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

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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 $\partial^2u/\partial x^2 + \partial^2u/\partial y^2 = -x^2y^2$ 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) + c f(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 $f(x) = x \sin x - 1$ correct up to four decimal places starting from $x_0 = 1$ [7+8]

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Code No: R09220306 **R09** **Set No. 4**

II B.Tech II Semester Examinations,APRIL 2011
NUMERICAL METHODS
Common to Mechanical Engineering, Mechatronics, Production Engineering
Time: 3 hours **Max Marks: 75**

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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 $t, t_1, t_2 \ldots\ldots\ldots\ldots t_n$ lie inside C, show that the remainder term in the error formula for polynomial interpolation can be written as:
   $\frac{\pi(t)}{2\pi i}\int\limits_C \frac{x(\tau)}{(\tau - t)\pi(\tau)}d\tau$ [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 $u(0,t) = T_0$, $u(l,t) = T_1$ 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]

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II B.Tech II Semester Examinations,APRIL 2011
NUMERICAL METHODS
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Answer any FIVE Questions
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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
   2x - y = 1
   - x + 2y - z = 0
   - y + 2z - w = 0
   - z + 2w = 1
   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]

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]

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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 Trepezoidal, 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 Legrange'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 $s_i = (a_{i1}^2 + a_{i2}^2 + ... + a_{in}^2)^{1/2}$ then the quantity $k = \frac{|A|}{s_1 s_2 .....s_n}$ 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]

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