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Total Number of Pages: 2

M.TECH
MDPE105

1st Semester Regular/Back Examination – 2014

NUMERICAL ANALYSIS

BRANCH(S): MACHINE DESIGN

Time: 3 Hours

Max Marks: 70

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.



- Q1 Answer the following questions: (2 x 10)
- Explain accelerating convergence.
 - Estimate truncation error using Taylor series.
 - What is the condition of convergence of fixed point iteration to solve a system of non-linear equation?
 - What is the condition of convergence of Gauss-Seidel method?
 - What do you mean by peicewise interpolation?
 - Define cubic spline.
 - Write the stability condition for implicit method to solve differential equation.
 - Define eigen value and eigen vector of a matrix.
 - Write the advantages of implicit method over explicit method.
 - Explain multistep method giving suitable example.
- Q2 a) Find the root of equation $e^{-x} - x = 0$ using fixed iteration method when the approximate error is less than 0.005%. (5)
- b) Find the positive root of the equation $e^x = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} e^{0.3}$, correct to two decimal places (5)
- Q3 a) Solve the following system of non-linear equation using fixed -point iteration method, (5)
- $$x^2 + y = 11, \quad y^2 + x = 7.$$
- b) Solve the following system of equations using Gauss-Seidel method, (5)
- $$\begin{aligned} -3x + y + 12z &= 50 \\ 6x - 3y - z &= 3 \\ 6x + 9y + z &= 30 \end{aligned}$$
- Q4 a) Find a peicewise quadratic polynomial for the data values (5)

x	0	1	2	3	4
y	1	1	0.56	0.36	0.26

- b) Obtain the cubic spline approximation for the function defined by the data (5)

x	0	1	2	3
y	1	2	33	40

- Q5 a) Find $f(x)$, $f'(x)$, $f''(x)$, $f'''(x)$, $f^{(4)}(x)$ at $x=3$ of the following data values (5)

x	0	1	2	3	4	5
f(x)	3	5	8	10	13	16

- b) Using Gauss Quadrature technique, evaluate $I = \int_0^1 \frac{\sin x}{5x} dx$ taking $h=0.25$. (5)

- Q6 a) Solve the I.V.P $\frac{dy}{dx} = -xy^2$, $y(2)=1$ using Runge-Kutta 4th order (5)

Method in the interval $[2, 2.6]$.

- b) Given the differential equation $y' = x + \sin y$ with $y(0) = 1$, show that it is sufficient to use Euler's method with the step $h = 0.2$ to compute $y(0.2)$ with an error less than 0.05 (5)

- Q7 a) Find the Fourier approximating polynomial of the following data (5)

x	0	$\pi/2$	π	$3\pi/2$	2π
	0	1/4	1/2	3/4	1

- b) Find the eigen value of the following matrix $A = \begin{bmatrix} 3 & 2 & 5 \\ 6 & -5 & 3 \\ -24 & 38 & 2 \end{bmatrix}$ (5)
- using basic power method.

- Q8 a) What do you mean by elliptic equation? Find the portion in xy -plane where the following equation becomes elliptic (5)

$$u_{xx} + 4u_{xy} + (x^2 + 4y^2)u_{yy} = \sin(xy)$$

- b) Derive the Crank-Nicolson finite difference scheme for solving partial differential equation $u_t - a^2 u_{xx} = 0$, $0 < x < 1$, $t > 0$, $u(0, t) = 0$, $t > 0$ and $u(x, 0) = f(x)$, $0 \leq x \leq 1$ (5)