

Code No: R09220306

R09**Set No. 2**

II B.Tech II Semester Examinations, APRIL 2011

NUMERICAL METHODS

Common to Mechanical Engineering, Mechatronics, Production Engineering

Time: 3 hours

Max Marks: 75

Answer any FIVE Questions

All Questions carry equal marks

1. The probability integral $P = \sqrt{\frac{2}{\pi}} \int_0^x \exp(-\frac{1}{2}t^2) dt$ has the following values

x	1.0	1.05	1.10	1.15	1.20	1.25
y	0.682689	0.706828	0.728668	0.789856	0.769861	0.788700

Calculate the values of P for $x = 1.235$. [15]

2. Evaluate the following taking the interval as 1 using finite difference method.

(a) Δe^x

(b) $\Delta \tan^{-1}x$

(c) $\Delta 3x$

(d) $2x/x!$

[15]

3. Find the a curve to the following data

x	0	2	4
y	5.1	10	31.1

[15]

4. Explain the procedure of improving the accuracy for an ill conditioned system given below.

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = b_1$$

$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = b_2$$

$$a_{31}x_1 + a_{32}x_2 + a_{33}x_3 = b_3$$

[15]

5. (a) State the Taylor's series formula to find $y(x_1)$ for solving $dy/dx = f(x,y)$ with the initial value of $y(x=0) = y_0$.

- (b) Solve $dy/dx = \log_{10}(x+y)$ with the initial value of $y(0) = 2$ using Euler's method and find the values of $y(0.2)$ and $y(0.4)$ using modified Euler's method.

[8+7]

6. Solve the Poisson's equation $\partial^2 u / \partial x^2 + \partial^2 u / \partial y^2 = -x^2 y^2$ in the square region bounded by the lines $x = 0, y = 3$ given that $u = 10$ thorough out the boundaries taking $h = 1$.

[15]

7. Determine a, b and c such that the formula $\int f(x) dx = h\{af(0) + bf(h/3) + cf(h)\}$ with the limits $x = 0$ to $x = h$ is exact for polynomials of as high order as possible and determine the order of the truncation error.

[15]

8. (a) State the merits and demerits of Newton-Raphson method.

- (b) By Newton-Raphson method find a real root of the following equation

$$f(x) = x \sin x - 1 \text{ correct up to four decimal places starting from } x_0 = 1 \quad [7+8]$$

Code No: R09220306

R09

Set No. 2

FIRSTRANKER

Code No: R09220306

R09**Set No. 4**

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1. Derive equations to fit an exponential curve of the form $y = bx^a$ where $b > 0$; by using the method of least squares. [15]
2. For the following system of equations

$$10x + 4y - 2z = 12$$

$$x - 10y - z = -10$$

$$5x + 2y - 10z = -3,$$
 show that Jacobi iteration scheme converges. Obtain the Jacobi iteration scheme in matrix form. [15]
3. If $x(t)$ is analytic inside the close contour C and if t, t_1, t_2, \dots, t_n lie inside C , show that the remainder term in the error formula for polynomial interpolation can be written as:

$$\frac{\pi(t)}{2\pi i} \int_C \frac{x(\tau)}{(\tau-t)\pi(\tau)} d\tau$$
 [15]
4. Solve the following boundary value problem with the step length 0.5 and extrapolate $y'' + 4y + 3 = 0$ with $y(2) = y(-1) = 0$. [15]
5. (a) Obtain the solution in the form general formula for Euler's method for solving the differential equation.
 (b) Given $dy/dx = x^2 / (y^2 + 1)$ with $y(0) = 0$, use Picard's method to obtain the y for different values of $x = 0.25$ and 0.5 . [7+8]
6. By Newton-Raphson method find a real root of the following equation $f(x) = x^3 - x^2 + x - 2$ correct up to four decimal places starting from $x_0 = 1$. [15]
7. Write the finite difference scheme to solve $u_{xx} = au_t$ with $u(0,t) = T_0$, $u(1,t) = T_1$ and the initial condition as $u(x,0) = f(x)$ and explain the procedure to solve it. [15]
8. (a) Derive the solution for the Simpson's $3/8^{th}$ rule from the Newton-Cotes formula for solving the integral equation.
 (b) A rod is rotating in a plane and the following table gives the angle θ (radians) through which the rod has turned for various values of time t (seconds).

t in seconds	0	0.2	0.4	0.6	0.8	1.0
θ in radians	0	0.12	0.49	1.12	2.02	3.20

 Calculate angular velocity and the angular acceleration of the rod when $t = 0.6$ s. [7+8]

Code No: R09220306

R09**Set No. 1**

II B.Tech II Semester Examinations, APRIL 2011

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1. The error function $erf(x)$ is defined by the integral $erf(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$. Approximate $erf(0.08)$ by linear interpolation in the given table of correctly rounded values. Estimate the total error.

x	0.05	0.1	0.15	0.2
f(x)	0.05637	0.11246	0.16800	0.22270

[15]

2. (a) What is the Error in modified Euler's method? And compare these errors in comparison with the Euler's method.

(b) Solve $y' = xy$, $y(1) = 0$, by Taylor's series method. Find $y(1.1)$. [8+7]

3. State the condition for the equation $Au_{xx} + 2Bu_{xy} + Cu_{yy} = f(u_x, u_y, x, y)$ to be

- (a) elliptic
(b) parabolic
(c) hyperbolic

when A, B, C are functions of x and y. [15]

4. Find the curve of best fit of the type $y = ae^{bx}$ to the following data by the method of least squares.

x	1	5	7	9	12
y	10	15	13	15	21

[15]

5. Jacobi iteration scheme is used to solve the system of equations

$$\begin{aligned} 2x - y &= 1 \\ -x + 2y - z &= 0 \\ -y + 2z - w &= 0 \\ -z + 2w &= 1 \end{aligned}$$

Find the rate of convergence of the method while starting with $x^{(0)} = [0.5, 0.5, 0.5, 0.5]^T$ and iterating three times. [15]

6. The boundary value problem $y'' - 2y(x)/x^2 = -5/x$; $1 < x < 2$; $y(1) = 1$; $y(2) = 2$ with the h value of 0.5. [15]

7. (a) Using Simpson's rule find $\int 4ex + 2e^{-x} dx$ for given $e^0 = 1$, $e^1 = 2.72$, $e^2 = 7.39$, $e^3 = 20.09$.

(b) State the Taylor's series formula to find $y(x_1)$ for solving $dy/dx = f(x,y)$, $y_0 = f(x_0)$ and explain the assumptions used. [8+7]

Code No: R09220306

R09

Set No. 1

8. Find a root for the non-linear equation $f(x) = 2x - \log_{10}x - 7$ in the interval (2,5) by using regular false position method. [15]

FIRSTRANKER

Code No: R09220306

R09**Set No. 3**

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1. Calculate the first and second order differences for $f(x) = ab^{cx}$ [15]2. (a) Solve $y' = \sin x + \cos y$ for $x = 3$ (0.5) 4 with the initial value of $y(0) = 2.5$ using Range Kutta fourth order method.

(b) Explain the Predictor Corrector method using suitable example. [8+7]

3. (a) The population of a certain town is shown in the following table.

Year x	1931	1941	1951	1961	1971	1981
Population y	40.62	60.80	79.95	103.56	132.65	142.35

Find the rate of growth of the population in 1961.

(b) Compare and contrast among Trapezoidal, Simpson's $1/3^{rd}$ rule and Simpson's $3/8^{th}$ rule. [8+7]

4. For the following data fit a polynomial

x	1	2	3	4
y	2	5	16	41

by using

(a) Newton's backward difference formula

(b) using Lagrange's interpolation formula.

Compare (a) and (b) and comment. [15]

5. Obtain a relation of the form $y = ab^x$ for the following data by the method of least squares.

x	2	3	4	5	6
y	8.3	15.4	33.1	65.2	127.4

[15]

6. Write down the implicit formula to solve one dimensional heat flow equation and suggest the suitable method to solve the equations. [15]

7. Explain the following

(a) When ill conditioning in the system is expected? Explain with an example.

(b) If $A = [a_{ij}]$ and $s_i = (a_{i1}^2 + a_{i2}^2 + \dots + a_{in}^2)^{1/2}$ then the quantity $k = \frac{|A|}{s_1 s_2 \dots s_n}$ indicates ill conditioning of matrix A. [7+8]

8. (a) State the pitfalls of regular false position method.

(b) Find a real root of Wall's equation $f(x) = x^3 - 2x - 5 = 0$ [7+8]
