3. 7b 2018

Find the values of the constants a, b, c such that the quadrature formula $\int_o^h f(x)dx = h\left[af(o) + bf\left(\frac{h}{3}\right) + cf(h)\right]$ is exact for polynomials of as high degree as possible, and hence find the order of the truncation error. *15*

4. 7c 2016

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 $\int_{2}^{4} 2x\,e^{x}dx$. *15*

*WEDDLE'S RULE

1. 5b 2018 IFoS

(b) A solid of revolution is formed by rotating about the x-axis, the area between the x-axis, the line $x = 0$ and a curve through the points with the following coordinates :

x	0·0	0·25	0·50	0·75	1·00	1·25	1·50
y	1·0	0·9896	0·9589	0·9089	0·8415	0·8029	0·7635

Estimate the volume of the solid formed using Weddle's rule. 10

12. EULER'S METHOD

1. 7b 2013

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

$$y' = x(y + x) - 2$$

$$y(0) = 2 \qquad 15$$

*MODIFIED EULER'S METHOD

1. 7c 2017 IFoS

7.(c) Find y for $x = 0{\cdot}2$ taking $h = 0{\cdot}1$ by modified Euler's method and compute the error, given that : $\frac{dy}{dx} = x + y,\ y(0) = 1.$ 10

2. 8c 2012 IFoS

(c) Using Euler's Modified Method, obtain the solution of

$$\frac{dy}{dx} = x + \left|\sqrt{y}\right|,\quad y(0) = 1$$

for the range $0 \le x \le 0.6$ and step size 0.2.

14

13. RUNGE KUTTA METHOD

1. 5d 2019

Using Runge-Kutta method of fourth order, solve $\dfrac{dy}{dx} = \dfrac{y^2 - x^2}{y^2 + x^2}$ with $y(0) = 1$ at $x = 0{\cdot}2$. Use four decimal places for calculation and step length $0{\cdot}2$. 10

2. 7a 2019 IFoS

Q7. (a) Given $\dfrac{dy}{dx} = x^2 + y^2$, $y(0) = 1$. Find $y(0{\cdot}1)$ and $y(0{\cdot}2)$ by fourth order Runge-Kutta method. *15*

3. 6b 2018 IFoS

(b) Apply fourth-order Runge-Kutta method to compute y at $x = 0{\cdot}1$ and $x = 0{\cdot}2$, given that $\dfrac{dy}{dx} = x + y^2$, $y = 1$ at $x = 0$. 12

4. 7c 2016 IFoS

7.(c) Use the Classical Fourth-order Runge-Kutta method with $h = {\cdot}2$ to calculate a solution at $x = {\cdot}4$ for the initial value problem $\dfrac{dy}{dx} = x + y^2$ with initial condition $y = 1$ when $x = 0$. 15

5. 7b 2015

Solve the initial value problem $\dfrac{dy}{dx} = x(y - x)$, $y(2) = 3$ in the interval $[2,\ 2{\cdot}4]$ using the Runge-Kutta fourth-order method with step size $h = 0{\cdot}2$. 15

6. 7c 2015 IFoS

(c) Use the classical fourth order Runge-Kutta methods to find solutions at $x = 0{\cdot}1$ and $x = 0{\cdot}2$ of the differential equation $\frac{dy}{dx} = x + y$, $y(0) = 1$ with step size $h = 0{\cdot}1$. 14

7. 6c 2014

Use Runge-Kutta formula of fourth order to find the value of y at $x = 0 \cdot 8$, where $\frac{dy}{dx} = \sqrt{x+y}$, $y(0 \cdot 4) = 0 \cdot 41$. Take the step length $h = 0 \cdot 2$. 20

8. 8a 2014 IFoS

8. *(a)* Using Runge-Kutta 4th order method, find y from

$$\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$$

with $y(0) = 1$ at $x = 0 \cdot 2,\ 0 \cdot 4$. 10

9. 8b 2013 IFoS

Use the Classical Fourth-order Runge – Kutta method with $h = 0{\cdot}2$ to calculate a solution at $x = 0{\cdot}4$ for the initial value problem $\frac{du}{dx} = 4 - x^2 + u$, $u(0) = 0$ on the interval $[0, 0{\cdot}4]$. 12

10. 8b 2010 IFoS

(b) Solve the initial value problem

$$\frac{dy}{dx} = \frac{y-x}{y+x}, \quad y(0) = 1$$

for $x = 0 \cdot 1$ by Euler's method. 13

14. NUMBER SYSTEMS & OPERATIONS

1. 5c 2020 IFoS

Answer the following questions :

(i) Convert $(14231)_8$ into an equivalent binary number and then find the equivalent decimal number.

(ii) Convert $(43503)_{10}$ into an equivalent binary number and then find the equivalent hexadecimal number. 8

2. 6a 2019

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 $(1101{\cdot}101)_8 \rightarrow (?)10$. 15

3. 6b 2018

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

(i) $(111011{\cdot}101)_2$ to decimal system

(ii) $(1000111110000{\cdot}00101100)_2$ to hexadecimal system

(iii) $(C4F2)_{16}$ to decimal system

(iv) $(418)_{10}$ to binary system 15

4. 7c 2018 IFoS

(c) Assuming a 16-bit computer representation of signed integers, represent –44 in 2's complement representation. 10

5. 7d 2017 IFoS

7.(d) Assuming a 32 bit computer representation of signed integers using 2's complement representation, add the two numbers –1 and –1024 and give the answer in 2's complement representation. 10

6. 5d 2016

Convert the following decimal numbers to equivalent binary and hexadecimal numbers : *10*

(i) 4096

(ii) 0·4375

(iii) 2048·0625

7. 5a 2015 IFoS

Store the value of -1 in hexadecimal in a 32-bit computer. *10*

8. 6b 2013 IFoS

Convert $(0{\cdot}231)_5$, $(104{\cdot}231)_5$ and $(247)_7$ to base 10. *12*

9. 5d(i) 2011

(d) (i) Compute $(3205)_{10}$ to the base 8.

10. 7c(i) 2010

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

11. 5c 2010 IFoS

(c) Convert the following : 10

(i) $(736 \cdot 4)_8$ to decimal number

(ii) $(41 \cdot 6875)_{10}$ to binary number

(iii) $(101101)_2$ to decimal number

(iv) $(AF63)_{16}$ to decimal number

(v) $(101111011111)_2$ to hexadecimal number

15. BOOLEAN ALGEBRA- LOGIC GATES, TRUTH TABLES, NORMAL FORMS, LOGIC CIRCUITS

1. 5c 2020

Let $g(w, x, y, z) = (w + x + y)(x + \bar{y} + z)(w + \bar{y})$ be a Boolean function. Obtain the conjunctive normal form for $g(w, x, y, z)$. Also express $g(w, x, y, z)$ as a product of maxterms. 10

2. 8a 2019

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. 15

3. 8a 2018

Simplify the boolean expression :

$(a + b) \cdot (\bar{b} + c) + b \cdot (\bar{a} + \bar{c})$ by using the laws of boolean algebra. From its truth table write it in minterm normal form. 15

4. 5c 2017

Write the Boolean expression

$z\,(y + z)\,(x + y + z)$

in its 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. *10*

5. 8c 2016

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

Let A, B, C be Boolean variables, $\bar{A}$ denote complement of A, A + B is an expression for A OR B and A . B 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.

$A \,.\, (A + B + C) \,.\, (\bar{A} + B + C) \,.\, (A + \bar{B} + C) \,.\, (A + B + \bar{C})$. *15*

6. 5c 2015

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? 10

7. 5d 2014

Use only AND and OR logic gates to construct a logic circuit for the Boolean expression $z = xy + uv$. 10

8. 8b 2014

For any Boolean variables x and y, show that $x + xy = x$. 15

9. 5d(ii) 2011

(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 $x \vee y = 1$ then prove that $y = x'$. 12

10. 7b 2011

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

20

11. 5d(i) 2010

(d) (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 ?

12. 5d(ii) 2010

(ii) If $A \oplus B = AB' + A'B$, find the value of $x \oplus y \oplus z$. 6+6

13. 7a 2010

7. (a) 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. 20

14. 7c(iii) 2010

(iii) Using Boolean algebra, simplify the following expressions

(i) $a + a'b + a'b'c + a'b'c'd + \ldots\ldots$

(ii) $x'y'z + yz + xz$

where x' represents the complement of x.

5+10+5

16. ALGORITHMS AND FLOWCHARTS

1. 7a 2020 IFoS

Write down the algorithm and flowchart for solving numerically the differential equation $\frac{dy}{dx} = f(x, y) = 1 + x\cos y$ with initial condition : at $x = x_0$, $y = y_0$ and step length h by Euler's method up to $x = x_n = x_0 + nh$. 7+8=15

2. 5e 2019

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. 10

3. 8b 2019 IFoS

(b) State the Newton–Raphson iteration formula to compute a root of an equation f(x) = 0 and hence write a program in BASIC to compute a root of the equation

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

lying between 0 and 1. Use DEF function to define f(x) and f′(x). *10*

4. 5e 2018

Write down the basic algorithm for solving the equation : $xe^x - 1 = 0$ by bisection method, correct to 4 decimal places. 10

5. 5c 2018 IFoS

(c) Write a program in BASIC to multiply two matrices (checking for consistency for multiplication is required). 10

6. 6d 2018 IFoS

(d) Write a program in BASIC to implement trapezoidal rule to compute $\int_0^{10} e^{-x^2} dx$ with 10 subdivisions. 8

7. 8b 2017

Write an algorithm in the form of a flow chart for Newton-Raphson method. Describe the cases of failure of this method. *15*

8. 5b 2017 IFoS

5.(b) Write a BASIC program to compute the multiplicative inverse of a non-singular square matrix. 12

9. 5c 2016 IFoS

5.(c) Develop an algorithm for Newton-Raphson method to solve $\phi(x) = 0$ starting with initial iterate x_0, n be the number of iterations allowed, eps be the prescribed relative error and delta be the prescribed lower bound for $\phi'(x)$. 8

10. 8a 2015 IFoS

Q8. (a) Write a BASIC program to compute the product of two matrices. *12*

11. 7b 2014

Draw a flowchart for Simpson's one-third rule. 15

12. 5b 2014 IFoS

(b) Write a program in BASIC to integrate

$$\int_0^1 e^{-2x} \sin x \, dx$$

by Simpson's $\frac{1}{3}$rd rule with 20 subintervals. 8

13. 6d 2014 IFoS

(d) Write a BASIC program to sum the series $S = 1 + x + x^2 + \ldots + x^n$, for $n = 30$, 60 and 90 for the values of $x = 0 \cdot 1 \; (0 \cdot 1) \; 0 \cdot 3$. 10

14. 7a 2013

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, eps be the prescribed relative error and delta be the prescribed lower bound for $f'(x)$. 20

15. 7b 2013 IFoS

(b) Write an algorithm to find the inverse of a given non-singular diagonally dominant square matrix using Gauss – Jordan method. 13

16. 8c 2013 IFoS

(c) Draw a flow chart for testing whether a given real number is a prime or not. 12

17. 5c 2012

(c) 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 is $y(a) = \alpha$, using Euler's method. 12

18. 5c 2012 IFoS

(c) Write a computer program to implement trapezoidal rule to evaluate

$$\int_0^{10} \left(1 - e^{-\frac{x}{2}}\right) dx.$$ 10

19. 7c 2012 IFoS

(c) Draw a flow chart for interpolation using Newton's forward difference formula. 14

20. 7c 2012

(c) In a certain examination, a candidate has to appear for one major and two minor 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 any one 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. 20

21. 7c 2011

Draw a flow chart for Lagrange's interpolation formula. 20

22. 8b 2011 IFoS

(b) Draw a flow chart to solve a quadratic equation with non-zero coefficients. The roots be classified as real distinct, real repeated and complex. 12

23. 6b 2011 IFoS

(b) Draw a flow chart to declare the results for the following examination system : 12

60 candidates take the examination.

Each candidate writes one major and two minor papers.

A candidate is declared to have passed in the examination if he/she gets a minimum of 40 in all the three papers separately and an average of 50 in all the three papers put together.

Remaining candidates fail in the examination with an exemption in major if they obtain 60 and above and exemption in each minor if they obtain 50 and more in that minor.

24. 6b 2010 IFoS

(b) Draw a flow chart for finding the roots of the quadratic equation $ax^2 + bx + c = 0$. 12

ROUGH WORK