GIET UNIVERSITY, GUNUPUR – 765022

RD19MTECH004

Registration No: | | | | | | | | | | |

Total Number of Pages : 02 **M.TECH**

AR-19

M.TECH 1ST SEMESTER EXAMINATIONS NOV/DEC 2019

Branch: CHEMICAL, MPCCH1010

APPLIED MATHEMATICS FOR CHEMICAL ENGINEERING

Time: 3 Hours **Max Marks : 70**

The figures in the right hand margin indicate marks.

PART-A (10 X 2=20 MARKS)

1. Answer the following questions.

a) Define Fast Fourier Transform.

b) Draw the basic butterfly diagram for DIF algorithm.

c) ''Multistep methods are not self starting.'' Justify.

d) State the conditions of the equation A u_{xx} + B u_{yy} + C u_{yy} +D u_x +E u_y + F u = G where A, B, C, D, E, F, G are function of x and y to be (i) elliptic (ii) parabolic (iii) hyperbolic

e) What is the value of k to solve $\frac{\partial u}{\partial t} = \frac{1}{2} u_{xx}$ by Bender-Schmidt method with h=1 if h and k are the increments of x and t respectively?

f) Find f (2.5) from the data using piecewise linear interpolation.

X:	1	2	3
F(x)	0	1	8

g) If $Y(X_{i-1}) = Y_{i-1}$ and $Y(X_i) = Y_i$. Write down the piecewise cubic spline interpolation formula for Y(X) Valid in $X_{i-1} \le X \le X_i$.

h) What are Hermites's interpolating conditions?

i) What is piecewise interpolation and what is the advantages of it?

j) What is interpolation? What is the difference between interpolation and extrapolation?

PART-B (5 X 10=50 MARKS)

Answer ANY FIVE questions

Q2 Analyze the following set of three linear algebraic equations in three variables using the Gauss Elimination method: **(10)**

$$3X_1 + X_2 - 2X_3 = 9$$
$$-X_1 + 4X_2 - 3X_3 = -8$$
$$X_1 - X_2 + 4X_3 = 1$$

Q3 Analyze the following set of three linear algebraic equations in three variables using the Gauss–Seidel method: **(10)**

$$10X_1 + X_2 + 2X_3 = 44$$
$$2X_1 + 10X_2 + X_3 = 51$$

$$X_l + 2X_2 + 10X_3 = 61$$

Q4 Evaluate the values of x and y that satisfy the following two nonlinear algebraic equations: **(10)**

$$f(x, y) = e^x + xy - 1 = 0$$
$$g(x, y) = \sin xy + x + y - 1 = 0$$

Q5 Solve the following ordinary differential equations: **(10)**

$$\frac{dy}{dx} = z, \quad \frac{dz}{dx} = -y$$

With the initial condition y (0) = 2, z (0) = 1. Determine the value of y and z at x =3. Compare the numerical solution with the analytical solution. The analytical solution of the given differential equations is y = Asin(x +α) and z = Acos(x +α).

Q6 **(10)**

Consider stirred vessels which initially contain 760 kg of solvent at 25°C.12 kg/min of solvent flows into the stirred vessels at 25°C and exits out also at the same rate. At t = 0 the flow of steam is started in a coil in the stirred vessels. The heat supplied by steam to the solvent is given by $Q = UA(T_S - T)$, where UA is the overall heat transfers coefficient multiplied by coil area through which heat exchange takes place and T_S is the temperature of steam and is 150°C. UA = 11.5 kJ/min-K. The Specific heat of the solvent is Cp = 2.3 kJ/kg- K.

Show that $\frac{dT}{dt}(\circ C/s) = 0.023 - 0.000373T$

Determine the solvent temperature after 50 min. Also determine the maximum temperature that can be reached in the tank. The Specific heat of the solvent is Cp = 2.3 kJ/kg- K

Q7 Using the Runge–Kutta fourth order method ,Integrate the ordinary equation **(10)**

$$\frac{dx}{dy} = x + y$$

The initial condition is: at x = 0, y = 0. Determine the value of y at x = 0.2. The analytical solution is given by $y = e^x - x - 1$.

Q8 Consider 1-dimensional steady state conduction without heat generation taking place in a rectangular slab. The temperature of the left side of the slab is 100°C and of the right side is 200°G. The length of the slab is 10 cm and the thermal conductivity of the slab is 120 W/cm-K. Make nine uniform divisions. The governing equation is $k\frac{d^2T}{dx^2} = 0$ **(10)**