INDIAN INSTITUTE OF TECHNOLOGY HYDERABAD

Department of Chemical Engineering

B.Tech Fractal Examinations, 2020

SUBJECT: CH2030 – Numerical Methods – I

Full marks: 20

Duration of examination: 1 hour (45 min – Coding, 15 min – Uploading codes)

Please read the instructions carefully before starting

1) **This is an open-book exam.**
2) **Usage of social networking sites such as facebook, gtalk, communication through e-mails, etc. is strictly prohibited –** ***If any 2 codes are found similar, then both the persons will not be awarded any marks.***
3) **Steps for Uploading codes:**
   - **After completion of coding, keep the Fortran Projects of both Question 1 and Question 2 in one folder.**
   - **Compress this single folder and name it with your Roll no., for example: ch18btech11007.**
   - **Upload the compressed folder in the GOOGLE CLASSROOM within the given time.**
4) **You are allowed to use your previous class codes but make sure to upload them.**

**** Happy Coding ****

Write a FORTRAN code to minimize $f(\mathbf{x}) = 100(x_1^2 - x_2)^2 + (1 - x_1)^2$ using the following methods:

Q1) To find the minima, ensure that the first order derivative of the function is set equal to 0. Then, solve the derivative using Newton-Raphson (NR) method, where $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0.1 \\ 0.8 \end{bmatrix}$ is the initial guess. Use the following termination criteria: $\left|\frac{\mathbf{x_{k+1} - x_k}}{\mathbf{x_k}}\right| \leq 10^{-7}$, where k is the iteration

number and $\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$. Print the values of **x** at each iteration of NR. Also, print the function value $\mathbf{f}(\mathbf{x})$ at the final values of **x**. **(10M)**

Q2) Take $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0.1 \\ 0.8 \end{bmatrix}$ as the initial point and find the minimum value of $\mathbf{f}(\mathbf{x})$ using Steepest Descent method. Use 1000 iterations, step length = 0.001 ($\lambda = 0.001$) and the following termination criteria: $\left|\frac{\mathbf{x_{k+1}} - \mathbf{x_k}}{\mathbf{x_k}}\right| \leq 10^{-7}$, where k is the iteration number and $\mathbf{x} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$**.** Report the values of **x** at each iteration and also print the function value $\mathbf{f}(\mathbf{x})$ at the final values of **x**. **(10M)**

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