PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester 1   Academic Year: 2009
Date: October 2, 2009   Time: 9:00-12:00
Subject: 226-302: Computer-Aided Manufacturing Room: R300

ทุจริตในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทุจริต และพักการเรียน 1 ภาคการศึกษา

Instructions

- There are 8 questions in 4 pages.
- Attempt all questions, write your answers in the answer-book separately provided.
- Only the hand-written notes on a 2-sided A4 sheet and a calculator are allowed. (*dictionary is _not_ allowed*)
- Each question carries different points as specified accordingly. The total score is 90.

| Name: .... | Student ID................... |

PART: *A*

Question #	Full Score	Assigned Score
1	10	
2	12	
3	18	
4	10	
5	10	
6	10	
7	10	
8	10	
Total	**90**	

Assoc. Prof. Somchai Chuchom

Question #1. (10 points) Industrial robots are used in many applications because of their flexibilities. Specify the major applications of industrial robots and comment on the trend for the next decade?

Question #2. (12 points)
2.1 Most robotics manipulators today use ....(specify the type of drive)...... drives.
2.2 One serious drawback of hydraulic-drive robots is ....(specify the problem)...., that makes it not desirable for assembly applications.
2.3 The robot with its configuration known as 'RRR' most closely resembles the anatomy of the human arm. It is also called .....(the name).... robot.
2.4 Draw the wrist coordinates of the robot arm, and also specify the Pitch, Yaw and Roll.

Question #3. (18 points)
Consider the single-axis robot in Figure 1 shown in the home position, which corresponds to $\theta = \pi/2$. Suppose the point p on the mobile link has coordinates $[p]^M = [0.5, 0.5, 2.0]^T$

(a) Find an expression for $R(\theta)$, the coordinate transformation matrix which maps mobile M coordinates into fixed F coordinates as a function of the joint variable θ.

(b) Use $R(\theta)$ to find $[p]^F$ when $\theta = \pi$.

Figure 1

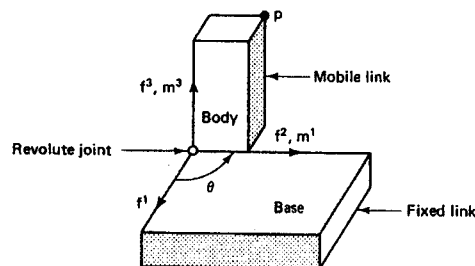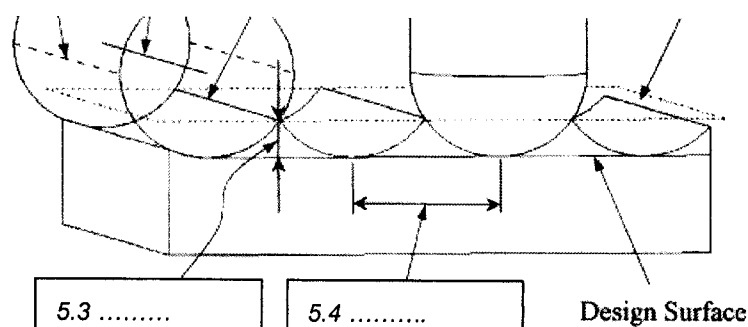5.3 ....   5.4 ....   Design Surface

Figure 2 Geometric elements of a machined surface

Question #4. (10 points)

Computer-aided manufacturing involves the use of computers to assist in all phases of manufacturing a product. Explain what you understand of CAM, and show in details of at least 2 technologies (tasks) of CAM that you know.

Question #5. (10 points)

The Bezier curve

$$P(u) = (1-u)^2 P_0 + 2u(1-u)P_1 + u^2 P_2$$

where

$$P_0 = [1 \quad 3]$$
$$P_1 = [4 \quad 7]$$
$$P_2 = [6 \quad 5]$$

Calculate the cutter locations to mill the curved surface. The tool path can be formed from 5 linear sections. Show the CL at $u = 0, 0.5,$ and 1.

Question #6. (10 points)

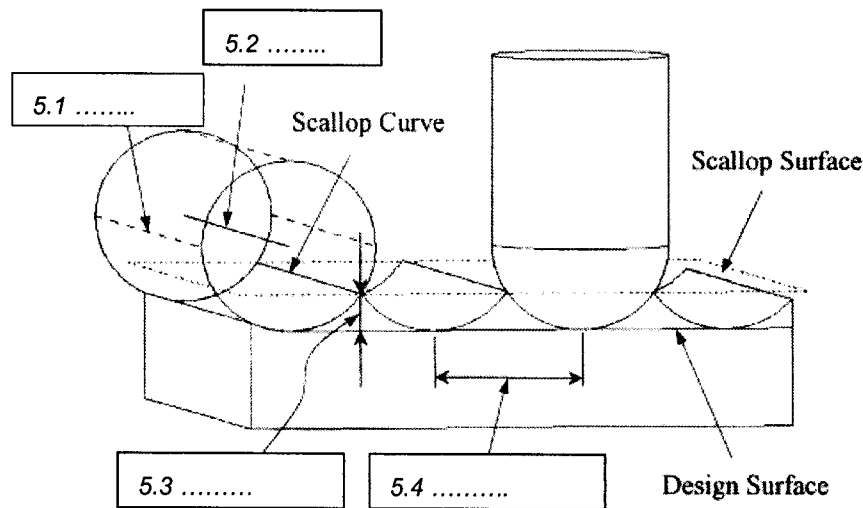From the geometric elements of a machined surface shown in Figure 2, specify the involved terminologies.

5.2 ....

5.1 ....

Scallop Curve

Scallop Surface

5.3 ....

5.4 ....

Design Surface

Figure 2 Geometric elements of a machined surface

Question #7. (10 points)
There are some most common patterns of tool path design such as one-way, zig-zag, contour parallel, and spiral. Sketch each of them and summarize its benefits and drawbacks when applied in machining the parts.

Question #8. (10 points)
Explain the concept of Direct Numerical Control, DNC, and how it can be enhanced for further development in CAM.