2007 MEC603 ADVANCED METROLOGY AND COMPUTER AIDED INSPECTION FINALTEST

Max. Marks 50 **Time: 3 Hours**

1. The Friction Force on the rake face during metal cutting is given by the expression $F=C\sin\alpha+T\cos\alpha$, where C is the cutting force, T the thrust force and α the rake angle. C is 100N, with expanded uncertainty +/-5N at 99% confidence level. 10 readings of T were obtained as 51, 52, 49, 47, 48, 49, 48, 53, 49, 47. The rake angle is measured as 10^o using a special digital instrument with least count 1^o. C and T are correlated with coefficient 0.5. Determine the 95% expanded uncertainty in determination of Friction Force. Neglect the correlation in determining the degrees of freedom.

(12 marks)

2. How does the resolution of an instrument affect its uncertainty?

(2 marks)

3. The results of a straightness measurement are given as (0,5), (100,2), (200,6), (300,4), (400,10) where the first number is the distance along x axis in mm and the second number deviation from a horizontal reference line in microns. Determine straightness error based on the least squares reference line.

(4 marks)

4. What is the Abbott Firestone curve? What is its importance?

(3 marks)

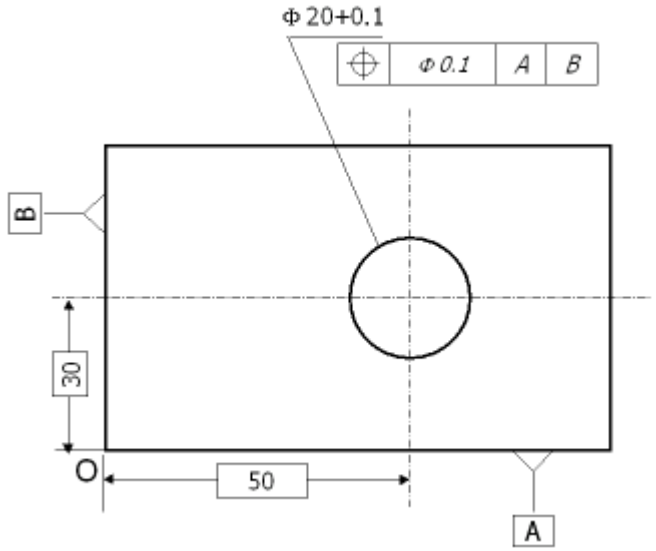
5. Compare the three methods of programming CMMs.

(3 marks)

6. How many points would you recommend to sample using a CMM to measure a circle of dia 30mm? Why?

(2 marks)

7. The drawing of a component is given below.



The coordinates of the centre of the produced hole were 30.07 from A and 50.09 from B. Is the position of the hole acceptable as per drawing? Exlain why or why not.

(2 marks)

8. Sketch the four methods of illumination for acquiring an image for machine vision applications.

(4 marks)

9. Explain the two strategies for compressing files.

(4 marks)

PTO

10. Define 4, 8 and m connectivity. For V={6,8} in the image below, identify whether a) p & q b) p & r are m connected. Why?

	9	q =8
8	p =6	5
r =7		

(4 marks)

11. Determine the results of operation of the Laplacian filter mask

0	1	0
1	-4	1
0	1	0

on the image

3	4	0	0
4	3	1	1
0	1	0	0
0	1	0	0

. Limit excursions of the mask upto the border.

(4 marks)

12. Sketch the object represented by the 4-directional shape number 101133110100.

(4 marks)

13. How do you recognize objects using minimum distance classifiers?

(4 marks)

14. a) Give one good point about this course b) Give one suggestion which you think will best improve this course.

SOLUTIONS TO NUMERICALS:

51	52	49	47	48	49	48	53	49	47
Average	49.3								
SD	2.057507								

$C_C = \sin \alpha = 0.173648$
$C_T = \cos \alpha = 0.984808$
$C\alpha = (C \cos \alpha - T \sin \alpha) * \pi/180 = 1.569399$

uC	1.937984	
uT	0.650641	
ualpha	0.288675	
uC(F)	0.336527	0.113251
uT(F)	0.640756	0.410568
ua(F)	0.453046	0.205251
uCT(F)		0.215632

Numerical approoach

	C+	C-	T+	T-	alpha+	alpha-		
	101.938	98.06202	100	100	100	100		
	49.3	49.3	49.95064	48.64936	49.3	49.3		
	10	10	10	10	10.28868	9.711325		
	0.173648	0.173648	0.173648	0.173648	0.178608	0.168684		
	0.984808	0.984808	0.984808	0.984808	0.98392	0.98567		
	66.25237	65.57931	66.5566	65.27508	66.36805	65.46196		
uC(F)	0.336527	uT(F)	0.640756	ua(F)	0.453044			0.5
	0.113251		0.410568		0.205249	uCT(F)		0.215632
ucomb(F)	0.971957							
dof	inf		9		inf			
			0.01873					
		dofc	47.64966					
		t	2.04227					
		U	1.984999					
		F+	67.90084	F-	64.94388			

3.

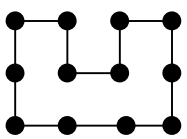
x	y	ypred	e
0	5	3	2
100	2	4.2	-2.2
200	6	5.4	0.6
300	4	6.6	-2.6
400	10	7.8	2.2
			2.2
			-2.6
		St error	4.8

7.
Distance from centre of actual hole to ideal position of hole = 0.114018, hence not acceptable

10. a) Yes b) No

11.

-2	0
0	2

12. 

PTO