

2008 MEC603 ADVANCED METROLOGY AND COMPUTER AIDED INSPECTION TEST II

Max. Marks: 20

Time: 60 minutes

1. A Company exports radiator caps. The effective diameter of its thread is specified as 30 ± 0.40 mm. The measured value for one cap was 29.68 mm with expanded uncertainty ± 0.10 mm. Can the Company accept the cap? Consider guard bands of 100% and 50%, and explain your result. (2 marks)
2. What is the necessity of a displacement transducer in a CMM? What are the common types of transducers used in CMMs? (2 marks)
3. While measuring with a CMM, sometimes measurement in two setups can be better than measurement in a single setup. Explain with an example. (2 marks)
4. What are Taylor's principles of Limit Gauging? (2 marks)
5. What is the problem with the shape of the position tolerance zone in conventional tolerancing vis-à-vis geometrical tolerancing? (2 marks)
6. The results of a straightness measurement are as follows:

x (mm)	100	200	300	400	500	600	700
y (mm)	4	7	5	6	9	9	6

Determine the straightness error with respect to the line $y = 5.5 + 0.005x$.

(2 marks)

7. The deviations of a shaft from an ideal circle, measured at various angles, are given below. Determine the centre and radius of the Least Squares Circle.

θ (degrees)	0	30	60	90	120	150	180	210	240	270	300	330
r (μ m)	1	5	8	0	4	2	0	1	6	4	3	1

(2 marks)

8. What are the types of datums used in stylus type surface roughness measuring instruments? Explain. (2 marks)
9. Define and explain Rsm with the help of a sketch. (2 marks)
10. What do you mean by the Abbott Firestone curve? What is its importance? (2 marks)
11. Determine the lag 1 autocorrelation for the series 1, 3, 5, 7, 5, 3, 1 (2 marks)

SOLUTIONS TO NUMERICALS:

1. Export, cheap component; hence stringent acceptance. 100% Guardband: Reject. 50% Guardband: Accept

6.

x	y	ycap	e
100	4	6	-2
200	7	6.5	0.5
300	5	7	-2
400	6	7.5	-1.5
500	9	8	1
600	9	8.5	0.5
700	6	9	-3
	emax	1	
	emin	-2	
	St error	3	

7.

θ	R	theta (rad)	R cos q	R sin q
0	1	0.0000	1.0000	0.0000
30	5	0.5236	4.3301	2.5000
60	8	1.0472	4.0000	6.9282
90	0	1.5708	0.0000	0.0000
120	4	2.0944	-2.0000	3.4641
150	2	2.6180	-1.7321	1.0000
180	0	3.1416	0.0000	0.0000
210	1	3.6652	-0.8660	-0.5000
240	6	4.1888	-3.0000	-5.1962
270	4	4.7124	0.0000	-4.0000
300	3	5.2360	1.5000	-2.5981
330	1	5.7596	0.8660	-0.5000

$r_0 = 2.9166\mu\text{m}$, $x_0 = 0.68301\mu\text{m}$, $y_0 = 0.18301\mu\text{m}$

11.

x_i	x_{i+1}	$x_i - \bar{x}$	$x_{i+1} - \bar{x}$	$(x_i - \bar{x})(x_{i+1} - \bar{x})$
1	3	-3	-1	3
3	5	-1	1	-1
5	7	1	3	3
7	5	3	1	3
5	3	1	-1	-1
3	1	-1	-3	3
$\bar{x} = 4$	$\bar{x}_{i+1} = 4$			10
			Cov	2
			sd(x_i)	2.09761
			sd(x_{i+1})	2.09761
			Correl	0.45454