CEE 3804 Final Exam (Spring 2024)

Computer Applications in CEE

Open Book and Notes (In Class - Two Hour Limit)

Your Name ____

Your Signature * ____

* The answers in this exam are the product of my own work. I certify that I have not received nor I have provided help to others while taking this examination.

Directions:

Solve the problems. Copy and paste the Matlab and VBA code and solutions such as graphs in a Word Document and convert to a single PDF file. **Make sure your code is not too small for me to be able to read it.**

Problem 1 (25 points)

Use Simulink, to solve the differential equation of the cooling process of Hot Mix Asphalt (HMA) - a commonly used material to pave roads. The Simulink model should solve the differential equation that models the temperature (T) variation of Hot Mix Asphalt (HMA) as a function of time (t). The differential equation is:

$$\frac{dT}{dt} = -H_1(T - T_a)$$ in degrees/minute

where:

$H_1 = H * [1 - \gamma * sin(T/\rho)]$ (1/minute)

$H = 0.18$ (1/minute)

$\gamma = 0.76$ dimensionless

$\rho = 3.98$ degrees C.

The initial temperature of the HMA mix is $T_o = 160$ degrees Celsius. The ambient temperature during the application of the HMA is $T_a = 20$ degrees Celsius.

Task 1

Create a Simulink model to model the HMA cooling process.

Task 2

Run the Simulink model created in Task 1 from time 0 to 50 minutes. Verify with solutions obtained in Task 1 that the model works as expected.

a) Export the temperature profile to Matlab and plot the HMA temperature vs. time (**a plot using the Simulink scope is not acceptable for this task**). Label accordingly.

b) Using the model developed, find the time for the HMA mixture to reach 15% above the ambient temperature. You can do this graphically if desired.

Include screen captures of the Simulink model and Matlab code required to plot the temperature profile over time.

Problem 2 (25 points)

A small dam in the midwest breaks and releases water according to the flows measured in Table 1 (also included in a companion Excel file).

Table 1. Measured Water Flow Rates after Dam Failure.

Time (minutes)	Flow Rate (cubic meters/minute)
0	300
300	490
600	480
900	360
1200	293
1500	211
1800	140
2100	95
2400	55
2700	35
3000	15
3300	10
3600	0

Task 1

Plot the water flow rate after the dam breaks as a function of time. Label accordingly.

Task 2

Use numerical integration to find the **total water discharged** after the dam breakup. State your answer clearly.

Include screen captures of Matlab code required to make the calculations.

Problem 3 (25 points)

Brief answers or True/False (T/F)

Number	Question	Answer
1	A VBA function can produce a single output given four inputs (T/F)	
2	The Matlab code **x=strcmp(State,'FL')** produces vector **x** of equal length as vector **State** (T/F)	
3	A relational database reduces the memory requirements of computations by breaking the data into multiple tables (T/F)	
4	The Matlab code z=interp1(stress, strain,0.006) find the value of strain when stress is 0.006 by interpolation (T/F)	
5	Function [speed, distance, acceleration]=myCalculator(x,y,z,h) produces three outputs (T/F)	
6	An Excel macro can be reused in multiple Excel files (T/F)	
7	The Matlab code **y=find(Speed>0)** produces a vector of zeros and ones (T/F)	
8	Name the person who estimated the computational gains of microchips over time.	
9	Option Explicit defines automatically the data types in my VBA code (T/F)	
10	A Matlab function calculates 35 million single precision numbers. How many bytes are required in computer memory to save all the values produced by the function?	

Problem 4 (25 points)

The following linear programming problem has been developed to predict the profit for a company that sells two types of cellular concrete products.

Maximize $Z = 610x_1 + 570x_2$

Subject to:

$0.9x_1 + x_2 <= 765$

$1.4x_1 + x_2 <= 910$

$1.9x_1 + x_2 <= 1200$

Task 1

Convert the problem shown above into standard (canonical) form to be solved by hand using the Simplex Method. Write down the transformed equations and add slack and artificial variables as needed.

Task 2

Show me the first two tables in the Simplex solution. Indicate the values of all the variables in every table. Indicate the value of the objective function Z in every table. This task requires hand calculations.

Task 3

Solve the problem using Excel Solver..

Include screen captures of the Solver panel, Excel spreadsheet setup and two tables of the Simplex method.