SECTION - E

9. Briefly answer all the following questions:

(a) What are the possible sources of error in the numerical solution of PDEs?

(b) What is the advantage of banded storage mode in Gauss elimination method?

(c) What is the condition for the convergence of Gauss - Seidal method?

(d) Find the next iterative value of the root of $x^2 - 4 = 0$ using the Newton-Raphson method, if the initial guess is 3.0. How round off errors are caused?

(e) Explain what is truncation error?

(f) What is the relationship between relaxation methods and Gauss Seidel method?

(g) What is the difference between elliptic and parabolic partial differential equations?

(h) Classify the partial differential equation:

(i) $5\dfrac{\partial^2 u}{\partial x^2} + 6\dfrac{\partial^2 u}{\partial y^2} = xy$

(ii) $x^2\dfrac{\partial^2 u}{\partial x^2} - 2xy\dfrac{\partial^2 u}{\partial x\,\partial y} + y^2\dfrac{\partial^2 u}{\partial y^2} = Sin\left(\dfrac{\partial u}{\partial x}\right)$

(i) Define predictor-corrector method.

(j) Define artificial neural networks. $(10\times2=20)$

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M. Tech 1st Semester Examination

Computational Methods in Water Resources Engineering

WRE-103

Time : 3 Hours   Max. Marks : 100

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Candidates are required to attempt five questions in all selecting one question from sections A, B, C, D and all the subparts of question in section E.

SECTION - A

1. (a) What is the condition for the convergence of Gauss - Seidal method?   (8)

   (b) Solve the following system of equations using Gaussian elimination:

   $2x + y + 3z = 1$

   $2x + 6y + 8z = 3$

   $6x + 8y + 18z = 5$ (12)

2. (a) If $f(x) = 0$ has root between $x = a$ and $x = b$, then write the first approximate root by the method of false position.   (10)

   (b) Find the real root of the equation

   $x \log_{10} x - 1.2 = 0$

   correct to decimal places by the method of False Positions.   (10)

SECTION - B

3.   (a)   What a differential equation and how are these classified?

$$(3+3=6)$$

    (b)   Give the recursive algorithm to obtain numerical solution of ordinary differential equation by Euler's method. (14)

4.   (a)   Using modified Euler's method, compute y(0.1) with h=0 from

$$\frac{dy}{dx} = y - \frac{2x}{y}, \ y(0) = 1 \tag{10}$$

    (b)   Given $\frac{dy}{dx} = x^3 + y, \ y(0) = 2,$ Compute y(0.2), y(0.4) and y(0.6) by Runge-Kutta method of fourth order. (10)

SECTION - C

5.   (a)   Explain the general procedure of approximating the derivatives in a PDE at discrete points and then use the table

x	0.5	0.6	0.7
Sin(x)	0.47943	0.56464	0.64420

to estimate the first derivative of sin(x) at each mesh point. Compare your estimates with the exact answer. Estimate the 2nd derivative of sin(x) at x = 0.6. Take h = 0.1.   (6+6=12)

    (b)   Given the value of function f at the points (x–h), (x+θh) where (0 < θ < 1) , find the first order formula for the derivative of function f at x.   (8)

6.   (a)   How the partial differential equations are classified? Give two examples of linear homogeneous partial differential equations.   (8)

    (b)   Consider the homogeneous linear PDE

$$c\frac{du}{dx} + \frac{du}{dt} = 0, \text{ subject to initial conditions:}$$

$x(s=0)=x_0; \ t(s=0)=0$ and

$u(x,0) = f(x) \ ; \ u(s=0) = f(x_0)$

Show that the characteristics curves arc lines given by

$t = \frac{1}{c}(x - x_0).$ Sketch the characteristics in (x, t) space.

$$(12)$$

SECTION - D

7.   (a)   Explain the difference between explicit and implicit finite difference schemes.   (8)

    (b)   Considering the initial boundary value problem:

$$u_{xx} = \frac{1}{c}u_t, \ u = u(x,t) : 0 < x < 1; \ t > 0$$

$u(0,t) = u(1, t) = 0; \ u(x,0) = f(x)$

where c is a constant. Using explicit finite difference scheme, obtain recursive relationship giving u in a given row (time) in terms of three consecutive values of u in the row below (one time step earlier).   (12)

8.   (a)   What is the basic processing unit in artificial neural network? Discuss its properties.   (10)

    (b)   With the help of a diagram explain the architecture of a simple neuron network.   (10)

[P.T.O.]