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[15]

 $\left[15\right]$ 

Code No: R09220306

## 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

	Х	1.0	1.05	1.10	1.15	1.20	1.25			
Ì	у	0.682689	0.706828	0.728668	0.789856	0.769861	0.788700			
Calculate the values of P for $x = 1.235$ .										

- 2. Evaluate the following taking the interval as 1 using finite difference method.
  - (a)  $\Delta e^x$
  - (b)  $\Delta tan^{-1}x$
  - (c)  $\Delta 3x$
  - (d) 2x/x!

Χ

у

3. Find the a curve to the following data

4. Explain the procedure of improving the accuracy for an ill conditioned system given below.  $a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = b_1$ 

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

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

- 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  $\int f(x) dx = h\{af(0) + bf(h/3) + c f(h)\}$  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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- 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 = 12x - 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  $t, t_1, t_2, \ldots, t_n$  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  $u(0,t) = T_0$ ,  $u(l,t) = T_1$ and the initial condition as u(x,0) = f(x) and explain the procedure to solve it. [15]
- (a) Derive the solution for the Simpson's 3/8<sup>th</sup> 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  $\theta$  (radians) through which the rod has turned for various values of time t (seconds).

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

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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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.

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

- 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.

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

Х	1	5	7	9	12
у	10	$1\overline{5}$	13	15	21

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]

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# 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]

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## II B.Tech II Semester Examinations, APRIL 2011 NUMERICAL METHODS

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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 o	f growt	h of the	popula	tion in 1	961.	

- (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 polynomia.

Х	1	2	3	4				
у	2	5	16	41				
hy using								

Jy using

- (a) Newton's backward difference formula
- (b) using Legrange's interpolation formula.

Compare (a) and (b) and comment.

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
У	8.3	15.4	33.1	65.2	127.4

- 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]