PRINCE OF SONGKLA UNIVERSITY

Department of Industrial Engineering

Midterm Exam: First Semester — Academic Year: 2005

Date: 2 August 2005 — Time: 9:00 – 12:00

Course:226-495 — Room: A 201

SPECIAL TOPICS IN MANUFACTURING ENGINEERING V (CAD/CAM TECHNOLOGY)

Instructions:

1. The exam has a total of 6 problems, 100 points as indicated in the table below.
2. Use of dictionaries and calculators is allowed.
3. This is an open book exam.

ทุจริตในการสอบ โทษขั้นต่ำ ปรับตกในรายวิชาที่ทุจริตและ

พักการเรียน 1 ภาคการศึกษา

Supapan Chaiprapat

Problem	Score	Your Score
1	15	
2	15	
3	10	
4	30	
5	20	
6	10	
Total	**100**	

1. What is the machine you designed in 226-305 (Machine Design) class? Define its functional requirements (FRs) and design parameters (DPs). For those who did not take the class, choose any machine you want to use as a case study. (15 points)

2. Parametric Equation

2.1 Write a parametric equation of $7X-2 = 5Y$ (5 points)

2.2 A cubic curve is defined by

$$\mathbf{P}(u) = (2u^3+5u^2)\mathbf{P_0} + (-4u^3+7u+5)\mathbf{P_1} + (u^3+3u^2-u)\mathbf{P_2} + (-2u^2+u-3)\mathbf{P_3}$$

From the above equation, we can explain the curve in a matrix form as follows.

$P(u) = \mathbf{[U][M][V]}$

where $\mathbf{[U]} = [u^3\ u^2\ u\ 1]$

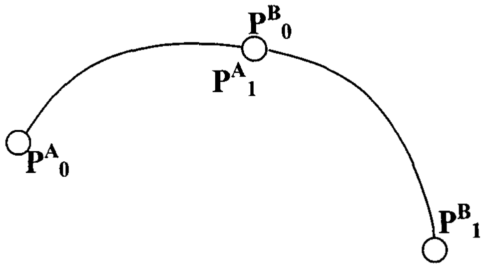
$\mathbf{[V]} = [\mathbf{P_0}\ \ \mathbf{P_1}\ \ \mathbf{P_2}\ \ \mathbf{P_3}]$

Find **[M]**. (10 points)

3. Given an equation of a Hermite cubic curve

$$\mathbf{P}(u) = (2u^3-3u^2+1)\mathbf{P}_0 + (-2u^3+3u^2)\mathbf{P}_1 + (u^3-2u^2+u)\mathbf{P'}_0 + (u^3-u^2)\mathbf{P'}_1,$$

if we want to join a Hermite cubic curve ("A") which have $\mathbf{P}_0$ = [-3 7], $\mathbf{P}_1$ = [5 4], $\mathbf{P'}_0$ = [1 2], and $\mathbf{P'}_1$ = [-2 -3] with another Hermite curve ("B"), fill in the blank provided below to make the statements satisfy the continuity rules of C^0, C^1, and C^2 (10 points)



$C^0 \rightarrow$ $\mathbf{P}^B_0$ = ____________________

$C^1 \rightarrow$ ______________ = ____________________

$C^2 \rightarrow$ ______________ = ____________________

5

4. Given an equation of a cubic Bezier curve with control points located at [1 2], [3 -5], [7 -3], and [8 1],

4.1 find a normal vector (a vector perpendicular to the curve) at any point of the curve. (20 points)

$$\mathbf{P}(u) = (-\mathbf{P}_0 + 3\mathbf{P}_1 - 3\mathbf{P}_2 + \mathbf{P}_3)u^3 + (3\mathbf{P}_0 - 6\mathbf{P}_1 + 3\mathbf{P}_2)u^2 + (-3\mathbf{P}_0 + 3\mathbf{P}_1)u + \mathbf{P}_0$$

4.2 calculate a tangent vector and a normal vector of the curve at u = 0.25.

(10 points)

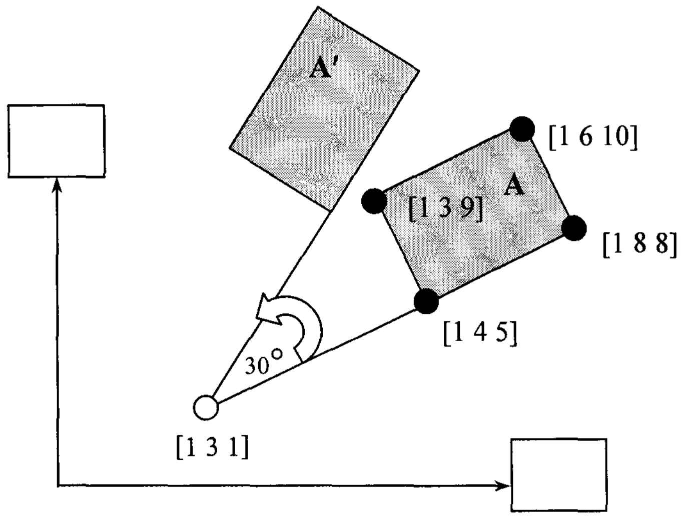
5. Fill the name of the axes in the diagram below and calculate all four points indicating the corners of A' when A' is derived from scaling A in z direction by 2 and rotating about [1 3 1] by 30° respectively. (20 points)

$(\cos(30) = 0.866, \sin(30) = 0.500)$

$R_x = [1\ 0\ 0;\ 0\ \cos(\theta)\ -\sin(\theta);\ 0\ \sin(\theta)\ \cos(\theta)]$

$R_y = [\cos(\theta)\ 0\ \sin(\theta);\ 0\ 1\ 0;\ -\sin(\theta)\ 0\ \cos(\theta)]$

$R_z = [\cos(\theta)\ -\sin(\theta)\ 0;\ \sin(\theta)\ \cos(\theta)\ 0;\ 0\ 0\ 1]$



6. Choose a product of your own and describe how CAE can be used to help improve a design of the product. (10 points)