University of Windsor
Faculty of Engineering

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GENG-2200-1/2 Numerical Analysis for Engineering

Assignment #2: Chapters 5 and 6

Due: Upload to Blackboard before 11:59 pm, Friday, January 24, 2020

****see note at the end of the assignment****

Instructions

- Attempt all questions; marking rubric and solutions will be available after the submission deadline
- Adhere to University of Windsor Academic Integrity policies by submitting your own work; review Bylaw 31: Academic Integrity
- Consult course textbook & UWindsor Blackboard course notes for assistance
- Utilize online resources (Matlab Help: https://www.mathworks.com/support/learn-with-matlab-tutorials.html)

Question 1

Water is flowing in a trapezoidal channel at a rate of Q = 20 m^3/s. The critical depth, y, for such a channel must satisfy the equation

$$0 = 1 - \frac{Q^2}{g{A_c}^3}B$$

where g = 9.81 m/s^2, A_c = the cross-sectional area (m^2), and B = the width of the channel at the surface (m). For this case, the width and the cross-sectional area can be related to depth, y, by

$$B = 3 + y$$

and

$$A_c = 3y + \frac{y^2}{2}$$

a) Solve for the critical depth of the channel using the graphical method (use MATLAB).
b) Solve for the critical depth of the channel using the bisection method. Use initial guesses of x_l = 0.5 and x_u = 2.5, and iterate until the approximate error falls below 1% or the number of iterations exceeds 10. (Round the final answer to four decimal places.) Show your calculations for three iterations and then provide all iterations in a table. Using MATLAB, provide your commands with your assignment submission.
c) Solve for the critical depth of the channel using the false-position method. Use initial guesses of x_l = 0.5 and x_u = 2.5, and iterate until the approximate error falls below 1% or the number of iterations exceeds 10. (Round the final answer to four decimal places.) Using MATLAB, provide your commands with your assignment submission.

Question 2

An oscillating current in an electric circuit is described by

$$I = 9e^{-t}\sin(2\pi t)$$

where t is in seconds. Using MATLAB and the `fzero` function, determine all values of t such that I =3.5 amperes. Show your work, include a graph plotted and labelled in MATLAB.

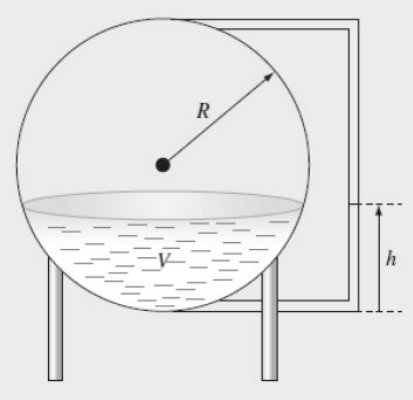
- The values of t are 0.01723 s and 0.23911 s
- The values of t are 0.006835 s and 0.05314 s and 0.40134 s
- The values of t are 0.001423 s and 0.057157 s and 0.03911 s
- The values of t are 0.06835 s and 0.40134 s

Question 3

You are designing a spherical tank (see the figure) to hold water for a small village in a developing country. The volume of liquid it can hold can be computed as

$$V = \pi h^2 \frac{(3R - h)}{3}$$

where V = volume [m^3], h = depth of water in tank [m], and R = the tank radius [m].



If R = 3 m, what depth must the tank be filled to so that it holds 30 m^3? Use three iterations of the most efficient numerical method possible *(hint: see note in Chapter 6 lecture notes)* to determine your answer. Determine the absolute approximate relative error after each iteration. (Round the final answer to six decimal places.) Show your calculations for three iterations and then provide all iterations in a table. Using MATLAB, provide your commands with your assignment submission.

Extra information:
For bracketing methods, initial guesses of 0 and R will bracket a single root for this example. (b) For open methods, an initial guess of R will always converge.

Regarding assignment uploads to Blackboard:

Please upload electronic file or files (pdf, image files, m-files, etc.) well in advance of the deadline. In the event of system technical issues, keep a record of upload confirmation (or a screen capture). Acceptable submissions include word files, image or pdf versions of hand-written assignments, excel files, m-files, etc. Consolidate the submission in a way that is easy to follow and supporting code is easily available (when applicable).

Keeping a copy of your submissions and proof of upload before the due date/time is VERY STRONGLY RECOMMENDED. After you submit your assignment, go back into the system and ensure your files are there. If any issues arise, email the marking GA and the instructor immediately (i.e. prior to the due date/time).