PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Midterm Exam Second Semester
Date 1 May 2016
Course 225-554 Automation Manufacturing

Academic Year 2016
Time 9:00-12:00
Room Robot

ทุจริตในการสอบ โทษขั้นต่ำ คือ พักการเรียน 1 ภาคการศึกษา และปรับตกในรายวิชาที่ทุจริต

Instructions

1. There are a total of 9 questions and 100 points.
2. Answer the questions in an answer book provided.
3. Only dictionaries are allowed.

Supapan Chaiprapat

1. (10 points) Process planning is one of the most important activities in a product cycle. What are inputs and outputs of this activity? Give details.
2. (5 points) CAPP technology emerged from incapability of human in process planning. List drawbacks of manual planning that CAPP can overcome. Also give example.
3. (10 points) *Variant* and *Generative* are widely known CAPP approaches. What situation may *Variant* be more preferable than *Generative* and vice versa? Also give example.
4. (10 points) From the Opitz code in Figure 1 below, answer the following questions.
    a. (5 points) What type of this code? (mono or poly) Explain.
    b. (5 points) What is the Opitz code (first 5 digits) of this part in Figure 2?

DIGIT 1			DIGIT 2			DIGIT 3			DIGIT 4		DIGIT 5	
PART CLASS			External shape Elements			Internal Shape Elements			Plane Surface Machining		Auxiliary Holes and Gear Teeth	
0	Rotational Parts	L/D <=0.5	0	Smoothing Shape Elements		0	No Hole, No Break Through		0	No Surface Machining	0	No Auxiliary Holes
1		0.5<L/D<3	1	Stepped one end or Smooth	No Shape Elements	1	Smooth or Stepped on One End	No Shape Elements	1	Surface Plane/ Curved	1	Axial, Not on Pitch Circle Dia
2		L/D > 3	2		Thread	2		Thread	2	External Plane Surface, Circular Graduation	2	Axial on Pitch Circle Diameter
3			3		Groove	3		Groove	3	External Groove and/or Slot	3	Radial, Not on Pitch circle Dia
4			4	Stepped Both Ends	No Shape Elements	4	Stepped Both Ends	No Shape Elements	4	External Spline (Polygon)	4	Radial, on Pitch Circle Dia
5	Non rotational Parts		5		Thread	5		Thread	5	External Plane Surface/Slot Spline	5	Axial and/ Radial and/ other Direction
6			6		Groove	6		Groove	6	Internal Plane Surface or Slot	6	Spur Gear Teeth
7			7	Functional Cone		7	Functional Cone		7	Internal Spline (Polygon)	7	Bevel Gear Teeth
8			8	Operating Speed		8	Operating Speed		8	Internal or Slot/ External Polygon	8	Other Gear Teeth
9			9	All Others		9	All Others		9	All Others	9	All Others

Figure 1

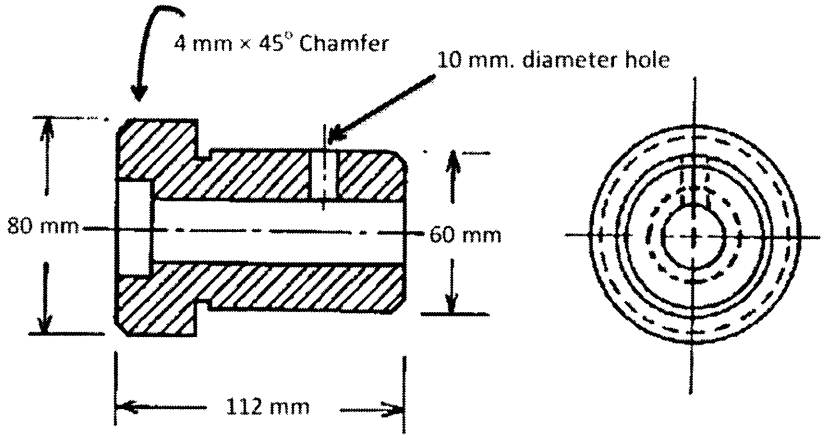


Figure 2

5. (5 points) What are the main components of a CNC machine and their functions?
6. (25 points) CNC problems
    a. (5 points) A CNC machine is commanded to move from A to B. If A is positioned at (5,3) and B is at (9,1), how many Basic Length Unit (BLU) needed to move from A to B if 1 BLU = 0.001 for both axes?
    b. (10 points) If a pitch of the leadscrew is 0.3 and one revolution of the stepping motor is driven by 1,200 electrical pulses, what is the machine resolution?
    c. (10 points) If you want to build a CNC machine with BLU = 0.0001 and a stepping motor is driven by 2,000 pulses per revolution, when there is 1:4 gear ratio between the motor and the leadscrew, what is a pitch of the leadscrew?
7. (20 points) In the following automated manufacturing line, determine suitable material handling equipment and unitizing equipment.
    a. Aluminum parts manufactured by this production line are changed every week. Parts' dimensions are no greater than 2x5x1 in. They need to go through 5 manufacturing stations. Production volume is 50,000 weekly. Product shipped in a package of 10 parts.
    b. It is a line of a steel product of moderate size (12x15x20 in approx.). A manufacturing line is designed specifically for this product. Production volume is 150 daily.
    c. From b, if the parts are as small as a tennis ball, and production volume is increased to be 2,000, do you insist on the same answer?
    d. A seafood processing line has a production capacity of 2 tons daily. Products are of limited types and only slight difference in processing details among them. Products are shipped in a package of 12 pieces.
8. (10 points) Design a furniture factory of the future. Explain roughly activities in each step of a product cycle starting from Need Forecast through Market.
9. (5 points) You have previously reviewed automated systems related to your thesis. Choose one of them and explain how it works.

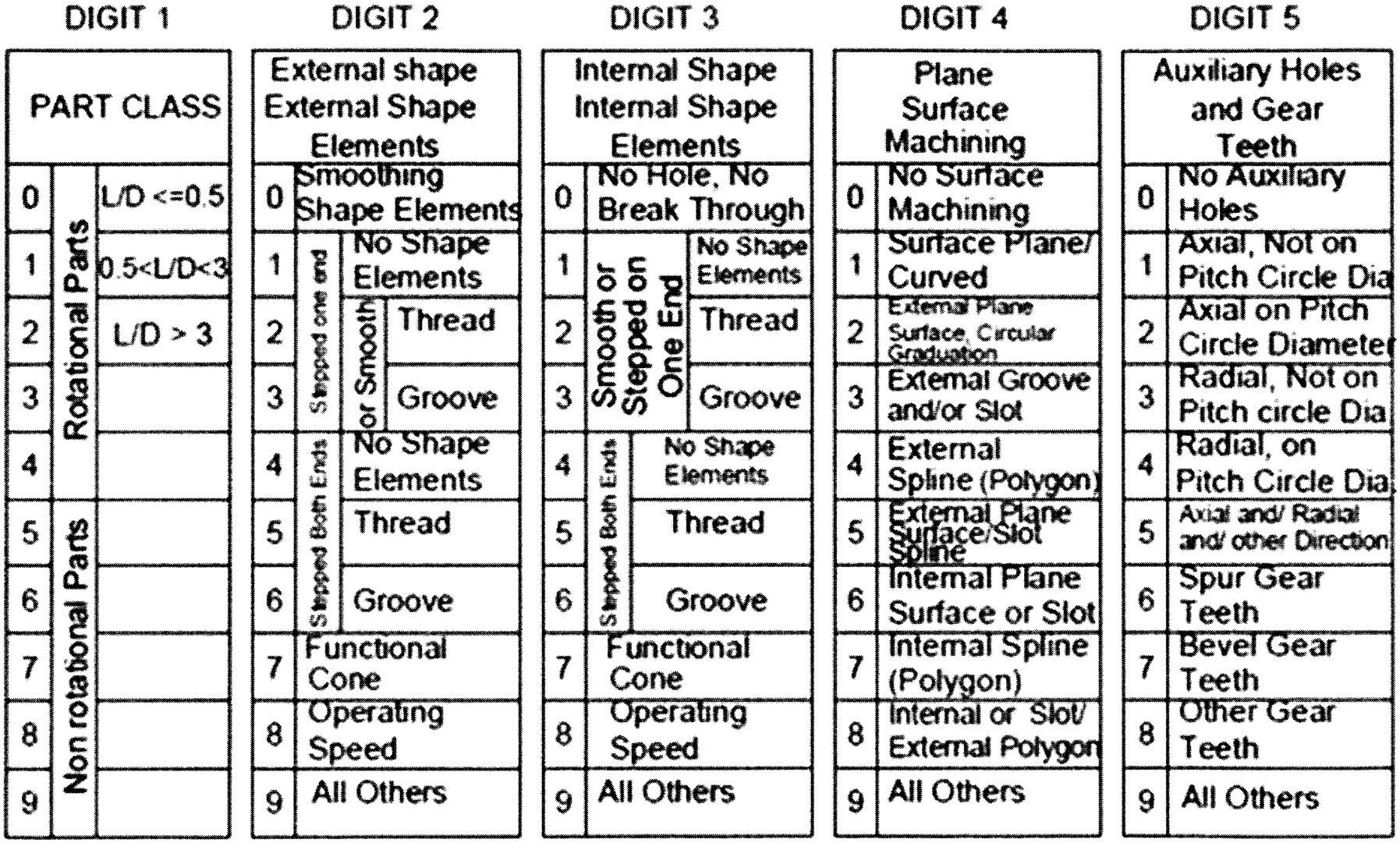
DIGIT 1		
PART CLASS		
0	Rotational Parts	L/D <=0.5
1		0.5<L/D<3
2		L/D > 3
3		
4		
5	Non rotational Parts	
6		
7		
8		
9		

DIGIT 2			
External shape External Shape Elements			
0	Smoothing Shape Elements		
1	Stepped one end	No Shape Elements	
2		Thread or Smooth	
3		Groove	
4	Stepped Both Ends	No Shape Elements	
5		Thread	
6		Groove	
7	Functional Cone		
8	Operating Speed		
9	All Others		

DIGIT 3		
Internal Shape Internal Shape Elements		
0	No Hole, No Break Through	
1	Smooth or Stepped on One End	No Shape Elements
2		Thread
3		Groove
4	Stepped Both Ends	No Shape Elements
5		Thread
6		Groove
7	Functional Cone	
8	Operating Speed	
9	All Others	

DIGIT 4	
Plane Surface Machining	
0	No Surface Machining
1	Surface Plane/ Curved
2	External Plane Surface, Circular Graduation
3	External Groove and/or Slot
4	External Spline (Polygon)
5	External Plane Surface/Slot Spline
6	Internal Plane Surface or Slot
7	Internal Spline (Polygon)
8	Internal or Slot/ External Polygon
9	All Others

DIGIT 5	
Auxiliary Holes and Gear Teeth	
0	No Auxiliary Holes
1	Axial, Not on Pitch Circle Dia
2	Axial on Pitch Circle Diameter
3	Radial, Not on Pitch circle Dia
4	Radial, on Pitch Circle Dia
5	Axial and/ Radial and/ other Direction
6	Spur Gear Teeth
7	Bevel Gear Teeth
8	Other Gear Teeth
9	All Others


DIGIT 1
PART CLASS
0
1
2
3
4
5
6
7
8
9
Rotational Parts
Non rotational Parts
L/D <=0.5
0.5<L/D<3
L/D > 3
DIGIT 2
External shape Elements
External Shape Elements
0 Smoothing Shape Elements
1 No Shape Elements
2 Thread
3 Groove
4 No Shape Elements
5 Thread
6 Groove
7 Functional Cone
8 Operating Speed
9 All Others
Stepped one end
or Smooth
Stepped Both Ends
DIGIT 3
Internal Shape Elements
Internal Shape Elements
0 No Hole, No Break Through
1 No Shape Elements
2 Thread
3 Groove
4 No Shape Elements
5 Thread
6 Groove
7 Functional Cone
8 Operating Speed
9 All Others
Smooth or Stepped on One End
Stepped Both Ends
DIGIT 4
Plane Surface Machining
0 No Surface Machining
1 Surface Plane/ Curved
2 External Plane Surface, Circular Graduation
3 External Groove and/or Slot
4 External Spline (Polygon)
5 External Plane Surface/Slot Spline
6 Internal Plane Surface or Slot
7 Internal Spline (Polygon)
8 Internal or Slot/ External Polygon
9 All Others
DIGIT 5
Auxiliary Holes and Gear Teeth
0 No Auxiliary Holes
1 Axial, Not on Pitch Circle Dia
2 Axial on Pitch Circle Diameter
3 Radial, Not on Pitch circle Dia
4 Radial, on Pitch Circle Dia
5 Axial and/ Radial and/ other Direction
6 Spur Gear Teeth
7 Bevel Gear Teeth
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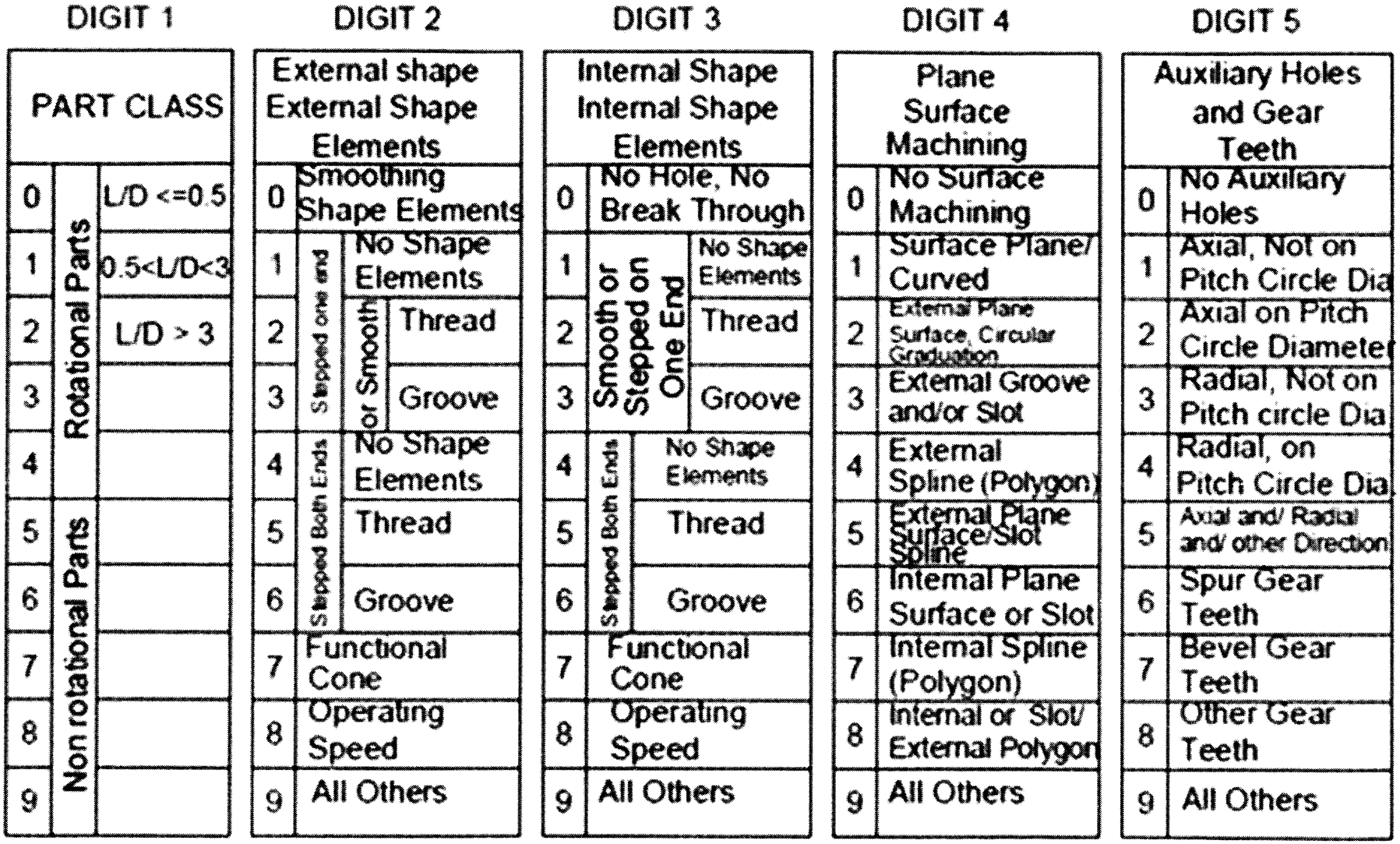
DIGIT 1
PART CLASS
0
1
2
3
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5
6
7
8
9
Rotational Parts
Non rotational Parts
L/D <=0.5
0.5<L/D<3
L/D > 3
DIGIT 2
External shape
External Shape
Elements
0 Smoothing Shape Elements
1 Stepped one end No Shape Elements
2 Stepped one end or Smooth Thread
3 Stepped one end or Smooth Groove
4 Stepped Both Ends No Shape Elements
5 Stepped Both Ends Thread
6 Stepped Both Ends Groove
7 Functional Cone
8 Operating Speed
9 All Others
DIGIT 3
Internal Shape
Internal Shape
Elements
0 No Hole, No Break Through
1 Smooth or Stepped on One End No Shape Elements
2 Smooth or Stepped on One End Thread
3 Smooth or Stepped on One End Groove
4 Stepped Both Ends No Shape Elements
5 Stepped Both Ends Thread
6 Stepped Both Ends Groove
7 Functional Cone
8 Operating Speed
9 All Others
DIGIT 4
Plane
Surface
Machining
0 No Surface Machining
1 Surface Plane/ Curved
2 External Plane Surface, Circular Graduation
3 External Groove and/or Slot
4 External Spline (Polygon)
5 External Plane Surface/Slot Spline
6 Internal Plane Surface or Slot
7 Internal Spline (Polygon)
8 Internal or Slot/ External Polygon
9 All Others
DIGIT 5
Auxiliary Holes
and Gear
Teeth
0 No Auxiliary Holes
1 Axial, Not on Pitch Circle Dia
2 Axial on Pitch Circle Diameter
3 Radial, Not on Pitch circle Dia
4 Radial, on Pitch Circle Dia
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6 Spur Gear Teeth
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DIGIT 1

		PART CLASS
0	Rotational Parts	L/D <=0.5
1		0.5<L/D<3
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3		
4		
5	Non rotational Parts	
6		
7		
8		
9		

DIGIT 2

			External shape External Shape Elements
0			Smoothing Shape Elements
1	Stepped one end		No Shape Elements
2		or Smooth	Thread
3			Groove
4	Stepped Both Ends		No Shape Elements
5			Thread
6			Groove
7			Functional Cone
8			Operating Speed
9			All Others

DIGIT 3

			Internal Shape Internal Shape Elements
0			No Hole, No Break Through
1	Smooth or Stepped on One End		No Shape Elements
2			Thread
3			Groove
4	Stepped Both Ends		No Shape Elements
5			Thread
6			Groove
7			Functional Cone
8			Operating Speed
9			All Others

DIGIT 4

	Plane Surface Machining
0	No Surface Machining
1	Surface Plane/ Curved
2	External Plane Surface, Circular Graduation
3	External Groove and/or Slot
4	External Spline (Polygon)
5	External Plane Surface/Slot Spline
6	Internal Plane Surface or Slot
7	Internal Spline (Polygon)
8	Internal or Slot/ External Polygon
9	All Others

DIGIT 5

	Auxiliary Holes and Gear Teeth
0	No Auxiliary Holes
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2	Axial on Pitch Circle Diameter
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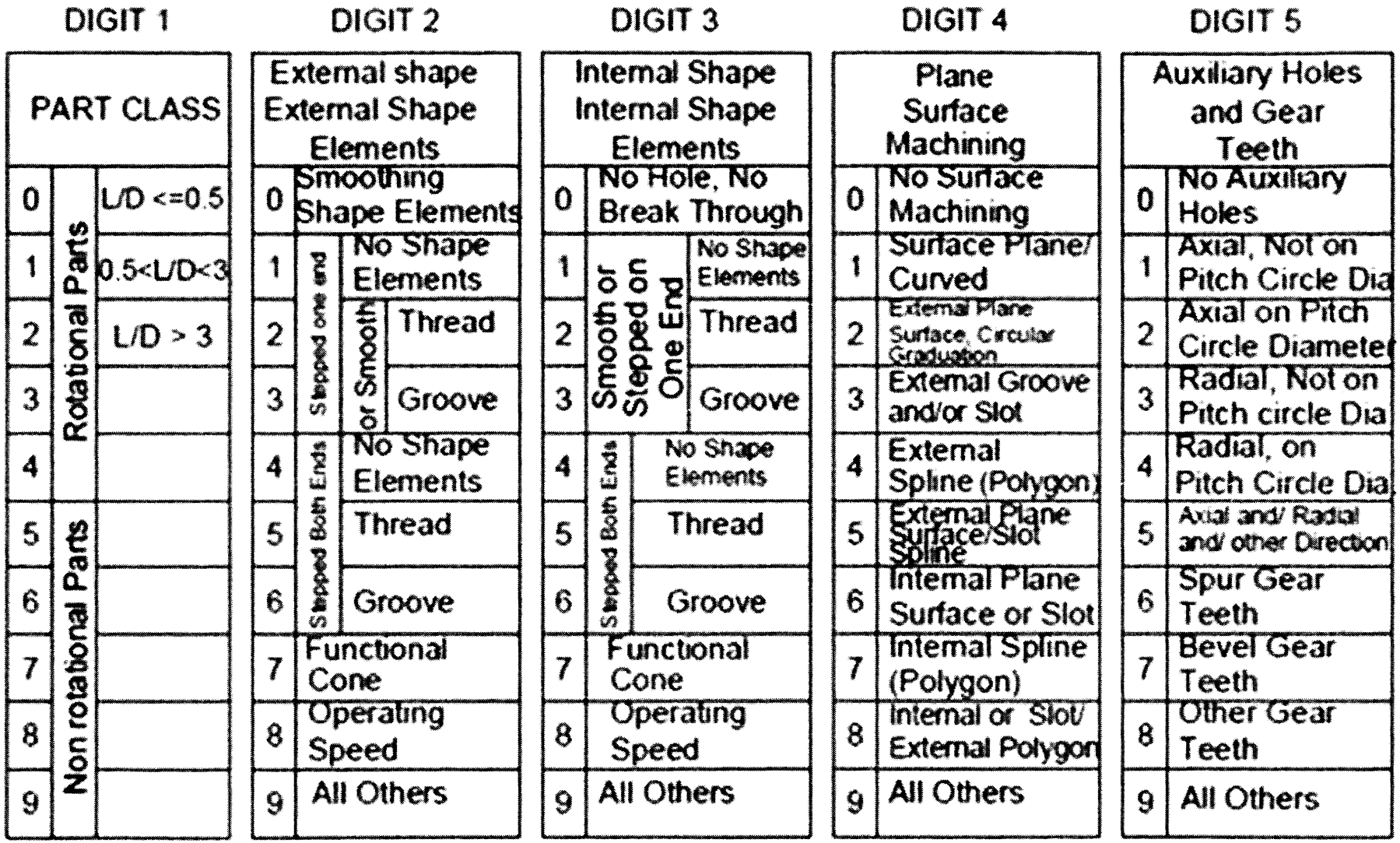
DIGIT 1
PART CLASS
0
1
2
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Rotational Parts
Non rotational Parts
L/D <=0.5
0.5<L/D<3
L/D > 3
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External shape
External Shape
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