National Testing Agency

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Numerical Analysis

Group Number :	1
Group Id :	603489272
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Break time :	0
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Is this Group for Examiner? :	No

Numerical Analysis-1

Section Id :	603489398
Section Number :	1
Section type :	Online
Mandatory or Optional :	Mandatory

Number of Questions :	20
Number of Questions to be attempted :	20
Section Marks :	20
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Sub-Section Number :	1
Sub-Section Id :	603489727
Question Shuffling Allowed :	Yes

Question Number : 1 Question Id : 60348919179 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

If a number is correct up to n significant figures and the first significant digit is k, then the relative error is less than

1. $(1/k)\ 10^{1-n}$
2. $(k)\ 10^{1-n}$
3. $(1/k)\ 10^{n-1}$
4. $(1/k)\ (1/2)^{1-n}$

Options :

60348972105. 1

60348972106. 2

60348972107. 3

60348972108. 4

Question Number : 2 Question Id : 60348919180 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Let f(x) be a fifth degree polynomial and the coefficient of leading term be 5. If we take h=2, then the fifth order forward difference of f(x) is

1. 19200
2. 160
3. 0
4. 600

Options :

60348972109. 1

60348972110. 2

60348972111. 3

60348972112. 4

Question Number : 3 Question Id : 60348919181 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

For the following set of data

x	1.5	2.0	2.5
y	1.14471	1.25992	1.35721
y'	0.25438	0.20999	0.18096

the degree of the Hermite interpolating polynomial is

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

Options :

60348972113. 1

60348972114. 2

60348972115. 3

60348972116. 4

Question Number : 4 Question Id : 60348919182 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Let $y = f(x)$. The inverse interpolation can be used to find

1. a root of an equation f(x)=0
2. the value of y when x is given
3. the derivative of a function f(x)
4. the integration of a function f(x)

Options :

60348972117. 1

60348972118. 2

60348972119. 3

60348972120. 4

Question Number : 5 Question Id : 60348919183 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Suppose the straight line $y=10.29851+2.05224\,x$ is obtained from the following table.

x :	0	2	4	6
y :	10	15	18	25

Then the sum of the square of errors/residues is or close to

1. 10.40584
2. 6.40584
3. 0.01043
4. 0.0305

Options :

60348972121. 1

60348972122. 2

60348972123. 3

60348972124. 4

Question Number : 6 Question Id : 60348919184 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Let $S(x) = 14T_2(x) + 10T_4(x) - 20T_6(x)$, where $T_n(x)$ represents the nth degree Chebyshev polynomial. Then the value of S(0) is

1. 5
2. 16
3. 4
4. 0

Options :

60348972125. 1

60348972126. 2

60348972127. 3

60348972128. 4

Question Number : 7 Question Id : 60348919185 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

The rate of convergence of the iteration method $x_{n+1} = x_n - \frac{f(x_n)}{f'(x_0)}$ is

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

Options :

60348972129. 1

60348972130. 2

60348972131. 3

60348972132. 4

Question Number : 8 Question Id : 60348919186 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Let a pair of equations be $x^2+y^2-4x=0$; $x^2+y^2-8x+15=0$. If the initial root is taken as (3.5, 1.0) then the value of y correct upto three decimal places by Seidal iteration method is or close to

1. 0.868
2. 0.968
3. 0.718
4. 0.818

Options :

60348972133. 1

60348972134. 2

60348972135. 3

60348972136. 4

Question Number : 9 Question Id : 60348919187 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

The Cholesky method is used to solve a system of linear equations Ax = b (A is square) if

1. A is symmetric and positive definite
2. A is any matrix
3. A is only non-singular
4. A is symmetric and negative definite

Options :

60348972137. 1

60348972138. 2

60348972139. 3

60348972140. 4

Question Number : 10 Question Id : 60348919188 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Let f(x)=0 be an equation whose one root belongs to [a,b] and it is rewritten as x=φ(x). The sequence $\{x_{n+1}= \varphi(x_n)\}$ for given x_0, converge to a root of the equation f(x)=0, if

1. $|\varphi'(x)| > 1$, for all $x \in [a,b]$
2. $|\varphi'(x)| < 1$, for all $x \in [a,b]$
3. $|\varphi(x)| < 1$, for all $x \in [a,b]$
4. $|\varphi(x)| > 1$, for all $x \in [a,b]$

Options :

60348972141. 1

60348972142. 2

60348972143. 3

60348972144. 4

Question Number : 11 Question Id : 60348919189 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Which type of matrix is generated by Rutishauser method during the computation of the eigenvalue of a matrix A?

1. diagonal
2. lower triangular
3. upper triangular
4. none of these

Options :

60348972145. 1

60348972146. 2

60348972147. 3

60348972148. 4

Question Number : 12 Question Id : 60348919190 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

The Newton-Cotes quadrature formula is
$\int_a^b f(x)\,dx \approx (b-a)\sum_{i=0}^{n} H_i y_i$, where H_i, i=0, 1, 2, ..., n, are called Cote's coefficients. Then the sum of Cote's coefficients is

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

Options :

60348972149. 1

60348972150. 2

60348972151. 3

60348972152. 4

Question Number : 13 Question Id : 60348919191 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

The degree of precision of Boole's quadrature formula is

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

Options :

60348972153. 1

60348972154. 2

60348972155. 3

60348972156. 4

Question Number : 14 Question Id : 60348919192 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Four methods are stated below to find the numerical integration. Which pair of methods are applicable to find the value of $\int_0^1 1/\sqrt{x}\, dx$?

A. Simpson 1/3 rule

B. 4-point Gauss-Legendre quadrature

C. 2-point Gauss-Chebyshev quadrature

D. Trapezoidal rule

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

Options :

60348972157. 1

60348972158. 2

60348972159. 3

60348972160. 4

Question Number : 15 Question Id : 60348919193 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

The nodes of the 4-point Gauss-Legendre quadrature formula are the roots of the equation

1. $5x^3-3x=0$
2. $35x^4-30x^2+3=0$
3. $x^4-x^2+3=0$
4. $x^4-1=0$

Options :

60348972161. 1

60348972162. 2

60348972163. 3

60348972164. 4

Question Number : 16 Question Id : 60348919194 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 :

60348972165. 1

60348972166. 2

60348972167. 3

60348972168. 4

Question Number : 17 Question Id : 60348919195 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

The following formula

$y_{i+1}=y_{i-1} + (h/3) [f(x_{i-1},y_{i-1})+4 f(x_i,y_i)+f(x_{i+1},y_{i+1})]$

is an iteration scheme to solve the differential equation $y' = f(x, y)$.
Tick the correct one

1. It is an explicit formula
2. It is a Milne's predictor formula
3. It is a Milne's corrector formula
4. It is an Adams-Bashforth-Moulton corrector formula

Options :

60348972169. 1

60348972170. 2

60348972171. 3

60348972172. 4

Question Number : 18 Question Id : 60348919196 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 ordinary differential equations with initial conditions
2. second order initial value problem
3. second order boundary value problem
4. a first order and first degree ordinary differential equation with initial condition

Options :

60348972173. 1

60348972174. 2

60348972175. 3

60348972176. 4

Question Number : 19 Question Id : 60348919197 Question Type : MCQ Option Shuffling : No Is Question Mandatory : No

Correct Marks : 1 Wrong Marks : 0

Shooting method is used to solve

1. a second order initial value problem
2. a second order boundary value problem
3. a system of first order ordinary differential equations
4. first order partial differential equation

Options :

60348972177. 1

60348972178. 2

60348972179. 3

60348972180. 4

Question Number : 20 Question Id : 60348919198 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 partial differential equation is

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

Options :

60348972181. 1

60348972182. 2

60348972183. 3

60348972184. 4

Numerical Analysis-2

Section Id :	603489399
Section Number :	2
Section type :	Offline
Mandatory or Optional :	Mandatory
Number of Questions :	10
Number of Questions to be attempted :	10
Section Marks :	30
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Sub-Section Number :	1
Sub-Section Id :	603489728
Question Shuffling Allowed :	No

Question Number : 21 Question Id : 60348919199 Question Type : SUBJECTIVE

Correct Marks : 3

For the following set of data

x	0	0.5	1
y	1	2	6

find the value of $y(0.75)$ by Lagrange interpolation formula.

Question Number : 22 Question Id : 60348919200 Question Type : SUBJECTIVE

Correct Marks : 3

Find the quadratic approximation to the function $y = e^x$ on *[0, 1]* by least squares method.

Question Number : 23 Question Id : 60348919201 Question Type : SUBJECTIVE

Correct Marks : 3

Describe Newton-Raphson method to solve a pair of non-linear equations $f(x,y) = 0$ and $g(x,y) = 0$.

Question Number : 24 Question Id : 60348919202 Question Type : SUBJECTIVE

Correct Marks : 3

Describe the least square method to solve a rectangular system of linear equations.

Question Number : 25 Question Id : 60348919203 Question Type : SUBJECTIVE

Correct Marks : 3

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

Question Number : 26 Question Id : 60348919204 Question Type : SUBJECTIVE

Correct Marks : 3

State 2-point Gauss-Legendre quadrature formula. Use this method to find the value of $\int_0^2 \frac{\cos x}{1+x^2}\,dx$ correct up to 3 decimal places.

Question Number : 27 Question Id : 60348919205 Question Type : SUBJECTIVE

Correct Marks : 3

Let $y' = \lambda y, y(0) = y_0$ be an initial value problem and λ be a complex number. Then show that the stability region of Euler's method is a disk $(1 + \lambda_R h)^2 + (\lambda_I h)^2 \leq 1$.

Question Number : 28 Question Id : 60348919206 Question Type : SUBJECTIVE

Correct Marks : 3

Deduce the standard five-point finite difference scheme to solve the elliptic partial differential equation, $u_{xx} + u_{yy} = 0$ with appropriate boundary conditions.

Question Number : 29 Question Id : 60348919207 Question Type : SUBJECTIVE

Correct Marks : 3

Write a short note regarding the choice of interpolating formulae for a given table of values.

Question Number : 30 Question Id : 60348919208 Question Type : SUBJECTIVE

Correct Marks : 3

Solve the following tri-diagonal system of equations:

$x_1 + x_2 = 3, \quad -x_1 + 2x_2 + 3x_3 = 4, \; 3x_2 - 5x_3 = -2.$

Numerical Analysis-3

Section Id : 603489400

Section Number : 3

Section type :	Offline
Mandatory or Optional :	Mandatory
Number of Questions :	7
Number of Questions to be attempted :	5
Section Marks :	50
Enable Mark as Answered Mark for Review and Clear Response :	Yes
Sub-Section Number :	1
Sub-Section Id :	603489729
Question Shuffling Allowed :	No

Question Number : 31 Question Id : 60348919209 Question Type : SUBJECTIVE

Correct Marks : 10

The wave equation is

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

with the 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 $t = 0,\ 0 \le x \le 1$. Find the value of u for $x = 0, 0.2, 0.4, \ldots, 1.0$ and $t = 0, 0.1, 0.2, .0.3$.

Question Number : 32 Question Id : 60348919210 Question Type : SUBJECTIVE

Correct Marks : 10

Describe Bairtow method to find all roots of a polynomial equation of degree n. What are the limitations of this method?

Question Number : 33 Question Id : 60348919211 Question Type : SUBJECTIVE

Correct Marks : 10

Describe Milne's predictor-corrector method to solve the following ordinary differential equation.

$$\frac{dy}{dx} = f(x, y), \qquad y(x_0) = y_0.$$

Write the local truncation error for Milne's predictor and corrector formulae. Also, write the major drawback of this method.

Question Number : 34 Question Id : 60348919212 Question Type : SUBJECTIVE

Correct Marks : 10

Describe Householder's method to find all eigen values and eigenvectors of a real symmetric matrix.

Question Number : 35 Question Id : 60348919213 Question Type : SUBJECTIVE

Correct Marks : 10

The following data for a function $f(x, y)$ is tabulated below:

x \ y	0	1
0	1	1.414214
1	1.732051	1

Find the Lagrange's bivariate interpolating polynomial and hence find an approximate value of $f(0.25, 0.75)$.

Question Number : 36 Question Id : 60348919214 Question Type : SUBJECTIVE

Correct Marks : 10

Deduce the Bessel's central difference interpolation formula from appropriate Gauss formulae.

Question Number : 37 Question Id : 60348919215 Question Type : SUBJECTIVE

Correct Marks : 10

Solve the following system of equations

$$8x_1 + x_2 - x_3 = 8, \quad 2x_1 + x_2 + 9x_3 = 12, \quad x_1 - 7x_2 + 2x_3 = -4$$

by relaxation method taking $(0,0,0)$ as initial solution correct upto two decimal places.