BRAINWARE UNIVERSITY

Term End Examination 2021 - 22
Programme – Master of Science in Mathematics
Course Name – Applied Numerical Analysis
Course Code - MSCMC402
(Semester IV)

Time allotted : 1 Hrs.15 Min. **Full Marks : 60**

[The figure in the margin indicates full marks.]

Group-A

(Multiple Choice Type Question) 1 x 60=60

Choose the correct alternative from the following :

(1) The Jacobi's method is a method of solving a matrix equation on a matrix that has no zer oes along ________

a) Leading diagonal
b) Last column
c) Last row
d) Non-leading diagonal

(2) How many assumptions are there in Jacobi's method?

a) 2
b) 3
c) 4
d) 5

(3) Which of the following is another name for Jacobi's method?

a) Displacement method
b) Simultaneous displacement method
c) Simultaneous method
d) Diagonal method

(4) The predictor-corrector method is a combination of ______________

a) midpoint and trapezoidal rules
b) backward Euler method and Trapezoidal rule
c) implicit and explicit methods
d) forward and backward Euler methods

(5) In the two-level predictor-corrector method, the prediction is done using _____________

a) trapezoidal rule
b) explicit Euler method
c) midpoint rule
d) implicit Euler method

(6) The stability of the two-level predictor-corrector method matches with that of the ______ ____

a) midpoint rule
b) trapezoidal rule
c) backward Euler method
d) forward Euler method

(7) To increase the order of accuracy, the multipoint method uses ___________

a) highly stable two-level methods for predictio n and correction
b) higher-order two-level methods for prediction and correction
c) additional points where data is already availa
d) additional points where data is interpolated

ble

(8) Which of these is used by the Adam-Bashforth method?

a) Newton's method
b) Frobenious covariant
c) Frobenious norm
d) Lagrange polynomial

(9) Runge-Kutta method has a truncation error, which is of the order

a) h^2
b) h^3
c) h^4
d) None of these

(10) The ordinary differential equations are solved numerically by?

a) Euler method
b) Taylor method
c) Runge-Kutta method
d) All of these

(11)

Consider the initial value problem $y' = x(y+x) - 2, y(0) = 2.$. Use Euler's method with step sizes $h = 0.3$ to compute approximations to $y(0.6)$ is equals to

a) 0.953
b) 0.0953
c) 0.909
d) -0.953

(12)

For $\frac{dy}{dx} = f(x,y), y(x_0) = y_0, y^{n+1}(x) = y_0 + \int_{x_0}^{x} f(x, y^n) dx$ is

a) Taylor's series method
b) Picard's method
c) Euler's method
d) modified Euler's method

(13)

$\frac{dy}{dx} = \frac{x}{y}, y(0) = 1$. Find step of Picard's method for y(1) is

a) 1/2
b) 1
c) 3.2
d) 2

(14)

$\frac{dy}{dx} = f(x,y), y(x_0) = y_0$, then $y_{n+1} = y_n + \frac{h}{2}[f(x_n, y_n) + f(x_{n+1}, y_n + hf(x_n, y_n))]$ is known as

a) Taylor's series method
b) Euler's method
c) Euler's modified method
d) Runge-Kutta method

(15) Error in modifed Euler's method is

a) $0(h^2)$
b) $0(h^3)$
c) $0(h^4)$
d) $0(h^5)$

(16) Milne's corrector formula is

a) $y_{n+1} = y_n + \frac{h}{3}(y'_{n-1} + 4y'_n + 4y'_{n+1})$
b) $y_{n+1} = y_{n-1} + \frac{h}{3}(y'_{n-1} + 4y'_n + y'_{n+1})$
c) $y_{n+1} = y_n + \frac{4h}{3}(y'_{n-1} + 4y'_n + 4y'_{n+1})$
d) None of these

(17) How many steps does the fourth-order Runge-Kutta method use?

a) Two steps
b) Five steps

c) Four steps

d) Three steps

(18) The first two steps of the fourth-order Runge-Kutta method finds the value at which poin t?

a) At the (n+0.5)th point

b) At the (n+1)th point

c) At the (n-1)th point

d) At the nth point

(19) How many predictor and corrector steps does the fourth-order Runge-Kutta method use?

a) Three predictor and one corrector steps

b) One predictor and three corrector steps

c) Two predictor and two corrector steps

d) One predictor and two corrector steps

(20) Consider an nth order accurate Runge-Kutta method. How many times is the derivative ev aluated at the fourth time-step?

a) one time

b) two times

c) four times

d) n times

(21) The Neumann and Dirichlet boundary conditions are _________ and _________ in mathe matical terms.

a) value specified, flux specified

b) flux specified, value specified

c) flux specified, gradient specified

d) value specified, time specified

(22) In Dirichlet boundary conditions, the flux values _________

a) can be calculated

b) are unknowns

c) are known

d) are 0

(23) Which among these is a combination of value specified and flux specified boundary condi tions?

a) Dirichlet

b) Mixed

c) Neumann

d) Symmetry

(24) The characteristic curves for an elliptic system are ___________

a) real and imaginary

b) both real

c) both imaginary

d) both zeros

(25) Which of these are correct for an elliptic equation?

a) There is no limited region of influence or dom ain of dependence

b) There is no region of influence or domain of d ependence

c) There is no region of influence, but there exist s a domain of dependence

d) There is no domain of dependence, but there e xists a region of influence

(26) The solution of elliptic equations depends on ___________

a) one of its boundaries

b) all its boundaries

c) its opposite boundaries

d) its adjacent boundaries

(27) The solution technique used to solve elliptic equations should ___________

a) allow each point to be influenced by its bound ary-side neighbours

b) allow each point to be influenced by its west n eighbour

c) allow each point to be influenced by its east ne ighbour

d) allow each point to be influenced by all its nei ghbours

(28) Which of these is the prototype elliptic equation?

a) Incompressible irrotational flow

b) Incompressible rotational flow

c) Compressible irrotational flow

d) Compressible rotational flow

(29) Robin boundary condition is also known as

a) first-type boundary condition

b) second type boundary condition

c) zero type boundary condition

d) third type boundary condition

(30)

$\partial y/\partial n = f$ is representation of

a) Neumann boundary condition
b) Dirichlet boundary condition
c) Cauchy boundary condition
d) Robin boundary condition

(31) The error occurring while approximating the physical problem is called as ____________

a) Modelling error
b) Physical error
c) Mathematical order
d) Iteration error

(32) A boundary combination which specifies the linear combination of the value of the functi on and the values of its derivate on the boundary of the domain is a

a) Neumann boundary condition
b) Dirichlet boundary condition
c) Cauchy boundary condition
d) Robin boundary condition

(33) A boundary condition which specifies the value of the normal derivative of the function is a

a) Neumann boundary condition
b) Neument boundary condition
c) Neumornn boundary condition
d) Deumann boundary condition

(34) When is the steady inviscid flow hyperbolic?

a) In supersonic flow regime
b) Never
c) Always
d) In subsonic flow regime

(35) To solve a hyperbolic equation, which of these is/are necessary?

a) Initial conditions and boundary conditions
b) Initial conditions
c) Boundary conditions
d) Neither initial nor boundary conditions

(36) Which of these equations is hyperbolic?

a) Unsteady Navier-Stokes equation
b) Steady Navier-Stokes equation
c) Steady Euler equation
d) Unsteady Euler equation

(37) While solving a partial differential equation using a variable separable method, we equate the ratio to a constant which?

a) can be positive or negative integer or zero
b) can be positive or negative rational number or zero
c) must be a positive integer
d) must be a negative integer

(38) When solving a 1-Dimensional heat equation using a variable separable method, we get th e solution if

a) k is positive
b) k is negative
c) k is 0
d) k can be anything

(39) The difference between the exact analytical solution of a partial differential equation and i ts numerical solution is as ___________

a) round-off error
b) discretization error
c) iteration error
d) modelling error

(40) If the order of a discretized equation is ‘k’, what does it mean?

a) The last term of the equation is of (k+1)th po wer
b) The last term of the equation is of kth power
c) Truncation error is proportional to (k-1)th pow er
d) Truncation error is proportional to kth power

(41) ___________ become significant after a repeated number of calculations.

a) Round-off errors
b) Discretization errors
c) Truncation errors
d) Modelling errors

(42) In Von Neumann analysis, the solution is expanded using ____________

a) Laurent series
b) McLaurin series
c) Taylor series
d) Fourier series

(43)

The region in which the following partial differential equation

$$x^3\frac{\partial^2 u}{\partial x^2}+27\frac{\partial^2 u}{\partial y^2}+3\frac{\partial^2 u}{\partial x\partial y}+5u=0$$

acts as parabolic equation is

a) $x>\left(\frac{1}{12}\right)^{1/3}$

b) $x<\left(\frac{1}{12}\right)^{1/3}$

c) For all values of x

d) $x=\left(\frac{1}{12}\right)^{1/3}$

(44) Heat equation is

a) $\frac{\partial u}{\partial x}=c^2\nabla^2 x^2$

b) $\frac{\partial u}{\partial y}=\frac{1}{c^2}\nabla^2 t^2$

c) $\frac{\partial u}{\partial t}=c^2\nabla^2 u$

d) $\frac{\partial u}{\partial t}=c^2\nabla^2 y^2$

(45)

The solution of $\frac{\partial u}{\partial x}=36\frac{\partial u}{\partial t}+10u$ if $\frac{\partial u}{\partial x}(t=0)=3e^{-2x}$ using the method of separation of variables, is

a) $-\frac{3}{2}e^{-2x}e^{-t/3}$

b) $3e^{x}e^{-t/3}$

c) $\frac{3}{2}e^{2x}e^{-t/3}$

d) $3e^{-x}e^{-t/3}$

(46)

Solve the differential equation $5\frac{\partial u}{\partial x}+3\frac{\partial u}{\partial y}=2u$ using the method of separation of variables if $u(0,y)=9e^{-5y}$.

a) $9e^{\frac{17}{5}x}e^{-5y}$

b) $9e^{\frac{13}{5}x}e^{-5y}$

c) $9e^{-\frac{17}{5}x}e^{-5y}$

d) $9e^{-\frac{13}{5}x}e^{-5y}$

(47)

The solution of one dimensional heat equation $\frac{\partial u}{\partial t}=\alpha^2\frac{\partial^2 u}{\partial x^2}$ exists if

a) Both LHS & RHS are constants
b) RHS is constant
c) LHS is constant
d) Always exists

(48)

The ends of a bar at $x=0$ and $x=L$ are kept at zero temperature. The bar is subjected tc an initial temperature $u(x,0)=\sin\frac{\pi x}{L}$, the temperature distribution is given by $u(x,t)=$

a) $\sin\frac{\pi x}{L}e^{-\frac{\alpha^2\pi^2 t}{L}}$

b) $\cos\frac{\pi x}{L}e^{-\frac{\alpha^2\pi^2 t}{L}}$

c) $\sin\frac{\pi x}{L}e^{\frac{\alpha^2\pi^2 t}{L}}$

d) $\cos\frac{\pi x}{L}e^{\frac{\alpha^2\pi^2 t}{L}}$

(49)

Consider an infinite bar (both sides extended to infinity) and the initial condition is $u(x=0)=f(x)$ $(-\infty<x<\infty)$, the temperature function will be $u(x,t)=$

a) $e^{k^2C^2t}\left[Ae^{ikx}+Be^{-ikx}\right]$

b) $e^{-kC^2t}\left[Ae^{ikx}+Be^{-ikx}\right]$

c) $e^{-k^2C^2t}\left[Ae^{ikx}-Be^{-ikx}\right]$

d) $e^{-k^2C^2t}\left[Ae^{ikx}+Be^{-ikx}\right]$

(50)

$$G(x,t)=\begin{cases} a+b\log t & if\ 0<x<t \\ c+d\log t & if\ t<x<1 \end{cases}$$

is a Green's function for $xy''+y'=0$ subject to y being bounded as x tends to 0 and $y(1)=y'(1)$ if

a) a=b=c=d=1

b) a=c=1, b=d=0

c) a=c=0, b=d=1

d) a=b=c=d=0

(51)

Solution of $\frac{\partial y}{\partial t}=\frac{\partial^2 y}{\partial x^2}$ where $y\left(\frac{\pi}{2},t\right)=y_x(0,t)=0$ and $y(x,0)=\cos 5x$ is

a) $e^{-25t}\sin 5x$

b) $e^{-25t}\cos 5x$

c) $e^{-5t}\cos 25x$

d) $e^{-5t}\sin 25x$

(52)

Heat equation in cylindrical coordinates (ρ,ϕ,z) is

a) $\frac{\partial^2 u}{\partial\phi^2}+\frac{1}{\rho}\frac{\partial u}{\partial\phi}+\frac{1}{\rho^2}\frac{\partial^2 u}{\partial\rho^2}+\frac{\partial^2 u}{\partial z^2}=\frac{1}{k}\frac{\partial u}{\partial t}$

b) $\frac{\partial^2 u}{\partial\rho^2}+\frac{1}{\rho}\frac{\partial u}{\partial\rho}+\frac{1}{\rho^2}\frac{\partial^2 u}{\partial\phi^2}+\frac{\partial^2 u}{\partial z^2}=\frac{1}{k^2}\frac{\partial u}{\partial t}$

c) $\frac{\partial^2 u}{\partial\rho^2}+\frac{1}{\rho}\frac{\partial u}{\partial\rho}+\frac{1}{\rho^2}\frac{\partial^2 u}{\partial\phi^2}+\frac{\partial^2 u}{\partial z^2}=\frac{1}{k}\frac{\partial u}{\partial t}$

d) None of these

(53)

If the solution of the BVP $u_{xx}+u_{yy}=0$, $x\in(0,\pi)$, $y\in(0,\pi)$, $u(x,0)=u(x,\pi)=u(0,y)=0$ satisfies the condition $u_x(x,y)=\sin y$, then the value of $u\left(x,\frac{\pi}{2}\right)$ is

a) $(\pi/2)(e^{\pi}-e^{-\pi})(e^{x}-e^{-x})$

b) $\pi(e^{x}-e^{-x})/(e^{\pi}+e^{-\pi})$

c) $(\pi/2)(e^{\pi}+e^{-\pi})(e^{x}+e^{-x})$

d) $(e^{x}-e^{-x})/(e^{\pi}+e^{-\pi})$

(54) Householder transformation reduces a symmetric matrix into

a) any matrix

b) symmetric diagonal matrix

c) any tridiagonal matrix

d) symmetric tridiagonal matrix

(55)

Find the sum of the Eigenvalues of the matrix

$$A = \begin{bmatrix} 3 & 6 & 7 \\ 5 & 4 & 2 \\ 7 & 9 & 1 \end{bmatrix}.$$

a) 7
b) 8
c) 9
d) 10

(56)

All the four entries of the 2 × 2 $P = \begin{bmatrix} p_{11} & p_{12} \\ p_{21} & p_{22} \end{bmatrix}$ matrix a
Eigen values is zero. Which of the following statements is tr

a) $p_{11}p_{22} - p_{12}p_{21} = -1$

b) $p_{11}p_{22} - p_{12}p_{21} = 1$

c) $p_{11}p_{22} - p_{12}p_{21} = 0$

d) $p_{11}p_{22} + p_{12}p_{21} = 0$

(57)

If $A = \begin{bmatrix} 2 & 1 & 1 \\ 1 & 2 & 1 \\ 0 & 0 & 5 \end{bmatrix}$, then the Eigen values of A^{-1} are

a) 2,2,5

b) $\frac{1}{2}, \frac{1}{2}, \frac{1}{5}$

c) $\frac{1}{5}, \frac{1}{3}, 1$

d) 1,3,5

(58)

Let $A = \begin{bmatrix} 4 & 2 \\ 5 & 7 \end{bmatrix}$, then the eigenvector associated with the do

a) $\begin{bmatrix} 0.4 \\ 1 \end{bmatrix}$

b) $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$

c) $\begin{bmatrix} 1 \\ 0.4 \end{bmatrix}$

d) $\begin{bmatrix} 1 \\ -1 \end{bmatrix}$

(59)

The number of linearly independent eigenvectors of $\begin{bmatrix} 2 & 1 \\ 0 & 2 \end{bmatrix}$

a) 0
b) 1
c) 2
d) 3

(60)

The eigenvectors of the matrix $\begin{bmatrix} 1 & 2 \\ 0 & 2 \end{bmatrix}$ are written in the form [

a) 0
b) 1/2
c) 1
d) 2