Date: 31 July 2018

Third Year Honours 2018
Department of Applied Mathematics
University of Dhaka
Math Lab III, AMTH- 350
Assignment No. 1

Name: Md. Nirab Hossain **Roll No.** FH-020-023

Write a MATLAB program to solve the following problems. Use Script/ Function file if needed.

No	Problem	Signature
1	Create a 10×8 matrix named as A a) Create a nine elements column vector named as *Ac* contains 3rd three elements of 2nd row and last six elements of 7th column b) Create a sixteen elements row vector named as *Ar* contains last column and 2nd to 7th elements of 5th column c) Replace last 5 elements by elements [4 5 6 7 8]	
2	The famous Collatz conjecture states that for any positive integer x_0, the sequence $\{x_k\}$ defined by $x_k = \begin{cases} \frac{x_{k-1}}{2} & , if\ x_{k-1}\ is\ even \\ 3x_{k-1}+1 & , if\ x_{k-1}\ is\ odd \end{cases}$ will eventually reach the number 1, regardless of which positive integer is chosen initially. (a) Write a script M-file to take an arbitrary positive integer less than 50 as input from keyboard and construct the above sequence. Then plot all the terms of the sequence. (b) Write a script M-file to construct a plot of s *versus* n where s is the total number of steps that it takes to reach 1 for a positive integer n. Vary n from 1 to 40.	
3	Solve the following system of equations $y + z + t = 1$ $x + 2z + 3y + 4t = -1$ $x + 6z + 10t = 2$ $x + 4y + 10z + 20t = 3$ And verify your answer.	
4	Consider the function $y = Cos(2x)$. a) Generate a data set of exactly 40 points for $0 \leq x \leq 2\pi$. Interpolate the set with a polynomial of degree 4 and estimate a value at 2. b) In the same graph, plot the date set with red diamonds and the fit with green dashed line. Use appropriate title and legends for the graph.	
5	Given that: $\frac{(x+1)^2-2x^2}{(x-1)^3-x+1}$, present it symbolically. a) Separate the denominator and numerator. b) Expand the equation. c) Factorize the equation. d) Simplify and solve the equation by letting equal to 0.	

6	Suppose, students of Dept. of Applied Mathematics has decided to go on a study tour. The tour will not be possible if less than 15 students want to go. Also, if more than 50 students join then the tour will be in abroad, otherwise inside Bangladesh. Again, if the journey is in abroad then the tour-fee will be 15,000 TK each, otherwise 5,000 TK each. There are three available modes of transport: air, bus and train. No matter where the tour takes place, if the journey is by air then another 10,000 TK will be added to the fee while for bus and train, extra 3,000 and 2,000 TK will be added respectively. For a given number of students, write a script M-file that will compute the total fee according to the above information.	

Assignment 02

Third Year B.S. (Honors) 2017-2018

Course Title: Math Lab III Course Code: AMTH 350

Department of Applied Mathematics, University of Dhaka

Name: Md. Nirab Hossain **Roll No:** FH-23 **Group:**

Write a MATLAB Script-M file to solve each of the following problems.

No.	Problem	Signature
1.	Find a zero, accurate to within 10^{-5},of the function $f(x) = e^x + x$ using Bisection Method following the stopping criterion $\lvert f(P_n)\rvert < TOL$ where P_n is the n^{th} approximation. Show your answer in a table with headings as follows: "Iteration No.", "a", "b", "P_n", "$\lvert f(P_n)\rvert$"	
2.	Using Fixed Point Iteration Method with initial guess 1, generate 20 approximations to the solution of $x^4 + 2x^2 - x - 3 = 0$ for each of the following choices of $g(x)$: (i) $g_1(x) = (3 + x - 2x^2)^{1/4}$ (ii) $g_2(x) = \left(\frac{x+3-x^4}{2}\right)^{1/2}$ (iii) $g_3(x) = \frac{3x^4+2x^2+3}{4x^3+4x-1}$ Show your answers in a table with suitable headings. Comment on the convergence of choices of $g(x)$.	
3.	Consider the equation $\text{Cot}\left(\frac{\pi x}{4}\right) - \sqrt{x} = 0$ for $0.5 < x < 2$ whose exact solution is evident by inspection. Use the Regula Falsi Method to approximate a solution of this equation within tolerance 10^{-5}. Also find absolute error, relative error and relative percentage error. Show your results in a table with headings as follows: "Iteration No.", "P_n", "Abs. Err.", "Rel. Err.", "Rel. Per. Err."	
4.	Use the Newton-Raphson Method with a suitable initial guess to approximate a solution of $Sin(x) + 4x^3 - e^x = 0$ within tolerance 10^{-7}. Show your answer in a table with suitable headings.	

Assignment 03

Third Year B.S. (Honors) 2017-2018

Course Title: Math Lab III **Course Code: AMTH 350**

Department of Applied Mathematics, University of Dhaka

Name: Md. Nirab Hossain **Roll No:** FH-020-029 **Group:** A

Write a MATLAB Script-M file to solve the following problem(s).

No.	Problem	Signature
1.	The world population in billions from 1950 through 2015 is given in the following table:	

Year	Population (in billions)
1950	2.562
1955	2.781
1960	3.040
1965	3.332
1970	3.692
1975	4.071
1980	4.447
1985	4.854
1990	5.296
1995	5.715
2000	6.118
2005	6.503
2010	6.885
2015	7.383

Using the logistic model, the rate of change of population can be modeled as $\frac{dP}{dt} = rP(1 - \frac{P}{K})$, where r is the maximum growth rate under unlimited conditions, P is the population, and K is the maximum population (also known as 'carrying capacity'). The analytical solution to this model is given by $P(t) = \frac{P_0 K}{P_0 + (K - P_0)e^{-rt}}$, where P_0 is the initial population. Simulate the world's population from 1950 to 2050 using:

(a) the analytical solution

(b) Euler's method

(c) Modified Euler's method

(d) the second-order RK method

(e) the fourth-order RK method

(f) built-in *ode23* function

(g) built-in *ode45* function

Use a step size of 5 years. Employ the following initial conditions and parameter values for your simulation:

$P_o\ (in\ 1950) = 2.562\ billion, r = 0.026/year$, and $K = 12\ billion$.

Compare your results by showing in a single plot with appropriate legends and a suitable title.

Complete within One Class

Assignment 04

Third Year B.S. (Honors) 2017-2018

Course Title: Math Lab III Course Code: AMTH 350

Department of Applied Mathematics, University of Dhaka

Name: Md. Nirab Hossain **Roll No:** FH-020-023 **Group:** A

Write a MATLAB Script-M file to solve the following problem(s).

No.	Problem	Signature
1.	Consider the initial-value problem $y' = y - t^2 + 1, \quad 0 \le t \le 2, \quad y(0) = 0.5$ The analytic solution is given by $y(t) = (t+1)^2 - 0.5\, e^t$. i) Use the exact values from this solution as the starting values and step size $h = 0.2$ to obtain approximations using a) Adams-Bashforth four step explicit method b) Adams-Moulton three step implicit method c) Adams fourth order predictor-corrector method Show your result in a table with headings as follows: "t", "Exact", "Adams-Bashforth", "Adams-Moulton", "Predictor-Corrector" ii) Compare the three methods by finding the errors at each step. Show your comparison in a table with headings as follows: "t", "Exact", "Error in AB-4", "Error in AM-3", "Error in A-4 PC" Also plot the exact solution along with the approximations obtained by the above three methods using different colors and legends. Which method do you think approximated the solution best?	18.09.18

Complete in a class

3rd Year B.S. (Honors) 2017-2018
Math Lab Assignment 05
Course: AMTH 350 (Math Lab III)
Department of Applied Mathematics
University of Dhaka

Name: Md. Nirab Hossain Roll No: FH-020-023

Write MATLAB program to solve the following problems using Script file.

No:	Problems	Signature
1	Mersenne number defined as $M_n = 2^n - 1$, how many numbers are prime there? Form a table to show prime and non prime numbers , when n ranges from 50 to 150.	25.09.17
2	If $\tau(n) = \prod_{i=1}^{k}(\alpha_i + 1), \sigma(n) = \prod_{i=1}^{k}\left(\frac{{p_i}^{\alpha_i+1}-1}{p_i-1}\right)$ and $\varphi(n) = n\prod_{i=1}^{n}(1-\frac{1}{p_i})$ Where $n = p_1^{\alpha_1} p_2^{\alpha_2} \dots p_k^{\alpha_k}$, then for any n calculate the values of $\tau(n)$, $\sigma(n)$ and $\varphi(n)$	25.09.17
3	Schedule a round-robin tournament for 8 teams so that every team plays other team exactly once. (Use the Congruence equation $i + j \equiv k \ (mod\ N - 1)$, where i, j represent the teams to play at kth round and N is the total number of teams)	25.09.17

Complete in one class

Assignment 06

Third Year B.S. (Honors) 2017-2018

Course Title: Math Lab III Course Code: AMTH 350

Department of Applied Mathematics, University of Dhaka

Name: **Roll No:** **Group:**

Write a MATLAB Script-M file to solve the following problem(s).

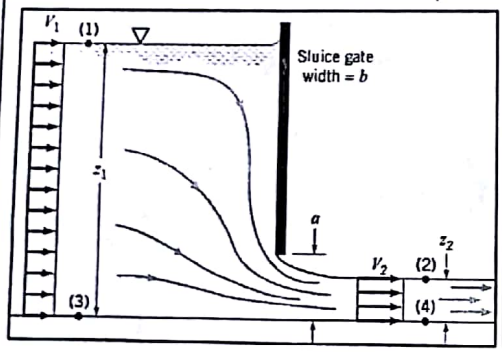
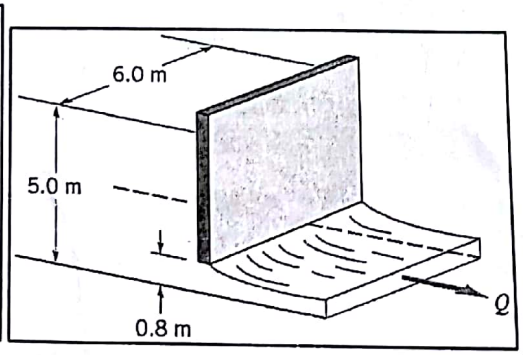
No.	Problem	Signature
1.	Consider the following linear system of equations: $10x_1 - x_2 + 2x_3 = 6$ $-x_1 + 11x_2 - x_3 + 3x_4 = 25$ $2x_1 - x_2 + 10x_3 - x_4 = -11$ $3x_2 - x_3 + 8x_4 = 15$ a) First, store the coefficients and constants in .txt or .dat files. Then load those data in two matrices named "**A**" and "**b**" and perform Gaussian elimination with backward substitution to find the solution of the system. b) Solve the same system, correct up to 5 decimal places, with initial guess $\boldsymbol{x_0} = (0,0,0,0)$ using: (i) Jacobi iterative method (ii) Gauss-Seidel iterative method (iii) SOR iterative method with $\omega = 1.1$ c) Comment on the efficiency of the methods used in part (b) by creating a table with headings as follows: "Exact Solution", "Jacobi", "G-S", "SOR", "Total iterations for Jacobi", "Total iterations for G-S", "Total iterations for SOR".	

Complete in one class

Assignment 07
Third Year B.S. (Honors) 2017-2018
Course Title: Math Lab III Course Code: AMTH 350
Department of Applied Mathematics, University of Dhaka

Name: Md. Niaab Hossain **Roll No:** FH-020-023 **Group:** A

Write a MATLAB Script-M file to solve the following problem(s).

No.	Problem	Signature
1.	The velocity components of a 2-D flow are $u = (1 + y^2)\ m/s$ and $v = (x - 1)\ m/s$. Determine the equation for the streamlines and graph (at least four) representative streamlines. Also indicate the direction of flow.	
2.	Consider the velocity $\boldsymbol{V} = \left(\frac{1}{2}x^2 - \frac{1}{3}x^3\right)\boldsymbol{i} + x(x-1)(y+1)\,\boldsymbol{j}$, where x and y are in feet. a) Is the motion possible? b) Check whether the motion is irrotational or not. c) Find the stagnation points (if any)	
3.	Check whether the stream function and the velocity potential exist for the velocity field $u = a(x^2 - y^2), v = -2axy$, where $a > 0$. If they exist, find them. Plot some representative streamlines and equipotential curves (at least four of each type) and interpret them.	
4.	The velocity potential of a 2-D flow is given by $\phi = \frac{ax^3}{3} - axy^2 - 2$, where $a > 0$. a) Plot some representative equipotential curves (at least four) b) Determine the stream function. c) Plot some representative streamlines (at least four). Also indicate the direction of flow in the first quadrant.	
5.	The flowrate per unit width for a sluice gate in an open channel shown in figure (i) is given by $\frac{Q}{b} = z_2\sqrt{\frac{2g(z_1 - z_2)}{1 - \left(\frac{z_2}{z_1}\right)^2}}$.  Figure (i)  Figure (ii) Use this formula and contraction coefficient $C_c = \frac{z_2}{a} = 0.61$, whenever $1 < \frac{a}{z_1} < 0.2$, to find the flowrate per unit width for the sluice gate shown in figure (ii) for values of ranging from 5.0 m to 15.0 m with increment	

Complete in one class

	$0.25\ m$. Take $g = 9.81\ m/s^2$. Using the generated values, plot a graph of $\frac{Q}{b}$ vs z_1 and determine whether the flowrate is directly proportional to the flow depth.	
6.	Consider two sources of the same strength $-0.314\ m^2/s$ at $(0,5)$ and $(0,-5)$. First, determine the stream function in Cartesian coordinates and then in polar coordinates. Plot some representative streamlines above and below the x $-$axis. Do the x and y axes act as streamlines? If so, interpret which one is the dividing streamline.	