AM5801/5810: Computational Lab (July-Nov. 2019)

End Semester

Total Marks: 30 **Time: 3 hours**

Answer All Questions

Instructions:

The MATLAB codes should be written in a generalized manner, such that other problems can be solved without major modifications.

Submit published PDF from MATLAB.

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1) Consider the governing equation for solving the four-bar linkage mechanism:

$$f(\phi) = R_1 \cos(\alpha) - R_2 \cos(\phi) + R_3 - \cos(\alpha - \phi) = 0$$

Given, $R_1 = 5/3$, $R_2 = 5/2$, $R_3 = 11/6$ and $\alpha = 40°$. Find ϕ using the Newton Raphson method. Perform iterations using the following convergence condition $|\phi_{n+1} - \phi_n| < 1e - 12$.

$$x_{N+1} = x_N - \frac{f(x_N)}{f'(x_N)}$$

Plot the true error vs iteration for both the methods using a semi-log plot. Finally, find the order of convergence (R).

$$\lim_{N\to\infty} \frac{|p - x_{N+1}|}{|p - x_N|^R} = K$$

where, K is an asymptotic constant.

2) Consider steady heat diffusion in the unit square $0 \le x \le 1, 0 \le y \le 1$. Let $T(0, y) = T(x, 0) = 50$ and $T_x(1, y) = T_y(x, 1) = 0$. Solve this problem using the 5-point Laplace stencil for 100 x 100 and 500 x 500 grid sizes. Solve with the help of Gauss Seidel method using an appropriate error tolerance. Plot the results using *contour*.

$$\nabla^2 u \approx \frac{u_{i+1,j} + u_{i-1,j} + u_{i,j+1} + u_{i,j-1} - 4u_{i,j}}{h^2} = 0$$