Higher Colleges of Technology

Fujairah Men's College

MTH 2503 - Fall 2014

Project

WEIGHTED AT **15 %** OF FINAL COURSE GRADE

Academic Honesty Declaration

Project: This is entirely my own work except where I have noted other sources in the text and listed them at the assignment's end. I have not submitted this work to HCT before. I understand that I may be interviewed on my submission.

THE PENALTY FOR CHEATING AT HCT IS SEVERE AND INCLUDES PERMANENT DISMISSAL FROM THE COLLEGE. I have read the above information and understand my responsibilities with regard to academic honesty during this project

Group members	ID

Standards	Completeness and correctness	Quality	Technology	Creativity	Total
Mark					

1. Application of Systems of linear equations

Determine the currents I_1, I_2 and I_3 for the electrical network shown in Figure 1.12.

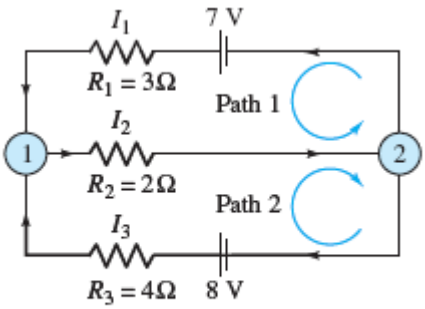

Figure 1.12

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2. Application of Matrix operations

A cryptogram is a message written according to a secret code (the Greek word kryptos means "hidden"). The following describes a method of using matrix multiplication to encode and decode messages. To begin, assign a number to each letter in the alphabet (with 0 assigned to a blank space), as follows.

0	-		
1	A	14	N
2	B	15	O
3	C	16	P
4	D	17	Q
5	E	18	R
6	F	19	S
7	G	20	T
8	H	21	U
9	I	22	V
10	J	23	W
11	K	24	X
12	L	25	Y
13	M	26	Z

(a) Write the uncoded row matrices of the indicated size for the given message. Then encode the message using the matrix A

- Message : HELP IS COMING
- Row matrix size : $1x4$
- Encoding Matrix $A = \begin{bmatrix} -2 & 3 & -1 & -1 \\ -1 & 1 & 1 & 1 \\ -1 & -1 & 1 & 2 \\ 3 & 1 & -2 & -4 \end{bmatrix}$

(b) Decoding a Message use $\boldsymbol{A^{-1}}$ to decode the cryptogram.

$$A = \begin{bmatrix} 3 & -4 & 2 \\ 0 & 2 & 1 \\ 4 & -5 & 3 \end{bmatrix}$$

112 -140 83 19 -25 13 72 -76 61 95 -118 71 20 21 38 35 -23 36 42 -48 32

3. Application of Determinants

(a) Finding the area of a Triangle with the given vertices $(1,1), (-1,1), (0,-2)$
(b) Determine whether the points are collinear $(-1,-3), (-4,7), (2,-13)$
(c) Find an equation of the line passing through the given points $(1,4), (3,4)$
(d) Find the volume of the Tetrahedron with the given vertices $(0,0,0), (0,2,0), (3,0,0), (1,1,4)$
(e) Find an equation of the plane passing through the given points $(0,-1,0), (1,1,0), (2,1,2)$

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4. Application of Eigenvalues and Eigenvectors

Population Growth Model A population has the following characteristics.

(a) A total of 60% of the population survives the first year. Of that 60%, 50% survives the second year. The maximum life span is 3 years.
(b) The average number of offspring for each member of the population is 2 the first year, 5 the second year, and 2 the third year.

The population now consists of 100 members in each of the three age classes. How many members will there be in each age class in 1 year? in 2 years?

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5. Modeling with First Order Differenatial Equations

Heat transfer from a body to its surroundings by radiation, based on the Stefan– Boltzmann5 law, is described by the differential equation

$$\frac{du}{dt} = -\alpha(u^4 - T^4) \qquad (i)$$

where $u(t)$ is the absolute temperature of the body at time t, T is the absolute temperature of the surroundings, and α is a constant depending on the physical parameters of the body.

However, if u is much larger than T, then solutions of Eq. (i) are well approximated by solutions of the simpler equation

$$\frac{du}{dt} = -\alpha u^4 \qquad (ii)$$

Suppose that a body with initial temperature 2000 K is surrounded by a medium with temperature 300 K and that

$$\alpha = 2.0 \times 10 - 12\ K - 3/s.$$

(a) Determine the temperature of the body at any time by solving Eq. (ii).
(b) Plot the graph of u versus t.
(c) Find the time τ at which $u(\tau) = 600$ - that is, twice the ambient temperature. Up to this time the error in using Eq.(ii) to approximate the solutions of Eq. (i) is no more than 1%.

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6. Mechanical and Electrical vibrations with S.O.D.E

A series circuit has a capacitor of $10^{-5}\ F$, a resistor of $3\ x10^2\Omega$, and an inductor of 0.2 H. The initial charge on the capacitor is 10^{-6} C and there is no initial current. Find the charge Q on the capacitor at any time t.

Instructions

- This project is a group project. Each group member is expected to participate effectively.
- Answer all problems in MS word. Use Times New Roman font with font size 10. Use math equation for math symbols and equations.
- Use geogebra for plotting
- Show all of the work
- Submission date is **Nov, 30th**
- Marking scheme will be according to the completeness the tasks, quality, correctness, creativity, and using Technology