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National Testing Agency

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Numerical Analysis

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Numerical Analysis-1

Section Id :	864351670
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 :	864351893
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 86435116433 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

If δx is the relative error while computing the value of X, then the relative error to compute $X^{1/k}$ is

1. k δx
2. δx^k
3. $\delta x^{(1/k)}$
4. (1/k) δx

Options :

86435155827. 1
86435155828. 2
86435155829. 3
86435155830. 4

Question Number : 2 Question Id : 86435116434 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Four statements are given below. Among them three statements are correct. Identify the correct group of statements.

A. The nth order divided difference of a polynomial of degree n is constant

B. Divided differences are symmetric

C. Divided difference is linear

D. Divided difference of a constant is one

1. A, B, C
2. A, B, D
3. B, C, D
4. A, C, D

Options :

86435155831. 1
86435155832. 2
86435155833. 3
86435155834. 4

Question Number : 3 Question Id : 86435116435 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

For the following set of data

x : 1 2 3

y : 10 13 18

The nearest value of y at x=1.5 obtained by Aitken interpolation formula is

1. 12.75
2. 11.25
3. 9.50
4. 13.25

Options :

86435155835. 1
86435155836. 2
86435155837. 3
86435155838. 4

Question Number : 4 Question Id : 86435116436 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The following table is obtained from a function y=f(x)

x : 0.15 p 0.28 0.34

y : 5.0675 5.1200 5.2352 5.3468

The value of p can be determined by

1. Lagrange interpolation
2. Bessel interpolation
3. Inverse interpolation
4. Cubic spline interpolation

Options :

86435155839. 1
86435155840. 2
86435155841. 3
86435155842. 4

Question Number : 5 Question Id : 86435116437 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Choose the correct one

1. In interpolation, the polynomial passes through all the given points
2. In curve fitting, the fitted curve passes through all the given points
3. In interpolation, the degree of the polynomial can be fixed up
4. In polynomial curve fitting, the polynomial must be passes through the end points

Options :
86435155843. 1
86435155844. 2
86435155845. 3
86435155846. 4

Question Number : 6 Question Id : 86435116438 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

If $T_n(x)$ is the Chebyshev polynomial of degree n, then the upper bound of $2^{1-n}T_n(x)$ is

1. 1
2. 2^n
3. 2^{1-n}
4. can't say

Options :
86435155847. 1
86435155848. 2

86435155849. 3
86435155850. 4

Question Number : 7 Question Id : 86435116439 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Bairstow method is used to find

1. all roots of a polynomial equation
2. only real roots of a polynomial equation
3. only complex roots of a polynomial equation
4. only one real root of a polynomial equation

Options :
86435155851. 1
86435155852. 2
86435155853. 3
86435155854. 4

Question Number : 8 Question Id : 86435116440 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Let f(x,y)=0 and g(x,y)=0 be two equations. For two suitable functions h and k, the Gauss-Seidal iteration scheme to solve this pair of equations is

1. $x_{n+1}=h(x_{n+1},y_n)$, $y_{n+1}=k(x_n,y_n)$
2. $x_{n+1}=h(x_n,y_n)$, $y_{n+1}=k(x_n,y_n)$
3. $x_{n+1}=h(x_n,y_n)$, $y_{n+1}=k(x_{n+1},y_n)$
4. $x_{n+1}=h(x_n,y_n)$, $y_{n+1}=k(x_n,y_{n+1})$

Options :
86435155855. 1
86435155856. 2
86435155857. 3

86435155858. 4

Question Number : 9 Question Id : 86435116441 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Identify the INCORRECT statement while solving a system of linear equations

1. Direct method gives the solution of a system of equations in one execution
2. There is no scope to update the solution obtained in direct method, but it is possible for iteration method
3. Iteration method is suitable for solving ill-condition system of equations
4. In direct method, same procedure is repeated for several times

Options :
86435155859. 1
86435155860. 2
86435155861. 3
86435155862. 4

Question Number : 10 Question Id : 86435116442 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

For solving a system of linear equations by least square method, the three among the following four statements are correct. Identify the correct group of statements.

A. Least square method is applicable only for consistent system of equations

B. Least square method gives solution with minimum error

C. Least square method is useful for the inconsistent system

D. Least square method is useful for square and rectangular system of equations

Choose the ***correct*** answer from the options given below:

1. A,B,C
2. A,B,D
3. A,C,D
4. B,C,D

Options :

86435155863. 1
86435155864. 2
86435155865. 3
86435155866. 4

Question Number : 11 Question Id : 86435116443 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

If $\lambda_1, \lambda_2, \ldots, \lambda_n$, be the eigenvalues of the matrix *A* of order n x n, then the product of the eigenvalues is

1. Trace (A)
2. det(A)
3. Trace (A^2)
4. $\det(A)^2$

Options :

86435155867. 1
86435155868. 2
86435155869. 3
86435155870. 4

Question Number : 12 Question Id : 86435116444 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Jacobi's method is use to find

1. All eigenvalues and eigenvectors of a square matrix
2. All eigenvalues and eigenvectors of a symmetric matrix
3. Only all eigenvalues of a square matrix
4. Only one eigenvalue and one eigenvector of a square matrix

Options :

86435155871. 1
86435155872. 2
86435155873. 3
86435155874. 4

Question Number : 13 Question Id : 86435116445 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The Cote's coefficients for Simpson 1/3 formula are

1. 1/3, 4/3, 1/3
2. 1, 4, 1
3. 1/3, 2/3, 1/3
4. 1/2, 1/2,1/2

Options :

86435155875. 1
86435155876. 2
86435155877. 3
86435155878. 4

Question Number : 14 Question Id : 86435116446 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The weight function of the Gauss-Legendre quadrature formula is

1. 1
2. $(1-x^2)^{-1/2}$
3. e^x
4. e^{x^2}

Options :

86435155879. 1
86435155880. 2
86435155881. 3
86435155882. 4

Question Number : 15 Question Id : 86435116447 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The weights of 3-point Gauss-Chebyshev quadrature are

1. $\pi/3, \pi/3, \pi/3$
2. $\pi/3, 2\pi/3, \pi$
3. $-1/\sqrt{3}, \quad 0, 1/\sqrt{3}$
4. 5/9, 8/9, 5/9

Options :
86435155883. 1
86435155884. 2
86435155885. 3
86435155886. 4

Question Number : 16 Question Id : 86435116448 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

The fourth order Runge-Kutta method can NOT be used to solve

1. A pair of first order ordinary differential equations
2. A second order Initial Value Problem
3. A second order Boundary Value Problem
4. A system of first order ordinary differential equations

Options :
86435155887. 1
86435155888. 2
86435155889. 3
86435155890. 4

Question Number : 17 Question Id : 86435116449 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 :
86435155891. 1
86435155892. 2
86435155893. 3
86435155894. 4

Question Number : 18 Question Id : 86435116450 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

In shooting method, a Boundary Value Problem is

1. Converted into two small Boundary Value Problems
2. Converted into two Initial Value Problems
3. Converted into two algebraic equations
4. Converted into a system of linear algebraic equations

Options :
86435155895. 1
86435155896. 2
86435155897. 3
86435155898. 4

Question Number : 19 Question Id : 86435116451 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No Correct Marks : 1 Wrong Marks : 0

Crank-Nicolson method converts a parabolic Partial Differential Equations into

1. A system of ordinary differential equations
2. Two first order Partial Differential Equations
3. A pair of Ordinary Differential Equations
4. A system of tri-diagonal linear equations

Options :
86435155899. 1
86435155900. 2
86435155901. 3
86435155902. 4

Question Number : 20 Question Id : 86435116452 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 :
86435155903. 1
86435155904. 2
86435155905. 3
86435155906. 4

Numerical Analysis-2

Section Id : 864351671

Section Number :	2
Section type :	Offline
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	10
Section Marks :	30
Mark As Answered Required? :	Yes
Sub-Section Number :	1
Sub-Section Id :	864351894
Question Shuffling Allowed :	No

Question Number : 21 Question Id : 86435116453 Question Type : SUBJECTIVE
Correct Marks : 3

Find the Lagrange's quadratic interpolating polynomial for $f(x)$ which satisfies the conditions $f(0) = 1, f(1) = 2$ and $f(3) = 6$.

Question Number : 22 Question Id : 86435116454 Question Type : SUBJECTIVE
Correct Marks : 3

If 1 is the first orthogonal polynomial with respective to the weight function $w(x) = 1$, then find the third orthogonal polynomial obtained by Gram-Schmidt orthogonalization process.

Question Number : 23 Question Id : 86435116455 Question Type : SUBJECTIVE
Correct Marks : 3

The iteration scheme of Newton-Raphson method for a pair of non-linear equations $f(x, y) = 0, g(x, y) = 0$ is $x_{n+1} = x_n + h$; $y_{n+1} = y_n + k$. Find the expressions for h and k.

Question Number : 24 Question Id : 86435116456 Question Type : SUBJECTIVE
Correct Marks : 3

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

Question Number : 25 Question Id : 86435116457 Question Type : SUBJECTIVE
Correct Marks : 3

Deduce 3-point Gauss-Legendre quadrature formula.

Question Number : 26 Question Id : 86435116458 Question Type : SUBJECTIVE
Correct Marks : 3

Describe finite difference method to solve second order initial value problem.

Question Number : 27 Question Id : 86435116459 Question Type : SUBJECTIVE
Correct Marks : 3

Let us consider the following function

$$f(x) = \begin{cases} -\frac{11}{2}x^3 + 26x^2 - \frac{75}{2}x + 18, & 1 \le x \le 2 \\ \frac{11}{2}x^3 - 40x^2 + \frac{189}{2}x + a, & 2 \le x \le 3 \end{cases}$$

Is $f(x)$ a cubic spline for a suitable value of a ? Find a, if exists.

Question Number : 28 Question Id : 86435116460 Question Type : SUBJECTIVE
Correct Marks : 3

Compare Newton-Cotes quadrature and Gaussion quadrature.

Question Number : 29 Question Id : 86435116461 Question Type : SUBJECTIVE
Correct Marks : 3

If $f(x)$ is a function defined by $f(x) = \frac{ax+b}{cx+d}$, where a, b, c, d are constants, then find the value of the divided difference $f[p,p,q]$.

Question Number : 30 Question Id : 86435116462 Question Type : SUBJECTIVE
Correct Marks : 3

Prove that $(1+\delta^2\mu^2) \equiv (1+\frac{\delta^2}{2})^2$, the symbols have their usual meanings.

Numerical Analysis-3

Section Id :	864351672
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 :	864351895
Question Shuffling Allowed :	No

Question Number : 31 Question Id : 86435116463 Question Type : SUBJECTIVE

Correct Marks : 10

Describe 4th order Runge-Kutta method to solve the following differential equations

$$\frac{dy}{dx} = f(x,y,z), \quad \frac{dz}{dx} = g(x,y,z), \; y(x_0) = a, z(x_0) = b.$$

And hence solve the following initial value problem

$$a(x)y'' + b(x)y' + c(x)y = f(x), y(x_0) = y_0$$

where $a(x), b(x), c(x)$ and $f(x)$ are some suitable functions such that the above equation has a solution.

Question Number : 32 Question Id : 86435116464 Question Type : SUBJECTIVE
Correct Marks : 10

Describe the power method to find the largest (in magnitude) eigenvalue of a square matrix.

Question Number : 33 Question Id : 86435116465 Question Type : SUBJECTIVE
Correct Marks : 10

The sequence , Trace of $B_k = AD_{k-1}, d_k = \frac{1}{k}$ Trace of B_k , $D_k = B_k - d_k I, D_0 = A$ are generated for a non-singular matrix A of order $n \times n$ by Leverrier-Faddeev method. Find the inverse of the matrix A from this sequence.

Question Number : 34 Question Id : 86435116466 Question Type : SUBJECTIVE
Correct Marks : 10

Let A be a matrix given by

$$A = \begin{bmatrix} 4 & 2 & 1 \\ 2 & 5 & -2 \\ 1 & -2 & 7 \end{bmatrix}.$$

Find the triangular factorization A=LU , where L and U represent lower and upper triangular matrices respectively.

Question Number : 35 Question Id : 86435116467 Question Type : SUBJECTIVE
Correct Marks : 10

Define cubic spline. Explain cubic spline interpolation method. Write one major advantage of this method.

Question Number : 36 Question Id : 86435116468 Question Type : SUBJECTIVE
Correct Marks : 10

If the approximate quadrature formula

$$\int_{-1}^{1} f(x)\,dx = w_1 f(-\sqrt{0.6}) + w_2 f(0) + w_3 f(\sqrt{0.6})$$

gives the exact results for $f(x) = 1, x, x^2$, then find the values of w_1, w_2, w_3.

Question Number : 37 Question Id : 86435116469 Question Type : SUBJECTIVE
Correct Marks : 10

Describe the finite difference method to solve the wave equation

$u_{tt} = c^2 u_{xx}$, $t > 0, 0 < x < 1$

with the initial conditions $u(x,0) = f(x)$ and $\frac{\partial u}{\partial t} = g(x)$, $t = 0, 0 < x < 1$ and boundary conditions $u(0,t) = \phi(t)$ and $u(1,t) = \psi(t), t \geq 0$.