

**PRINCE OF SONGKLA UNIVERSITY**  
**FACULTY OF ENGINEERING**

Mid-Term Examination: Semester 2

Date: December 21, 2006

Subject: 226-332 Basic CAD/CAM

Academic Year: 2006

Time: 9:00-12:00

Room: R300

**Instructions**

- This is a closed book exam.
- Use of dictionary and calculator are allowed.
- There are 2 Parts and 13 problems in 10 pages.
- Answer all problems in these sheets.
- Total score is 60.
- Your answers could be in English or Thai.
- Please check all questions before start working.

Name: .....	Student ID.....
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Problem	Full Score	Assigned Score
Part I	30	
Part II	30	
<b>Total</b>	<b>60</b>	

Asst. Prof. Dr. Thanate Ratanawilai

Mr.Srisit Chianrabutra

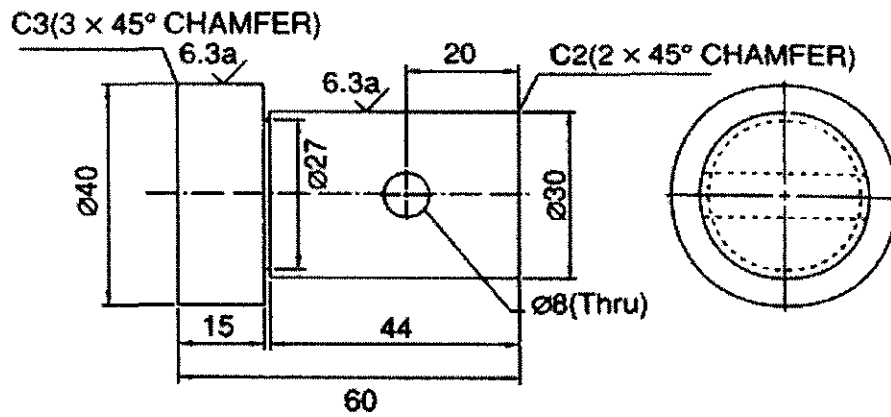
ทุจริตในการสอบโทษขั้นต่ำ คือ พักการเรียน 1 ภาคการศึกษา และปรับตกในรายวิชา

*one*

## Part I

Problem 1: For the part shown, develop its code using the Vuoso-Praha system.

Assume that the material is plain steel. (5 points; Coding System)



*one*

**Problem 2:** Determine the most suitable machine tool for the job. (15 points; Selection of Machine Tools)

Suppose 800 units of a shaft are to be manufactured within  $30 \pm 0.05$  mm. Suppose there are four alternative machine tools as follows:

Types of Machine Tools	Standard Deviation (mm)	Processing Cost per Unit (\$/unit)	Processing time per Unit (min/unit)	Setup Time (min)
M/C #1	0.1750	7	1.25	10
M/C #2	0.0750	10	1.00	15
M/C #3	0.0125	12	0.95	20
M/C #4	0.0100	17	0.75	25

Unit Raw Material Cost = \$12.00

Unit Salvage Value = \$1.00

Process Average = 30.015 mm.

Note:

$$SC = 1 - \Phi(Z^u) + \Phi(Z^l)$$

$$Y^l = Y^o + Y^s$$

$$T = S + tY^j$$

$$k^s = \frac{SC}{1 - SC}$$

$$Y^s = k^s Y^o$$

$$X^o = k^i X^j - k^s X^s + k^i f(Y^i)$$

$$k^i = 1 + k^s$$

$$Y^j = k^i Y^o$$

*Done*

Problem 3: The Cool-Age Corporation Inc. (CACI) Manufactures a line of refrigerators. CACI wants to mechanize its painting shop, which currently employs 2 persons. The Management of CACI is planning to buy a robotic system, which is expected to cost the company \$200,000 with an operating and maintenance cost of \$2.50 per hour. At present the manual labor cost is \$25 per hour per person including all benefits. Determine the payback period for this proposed investment in the robotic system. Is the investment justified? (10 points; Justification of Robots)

*One*

## Part II

1. What improvements do CNC machines offer over traditional NC machine?

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2. What is meant by the terms direct numerical control and distributive numerical control?

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3. Name four requirements that must be satisfied prior to using CNC in a shop.

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4. Explain the difference between an open loop system and a closed loop system.

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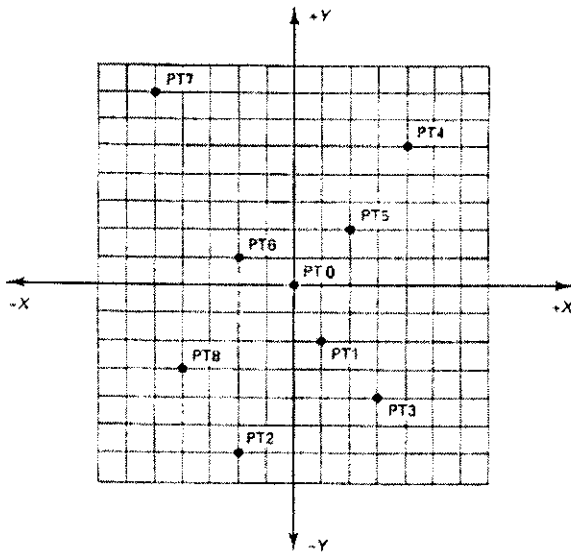
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*onu*

5. Write the absolute and incremental X and Y coordinates of the points shown in Figure below.



Point	Absolute		Incremental	
	X	Y	X	Y
0	0	0	0	0
1				
2				
3				
4				
5				
6				
7				
8				

6. Explain an advantage and a disadvantage of using a collet-and-chuck holder as opposed to an end mill holder.

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7. Match the terms on the left with the definitions on the right:

- |               |   |
|---------------|---|
| ___ Character | 1. A letter describing the meaning of a number following the letter |
| ___ Address   | 2. A sequence of blocks   |
| ___ Word      | 3. Alphanumeric or punctuation mark                                 |
| ___ Block     | 4. An address followed by a number                                  |
| ___ Program   | 5. A complete command to the CNC machine                            |

*One a*

8. What is the difference between modal and nonmodal G codes?

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9. Match the terms on the left with the definitions on the right:

- |               |                                      |
|---------------|--------------------------------------|
| ___ Chuck     | 1. Moves tool into work              |
| ___ Carriage  | 2. Supports right end of work        |
| ___ Turret    | 3. Clamps the work                   |
| ___ Tailstock | 4. Stores and execute CNC program    |
| ___ MUC       | 5. Provides a path for falling chips |
| ___ Headstock | 6. Machinery to rotate spindle       |
| ___ Slant bed | 7. Hold cutting tool                 |

10. Explain the significant of the following points:

- (a) Reference point
- (b) Machining origin
- (c) Programming origin

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Kind of workpiece	Rotational workpieces					Flat and irregular	Boxlike	Other mainly nonmachined	Materials																																																									
	Hole in axis			Geared and splined					6	7	8	Plain steel STL																																																						
	None	Blind	Trough	Hole in axis								12010 14120 18120	12020 14221 16121	12023 15124 16130	16220	16320	16420	16520																																																
				None	Trough														4	5																																														
1	2	3	4	5	6	7	8	1	2	3	4																																																							
Class of workpiece	D	LD	Rough form		Rough form	Lmax	Rough weight	Made of	<table border="1"> <tr> <td>12030</td><td>14140</td><td>15230</td></tr> <tr> <td>040</td><td>190</td><td>231</td></tr> <tr> <td>050</td><td>240</td><td>240</td></tr> <tr> <td>060</td><td>330</td><td>260</td></tr> <tr> <td>061</td><td>301</td><td>261</td></tr> <tr> <td>072</td><td>341</td><td>16240</td></tr> <tr> <td>13122</td><td>342</td><td>258</td></tr> <tr> <td>141</td><td>15130</td><td>351</td></tr> <tr> <td>240</td><td>131</td><td>030</td></tr> <tr> <td>242</td><td>151</td><td>440</td></tr> <tr> <td></td><td>224</td><td>521</td></tr> <tr> <td>14100</td><td>13151</td><td>16341</td></tr> <tr> <td>14103</td><td>15241</td><td>16640</td></tr> <tr> <td>14200</td><td></td><td></td></tr> <tr> <td colspan="3">Other alloys</td> <td colspan="3">Heat treated</td> </tr> <tr> <td colspan="3">Nonferrous</td> <td colspan="3">Hard.</td> </tr> </table>				12030	14140	15230	040	190	231	050	240	240	060	330	260	061	301	261	072	341	16240	13122	342	258	141	15130	351	240	131	030	242	151	440		224	521	14100	13151	16341	14103	15241	16640	14200			Other alloys			Heat treated			Nonferrous			Hard.		
	12030	14140	15230																																																															
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0	<1	□		Gibbika L/B >5	mm 0-200	0-30 kg	Extruded forms																																																											
1	0-40	1-6	□		Platforms L/B <5	mm 200-	30-200 kg	Bars																																																										
2	>6	□		Leverlike	mm 0-200	200-500 kg	Tubes																																																											
3	<3	□		Irregular	mm 200-	500-1000 kg	Sheets																																																											
4	40-80	1-4	□		mm 0-200	1000-kg	Wires																																																											
5	>4	□		Prismlike	mm 200-																																																													
6	80-200	<3	□		mm 0-200																																																													
7	80-	>3	□		mm 200-																																																													
8	200-	<3	□		mm 0-200																																																													
9	Various	>30	□		mm 200-																																																													
Group of workpiece	0 Smooth	Spur geared		Spined	Flat parallel	Boxes spindlestocks frames	Flat	Non mach.																																																										
	1 Thread in axis	Other		Other	Flat other	Columns	Flat	Part mach.																																																										
	2 Holes not in axis	Taper geared		Spined	Rotat. parallel	Beds bridges	Bent	Non mach.																																																										
	3 Splines or grooves	Other		Other	Rotat. other	Outriggers knees	Bent	Part mach.																																																										
	4 Comb. 1+2	Worm geared		Spined	Flat parallel rotat. parallel	Tables slides	Formed	Non mach.																																																										
	5 Comb. 1+3	Other		Other	Flat parallel rotat. other	Lids	Formed	Part mach.																																																										
	6 Comb. 2+3	Multiple gears		Spined	Flat other rotat. parallel	Basins containers	Welded	Non mach.																																																										
	7 Comb. 1+2+3	Other		Other	Flat other rotat. other		Welded	Part mach.																																																										
	8 Taper	Spined		Spined	Geared																																																													
9 Unround	Other		Other		Counterweights																																																													

Example of a class number

3	3	7	2
Kind	Class	Group	Material

3 - Rotational trough hole  
 3 - max ø40-80 L/D <1  
 7 - Threaded, holes not in axis, splines  
 2 - Alloy steel

DMU 9

# Appendix A

## Tail Area of Unit Normal Distribution

Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859



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Z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641
0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
3.5	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
3.6	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.7	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.8	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
3.9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

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