National Testing Agency

Question Paper Name :	Numerical Analysis 30 Sep 2020 Shift 2
Subject Name :	Numerical Analysis
Creation Date :	2020-09-30 18:37:37
Duration :	180
Number of Questions :	34
Total Marks :	100
Display Marks:	Yes

Numerical Analysis

Group Number :	1
Group Id :	899514191
Group Maximum Duration :	0
Group Minimum Duration :	120
Show Attended Group? :	No
Edit Attended Group? :	No
Break time :	0
Group Marks :	100
Is this Group for Examiner? :	No

Numerical Analysis-1

Section Id :	899514261
Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory
Number of Questions :	20
Number of Questions to be attempted :	20

Section Marks :	20
Mark As Answered Required? :	Yes
Sub-Section Number :	1
Sub-Section Id :	899514306
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 89951416297 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Suppose the value of $y = f(x)$ is known at three points x_0, x_1 and x_2. If $L_i(x), i =$ 0,1,2 represents the Lagrange's function, then the value of $L_0(x) + L_1(x) + L_2(x)$ for all x is

1. 0
2. 1
3. 2
4. 3

Options :

89951463639. 1

89951463640. 2

89951463641. 3

89951463642. 4

Question Number : 2 Question Id : 89951416298 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Let $a_0x^n + a_1x^{n-1} + \cdots + a_{n-1}x + a_n = 0$ be a polynomial equation, where $a_0 > 0, a_1, a_2, \ldots, a_{m-1} \geq 0$, $a_m < 0$, for some $m \leq n$, and B is the greatest of the absolute values of the negative coefficients. Then the upper bound of the positive roots of the equation is

1. $1 + \left(\frac{B}{a_0}\right)^{1/m}$
2. $1 + \left(\frac{B}{a_0}\right)^{m}$
3. $1 + B^m$
4. $1 + B^{1/m}$

Options :

89951463643. 1

89951463644. 2

89951463645. 3

89951463646. 4

Question Number : 3 Question Id : 89951416299 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The following table represents the velocity of a particle as a function of time

Time (s) :	0	5	7	9	11
Velocity(m/s):	25	34	81	72	55

If you want to fit a quadratic polynomial for this data, the three data points of time you would choose for interpolation are

1. 0,5,7
2. 0,7,11
3. 7,9,11
4. 5,7,9

Options :

89951463647. 1
89951463648. 2
89951463649. 3
89951463650. 4

Question Number : 4 Question Id : 89951416300 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The value of

$$\frac{\Delta^2}{E}x^2$$

when step length 1 is

1. $2x^2$
2. x^2
3. $2x$
4. 2

Options :

89951463651. 1
89951463652. 2
89951463653. 3
89951463654. 4

Question Number : 5 Question Id : 89951416301 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

From Newton's divided difference interpolation formula one can deduce

1. only Newton's forward difference interpolation formula

2. only Newton's backward difference interpolation formula
3. only Lagrange's interpolation formula
4. all the above three formulae

Options :

89951463655. 1
89951463656. 2
89951463657. 3
89951463658. 4

Question Number : 6 Question Id : 89951416302 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The value of $\lim_{h \to 0} \frac{\Delta^2 f(x)}{h^2}$ is

1. $h^2 f'(x)$
2. $h^2 f''(x)$
3. $f''(x)$
4. $f'(x)$

Options :

89951463659. 1
89951463660. 2
89951463661. 3

89951463662. 4

Question Number : 7 Question Id : 89951416303 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The rate of convergence of fixed point iteration method is

1. 0
2. 1
3. 1.61
4. 2

Options :

89951463663. 1

89951463664. 2

89951463665. 3

89951463666. 4

Question Number : 8 Question Id : 89951416304 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The velocity of a particle is given by
$v(t) = 5e^{-t} + 6$, t and v are measure in second and m/s. The time t when the velocity of the particle 8 m/s is

1. 0.8315
2. 0.5831
3. 0.9863
4. 0.9163

Options :

89951463667. 1

89951463668. 2

89951463669. 3

89951463670. 4

Question Number : 9 Question Id : 89951416305 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The following n data points $(x_1,y_1),(x_2,y_2),\ldots,(x_n,y_n)$ are given. For constructing quadratic spline interpolation the x-data needs to be

1. equally spaced
2. placed in ascending or descending order of x-values
3. integers
4. positive

Options :

89951463671. 1

89951463672. 2

89951463673. 3

89951463674. 4

Question Number : 10 Question Id : 89951416306 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The following incomplete table gives the value of y for a given x:

x:	1	2	4	6	7
y:	5	11	?	?	32

The data is fit by quadratic spline interpolants given by

$f(x) = ax - 1, \quad 1 \le x \le 2$

$f(x) = -2x^2 + 14x - 9, \quad 2 \le x \le 4$

$f(x) = bx^2 + cx + d, \quad 4 \le x \le 6$

$f(x) = 25x^2 - 303x + 928, \quad 6 \le x \le 7$

where a, b, c and d are constants. The value of a is most nearly

1. -6.00
2. 6.00
3. 14.000
4. -14.50

Options :

89951463675. 1

89951463676. 2

89951463677. 3

89951463678. 4

Question Number : 11 Question Id : 89951416307 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

In explicit method to solve the wave equation $u_{tt} = c^2 u_{xx}$, the number of values of u required to find the value of another u is

1. 2
2. 3
3. 4
4. 5

Options :

89951463679. 1

89951463680. 2

89951463681. 3

89951463682. 4

Question Number : 12 Question Id : 89951416308 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Finite difference method reduces a BVP to

1. a system of first order ODE's
2. a recursive algebraic equation
3. an algebraic equation
4. a system of linear algebraic equations

Options :

89951463683. 1

89951463684. 2

89951463685. 3

89951463686. 4

Question Number : 13 Question Id : 89951416309 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Which one is incorrect?

1. Milne-Simpson's predictor formula is an explicit formula
2. Milne-Simpson's corrector formula is an explicit formula
3. Forth order Runge-Kutta method is an explicit method
4. Modified Euler method is an implicit method

Options :

89951463687. 1
89951463688. 2
89951463689. 3
89951463690. 4

Question Number : 14 Question Id : 89951416310 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The Gauss-Legendre quadrature is used

1. for proper integral only
2. for first type improper integral only
3. for all type of improper integrals only
4. for second type improper and proper integrals

Options :

89951463691. 1
89951463692. 2
89951463693. 3
89951463694. 4

Question Number : 15 Question Id : 89951416311 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Let $f(x) = 5x^2 + 2x - 100$ be defined on $[-100,100]$. The error of the integration of $\int_0^{100} f(x)\,dx$ by Simpson 1/3 rule is

1. 0
2. 104.5
3. -54.5
4. 20.4

Options :

89951463695. 1
89951463696. 2
89951463697. 3
89951463698. 4

Question Number : 16 Question Id : 89951416312 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Power method is use to find

1. all eigenvalues and eigenvectors of any square matrix
2. all eigenvalues and eigenvectors of any symmetric matrix only
3. all eigenvalues of any square matrix
4. only one eigenvalue and one eigenvector of any square matrix

Options :

89951463699. 1

89951463700. 2

89951463701. 3

89951463702. 4

Question Number : 17 Question Id : 89951416313 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

How many rotations are required to convert a real symmetric matrix A of order $n \times n$ to a tri-diagonal matrix by Householder method?

1. n
2. $n-1$
3. $n-2$
4. it may be more than n

Options :

89951463703. 1

89951463704. 2

89951463705. 3

89951463706. 4

Question Number : 18 Question Id : 89951416314 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

In shooting method, a second order BVP is

1. converted into two small BVPs
2. converted into two IVPs
3. converted into two algebraic equations
4. converted into a system of linear algebraic equations

Options :

89951463707. 1

89951463708. 2

89951463709. 3

89951463710. 4

Question Number : 19 Question Id : 89951416315 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The truncation error of finite difference scheme used to solve hyperbolic PDE equation is

1. $(h + k)$
2. $(h^2 + k^2)$
3. $(h^3 + k^3)$
4. $(h + k^2)$

Options :

89951463711. 1

89951463712. 2

89951463713. 3

89951463714. 4

Question Number : 20 Question Id : 89951416316 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The fourth order Runge-Kutta method cannot be used to solve

1. a pair of first order and first degree ODEs with initial conditions
2. second order initial value problem
3. second order boundary value problem
4. a first order and first degree ODE with initial condition

Options :

89951463715. 1
89951463716. 2
89951463717. 3
89951463718. 4

Numerical Analysis-2

Section Id :	899514262
Section Number :	2
Section type :	Offline
Mandatory or Optional :	Mandatory
Number of Questions :	7
Number of Questions to be attempted :	5
Section Marks :	30
Mark As Answered Required? :	Yes
Sub-Section Number :	1
Sub-Section Id :	899514307
Question Shuffling Allowed :	No

Question Number : 21 Question Id : 89951416317 Question Type : SUBJECTIVE
Correct Marks : 6

For the following table

x	1.8	2.0	2.2	2.4
y	3.9422	4.2561	6.5501	7.2110

Construct forward and backward difference tables and compare them. Also, find the value of y when $x = 1.9$ using Newton forward difference interpolation method.

Question Number : 22 Question Id : 89951416318 Question Type : SUBJECTIVE
Correct Marks : 6

Describe least square method to solve a system of linear equations. Use this method to find the solution of the following system of equations

$$2x - 3y = 1, \quad 5x + y = 11.1, \quad -2x + 3y = -1.2.$$

Also, estimate the error.

Question Number : 23 Question Id : 89951416319 Question Type : SUBJECTIVE
Correct Marks : 6

What do you mean by ill-conditioned and well-conditioned system of equations ? Explain with examples.

Describe a suitable method to solve ill-conditioned system of linear equations.

Question Number : 24 Question Id : 89951416320 Question Type : SUBJECTIVE
Correct Marks : 6

Describe partial pivoting method to find inverse of a square matrix. Find the inverse of the following matrix by partial pivoting

$$\begin{bmatrix} 8 & 1 & -1 \\ 2 & 1 & 9 \\ 1 & -7 & 2 \end{bmatrix}$$

Question Number : 25 Question Id : 89951416321 Question Type : SUBJECTIVE
Correct Marks : 6

Deduce 2-point Gauss-Legendre quadrature formula. Use this method to find the value of

$$\int_0^2 \frac{x}{1+x^2}\, dx$$

correct up to 3 decimal places.

Question Number : 26 Question Id : 89951416322 Question Type : SUBJECTIVE

Correct Marks : 6

Find the value of $y(0.5)$ by solving the boundary value problem

$$y'' + xy' + 1 = 0 \text{ with } y(0) = 0, \quad y(1) = 0 \text{ by taking } h = 0.25.$$

Question Number : 27 Question Id : 89951416323 Question Type : SUBJECTIVE
Correct Marks : 6

Describe fourth Runge-Kutta method to solve the following equations

$\frac{dy}{dx} = f(x,y,z)$ and $\frac{dz}{dx} = g(x,y,z)$, $y(x_0) = y_0$, $z(x_0) = z_0$.

Solve the following pair of differential equations

$\frac{dy}{dx} = \frac{x+y}{z}$ and $\frac{dz}{dx} = xy + z$

with initial conditions $x_0 = 0.5$, $y_0 = 1.5$, $z_0 = 1$ for $x = 0.6$.

Numerical Analysis-3

Section Id :	899514263
Section Number :	3
Section type :	Offline
Mandatory or Optional :	Mandatory
Number of Questions :	7
Number of Questions to be attempted :	5
Section Marks :	50
Mark As Answered Required? :	Yes
Sub-Section Number :	1
Sub-Section Id :	899514308
Question Shuffling Allowed :	No

Question Number : 28 Question Id : 89951416324 Question Type : SUBJECTIVE
Correct Marks : 10

Using Hermite's interpolation formula, estimate the value of log 3.2 from the following table.

x	:	3.0	3.5	4.0
y	:	1.09861	1.25276	1.38629
y	:	0.33333	0.28571	0.25000

Question Number : 29 Question Id : 89951416325 Question Type : SUBJECTIVE Correct Marks : 10

Describe Birge-Vieta method to find all roots of a polynomial equation of degree n. Discuss the merits and demerits of the method.

Question Number : 30 Question Id : 89951416326 Question Type : SUBJECTIVE Correct Marks : 10

Describe a method to approximate the function $y = f(x)$ with the help of orthogonal polynomials. Assume that the necessary conditions are valid for the function $f(x)$.

What is the advantage to use orthogonal polynomials for approximation of function?

Question Number : 31 Question Id : 89951416327 Question Type : SUBJECTIVE Correct Marks : 10

Consider the following system of linear equations

$$2x_1 - 2x_2 + x_3 = 2, \quad 5x_1 + x_2 - 3x_3 = 0, \quad 3x_1 + 4x_2 + x_3 = 9$$

and let the coefficient matrix be A. Write $A = LU$, where LU are lower and upper triangular matrices.

Then use LU-decomposition method to solve the above system of linear equations.

Question Number : 32 Question Id : 89951416328 Question Type : SUBJECTIVE

Correct Marks : 10

Find the value of

$$\int_1^2 \int_1^2 \frac{dx\,dy}{x^2+y^2}$$

using trapezoidal rule, taking $h = k = 0.5$.

Question Number : 33 Question Id : 89951416329 Question Type : SUBJECTIVE
Correct Marks : 10

Describe Leverrier-Faddeev method to find the characteristic equation of a square matrix. Also, construct such equation for the following matrix

$$\begin{bmatrix} 2 & 3 & 1 \\ 3 & 4 & 0 \\ -1 & -1 & 3 \end{bmatrix}$$

Question Number : 34 Question Id : 89951416330 Question Type : SUBJECTIVE
Correct Marks : 10

Solve the second-order wave equation

$$\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$$

with boundary conditions $u = 0$ at $x = 0$ and 1, $t > 0$ and the initial conditions

$$u = \frac{1}{2} sin\, \pi x, \qquad \frac{\partial u}{\partial t} = 0,$$

when $t = 0$, $0 \leq x \leq 1$, for $x = 0, 0.2, 0.4, \ldots, 1.0$ and $t = 0, 0.1, 0.2, \ldots, 0.4$.