INDIAN INSTITUTE OF TECHNOLOGY HYDERABAD

Department of Chemical Engineering

B.Tech / M.Tech / Ph.D. Fractal Examinations, 2019

SUBJECT: CH2030/CH5010 – Numerical Methods – I

Full marks: 20 Duration of examination: 50 minutes

Instructions:

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.
3) Usage of mobile phones is not allowed.
4) **Keep all codes in one folder. Please compress the folder containing all your .f95 files and name it with your Roll no., for example: ch18btech11007. Upload the compressed folder in the GOOGLE CLASSROOM within the given time.**
5) 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:

1) Take $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} -2 \\ -2 \end{bmatrix}$ as the initial point and find the minimum value of $f(\mathbf{x})$ with the help of Newton-Raphson method. Use absolute difference between values of both x_1 and x_2 at successive iterations as termination criteria. Set the tolerance in termination criteria as 1e-7. Print the values of **x** and **f(x)** at each iteration. (10M)

   (**Hint**: To find the minima, ensure that the first order derivative of the function is set equal to 0).

2) Take $\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} 0.9 \\ 0.9 \end{bmatrix}$ as the initial point and find the minimum value of $\mathbf{f}(\mathbf{x})$ using Steepest Descent method (You may refer to the class notes). Use 10000 iterations, step length = 0.001 ($\lambda = 0.001$). and tolerance = 1e-7. Use absolute difference between values of both x_1 and x_2 at successive iterations as termination criteria. Set the tolerance in termination criteria as 1e-7. Report the values of **x** and **f(x)** at each iteration. (10M)