Mahindra University Hyderabad
École Centrale School of Engineering
Minor-II exam

Program: B. Tech.   Branch: AI, CAM, CE, CSE, ECE, NT   Year: II   Semester: II
Subject: Numerical Methods (MA2208)

Date: 16/04/2024   **Start Time: 10:00 AM**
Time Duration: 1.5 Hours   **Max. Marks: 15**

Instructions:

1) Answer all the questions.

2) All questions are self-explanatory; no clarification will be provided during the exam.

3) Use of non-programmable scientific calculator is allowed. However, sharing calculators during exams is strictly prohibited.

Question 1   (5 marks)
An investigator has reported the data tabulated below.

x	1	2	3	4	5
$f(x)$	0.5	2	2.9	3.5	4

It is known that such data can be modelled by the following equation

$$x = \exp\left(\frac{y - b}{a}\right)$$

where a and b are parameters. Use non-linear regression to determine a and b. Based on your analysis predict y at $x = 2.6$.

Question 2   (5 marks)
Find the largest eigenvalue (in absolute value) of the following matrix

$$A = \begin{bmatrix} 1 & 2 & 0 \\ -2 & 1 & 2 \\ 1 & 3 & 1 \end{bmatrix}$$

along with its eigenvector using the power method. Choose initial $x_0 = [1, 1, 1]^T$ and perform five iterations.

Question 3   (5 marks)

(a) Examine the provided MATLAB code snippet and answer the subsequent questions: [2]

```
A = [1, 2, 1;1, 5, -6;0, 1, 2];
[m,n]=size(A);
v=zeros(1,n);
for j=1:n
    v(j)=sum(abs(A(:,j)));
end
disp(max(v))
```

i. What value does the code display?

ii. The displayed value corresponds to some norm of the matrix A. Specify which of the following norms it represents: $\|A\|_\infty$, $\|A\|_1$, $\|A\|_F$, or $\|A\|_2$.

(b) Suppose the system of equations $Ax = b$ is to be solved with [3]

$$A = \begin{bmatrix} 1 & k \\ 2k & 1 \end{bmatrix}, \; k \neq \sqrt{2}/2, \, k \text{ real.}$$

Find a necessary and sufficient condition on k for convergence of the Gauss-Jacobi method.

End of exam