

PGIVS-N 1509 A-2K14**M.Sc. IVth Semester (CBCS) Degree Examination****Mathematics****Paper - HCT 4.3****(Computational Numerical Methods)****(New)**

Time :3 Hours

Maximum Marks : 80

Instructions to Candidates :

- 1) Answer any **Five** questions.
- 2) All questions carry **equal** marks

1. a) Using Runge-Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with $y(0)=1$, $h=0.2$ at $x=0.2, 0.4$, find $y(0.2), y(0.4)$ (08)
- b) Solve simultaneous equations $\frac{dy}{dx} = z, \frac{dz}{dx} = xz - y$ in $0 \leq x \leq 0.2$ with $h=0.1$, $y(0)=3$ and $z(0)=0$ by classical Runge-kutta method of fourth order. (08)
2. a) Derive Adam-Bashforth's predictor-Corrector method formula. (08)
- b) Find $y(0.4)$ for the IvP $y' = x + y^2$, $y(0)=1$, in $0 < x < 0.4$ with $h=0.1$ by Milne's predictor corrector method. (08)
3. a) Discuss explicit finite difference scheme for parabolic partial differential equation. (08)
- b) Solve by Crank - Nicholson scheme the equation $u_{xx} = u_t$, subject to the conditions $u(x,0)=0$, $u(0,t)=0$ and $u(1,t)=t$ for 3 times steps, choose $h=0.25$. (08)
4. a) Discuss the classification of partial differential equation. (06)
- b) Using Alternating Direction Implicit (ADI) method solve upto 3 levels $u_t = u_{xx} + u_{yy}$ with the initial condition $u(x, y, 0) = \sin \pi x \sin \pi y$, $0 \leq x \leq 1$, $0 \leq y \leq 1$ and boundary conditions $u(x, y, t) = 0$ for $x = 0$ and $x = 1$, $u(x, y, t) = 1$ for $y = 0$ and $y = 1$ for $t > 0$, choose $h = 1/3$ and $r = 1$ (10)

5. a) Discuss parabolic equations with derivative boundary conditions. (08)
b) Discuss Alternating Direction Implicit (ADI) method for parabolic partial differential equation. (08)
6. a) Write the iterative formulas for
i) Jacobi method
ii) Gauss-Seidal method
iii) Line Relaxation method
iv) Successive over relaxation method of elliptic PDE. (08)
- b) Solve $\nabla^2 u = 9u$, $0 \leq x \leq 1, 0 \leq y \leq 1$ where 'u' satisfying the above equation at every point inside the square and is subject to B.C.'S : $u=x$ at $y=0$, $u=x+1$ at $y=1$, $u_x = -2u-y$ at $x=0$, $u=2$ at $x=1$, $0 < y < 1$, by taking $h=1/3$. (08)
7. a) Discuss the solution of hyperbolic equation by characteristics. (08)
b) Solve $u_{xx} - u_{tt} = 0$, $0 < x < 1$, for $t > 0$ with initial conditions.
i) $u = 5(x-0.3), 0.3 < x < 0.5$
 $= 5(0.7-x), 0.5 < x < 0.7$
 $= 0$
for all other points
ii) $u_t = 0$ at $t=0$ and boundary conditions: $u(0,t)=0$, $u(1,t)=0$. (08)
8. a) Discuss implicit method for hyperbolic partial differential equation (08)
b) Solve $u_{xx} + u_{yy} = 0$ subject to the boundary conditions $u(0,y)=0$, $u(x,0)=0$, $u(x,1)=100x$, $u(1,y)=100y$ for square region with $h=0.25$ (08)