1 to 3:20 PM
5-23-2005

MAE 4301
Final Exam Part2

Name:_____

Rules:

1. Open book and notes
2. Work independently
3. Write answer in the problem sheet and turn in the m-files for your solutions

Grades

Problem 1(20%)_____

Problem 2(20%)_____

Problem 3(20%)_____

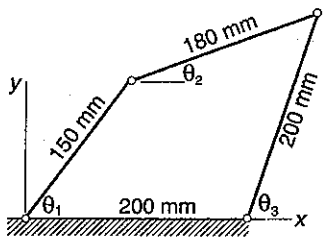
Problem 4(20%)_____

Problem 5(20%)_____

Problem 6(5%)_____

Total _____

Problem 1



The three angles shown in the figure of the four-bar linkage are related by

$$150\cos\theta_1 + 180\cos\theta_2 - 200\cos\theta_3 = 200$$
$$150\sin\theta_1 + 180\sin\theta_2 - 200\sin\theta_3 = 0$$

Determine θ_1 and θ_2 when $\theta_3 = 75°$. Note that there are two solutions.

Answers:

First solution

th1= th2=

Second solution

th1= th2=

Problem 2

Generate x,y data use the following Matlab commands

```
X=linspace(0,5,15);
Y=sin(X);
```

(A)Use Matlab function **polyfit** to fit polynomial of order 1 to 4 to the above data.

(B) Plot the data points with red circles

(C) Evaluate and plot the fitted functions use data at XX, where

```
XX=linspace(0,5,200) ;
```

(Hint: use Matlab function **polyval**)

(D) Use legend to identify the fitted functions.

Answers

Part A:

Coefficients of the fitted polynomial:

Linear (1st order)

Second order:

Third order:

Fourth order:

Problem 3

The differential equation describing the angular position θ of a mechanical arm is

$$\ddot{\theta} = \frac{a(b-\theta) - \theta\dot{\theta}^2}{1+\theta^2}$$

where $a = 100\ \text{s}^{-2}$ and $b = 15$. If $\theta(0) = 2\pi$ and $\dot{\theta}(0) = 0$, compute θ and $\dot{\theta}$ when $t = 0.5$ s.

Hint: The equations of motion in first order form are

$$\dot{y}_1 = \theta = y_2$$

$$\dot{y}_2 = \frac{a(b-y_1) - y_1 y_2^2}{1+y_1^2}$$

Also plot the solutions.

Answer: th(0.5)=

HINT: Use ODE45 to solve the problem. Define your own TSPAN so the t=0.5 is in the list of TSPAN. (e,g., TSPAN(20)=0.5, then you can find the th(20)=y(20,1))

Problem 4

Given f= 1/sqrt(sin(x))

(a) Find the derivative of f at x=0.2
By centaal difference and complex variable method use dx=0.001. Compare the solution with the analytical solution.

Ans=[CD CVM Exact]=

[ ]

(b) Find the integral of f(x) from 0 to pi/4.
(1) symbolically
(2) numerically use Matlab quad function.
(3) Use Matlab function trapz

Ans: I1=
I2=
I3=

Problem 5

Find the roots of the following polynomial

P(x)= 10 x^5 + 6 x^4 – 40 x^3 - 33 x^2 -11 x + 9 =0

(1) By symbolic calculation
(2) By Matlab function roots
(3) Graphically. (by plotting the function and use the ginput command to find where P(x)=0). Also show the roots on the figure.

Answers:

(1) X=

(2) X=

(3) X=

Problem 6 (5%)

Find the eigenvalues and the associated eigenvectors of the eigenvalue problem

A * x = Lambda * B * x

Where

```
A=[45 -20;
   -20 20]
B=[1  0
   0 2];
```

Hint: Use Matlab function eig (type eig to see how to use the function)

Answers:

Eigenvalues=

Eigenvectors =