

Name:.....

Roll No.:.....

NATIONAL INSTITUTE OF TECHNOLOGY CALICUT
Department of Mechanical Engineering
End Semester Examination, Nov-Dec 2009
I Semester M.Tech. – Manufacturing Technology

MEC603 ADVANCED METROLOGY AND COMPUTER AIDED INSPECTION

Time: Three hours

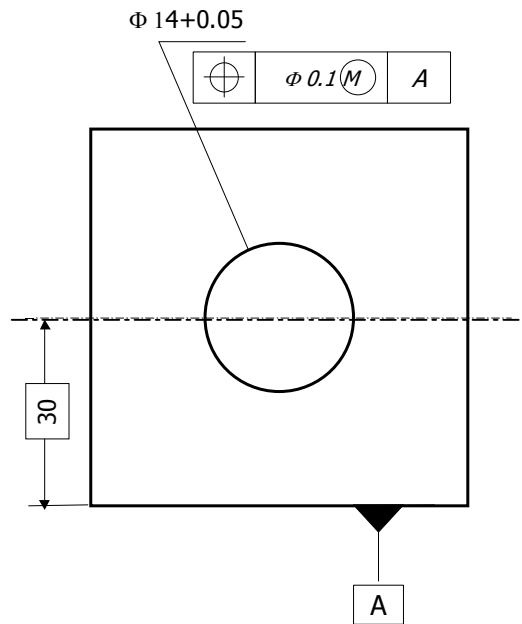
Maximum Marks: 50

1. Differentiate between 'Measurement Accuracy' and 'Measurement Trueness'. (2 marks)
2. The time period P of a pendulum is given as $P = 2\pi\sqrt{L/g}$, where L is the length of the pendulum and g the acceleration due to gravity. The length was measured as $L = T - B/2$, where T is the total length from the point of oscillation to the bottom of the bob and B the diameter of the bob. Six measurements of T were 1.02, 1.04, 1.06, 1.05, 1.05 and 1.02 m, while four measurements of B were obtained using the same scale as 0.04, 0.05, 0.06 and 0.05 m, leading to their being correlated with a coefficient of 0.6. The value of g was obtained from a handbook as 9.6 m/s^2 , with the error not exceeding 0.1 m/s^2 . Determine the time period of the pendulum and its combined standard uncertainty. (12 marks)
3. Determine the effective degrees of freedom in calculating the length L of the pendulum in the above problem. Neglect the contribution of the correlated component. (4 marks)
4. Explain the differences between CCD and CMOS sensors. (2 marks)
5. Explain the process used in jpeg compression. (2 marks)
6. Determine the result of median filtering with a 3X3 mask on the image $\begin{bmatrix} 1 & 2 & 1 & 2 \\ 2 & 7 & 4 & 5 \\ 1 & 4 & 5 & 4 \\ 2 & 5 & 4 & 3 \end{bmatrix}$ limiting excursions of the mask till the border. (2 marks)
7. Explain the region growing method of segmentation. (2 marks)
8. Sketch the signature of a square of side 50mm. (2 marks)
9. Explain the method of recognition by syntactic recognition of trees. (2 marks)
10. What is 'lay'? What is its importance in surface finish measurement? (2 marks)
11. Determine Rsm for the data given below. Graph sheet will be provided if necessary.

x (mm)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y (μm)	0	2	-3	2	-6	4	-3	4	-1	-4	1

 (4 marks)
12. Explain the concept of fractals and how it can be used in surface finish measurement. (2 marks)
13. What is 'cut off'? What is its importance in surface finish measurement? (2 marks)
14. What are Taylor's principles of gauging? (2 marks)
15. Explain how datum precedence can affect measurement, with an example. (2 marks)
16. Sketch the symbol for total runout and explain how it is measured. (2 marks)

17. Four points were measured on the section of a circular shaft as (100,50), (50,90), (0,50), and (50,10). Determine the centre and radius of the Minimum Circumscribing Circle by inspection. (2 marks)
18. Sketch and label the different parts of the probing system of a CMM (2 marks)
19. What is the necessity of stylus qualification in a CMM? (2 marks)
20. What is the possible danger in uniform sampling of a flat surface with a CMM? (2 marks)
21. The drawing of a component is given below. If the diameter of the hole was 14.04 mm and its distance from A 30.13mm, is the component acceptable? Why or why not? (2 marks)



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

SOLUTIONS TO NUMERICALS:

2.

		u	T+	T-	B+	B-		g+	g-
T	1.04	0.006831	1.046831	1.033168	1.04	1.04		1.04	1.04
B	0.05	0.004082	0.05	0.05	0.054082	0.045917		0.05	0.05
g	9.6	0.057735	9.6	9.6	9.6	9.6		9.657735	9.542264
P	2.043041		2.049905	2.036155	2.040986	2.045095	0.6	2.036926	2.049213
			uT(P)	0.006875	uB(P)	-0.002054		ug(P)	-0.006143
				4.726E-05		4.220E-06	-1.69E-05		3.774E-05

uc = 0.00850202 s

$$P = 2\pi \sqrt{\frac{T - B/2}{g}}$$

$$c_T = \frac{\pi}{\sqrt{g(T - B/2)}} = 1.00642458$$

$$c_B = \frac{-\pi}{2\sqrt{g(T - B/2)}} = -0.50321229$$

$$c_g = -\frac{\pi \sqrt{T - B/2}}{\sqrt{g^3}} = -0.106408432$$

3. Neglecting uncertainty contribution due to the correlated component,

		T+	T-	B+	B-
T	1.04	1.046831	1.033168699	1.04	1.04
B	0.05	0.05	0.05	0.054082483	0.045917517
L	1.015	1.021831	1.008168699	1.012958759	1.017041241
		uT(L)	0.006831301	uB(L)	-0.002041241
		uc(L)	0.00712975		

		dof	
L	1.015		
uT(L)	0.006831301		
uT(L)^4	2.17778E-09	5	4.35556E-10
uB(L)	-0.002041241		
uB(L)^4	1.73611E-11	3	5.78704E-12
uc(L)	0.00712975		
uc(L)^4	2.58403E-09	5.854925	~5 (round down)

4.

2	4
4	4

11.

Upward crossings	Spacing
0	
0.26	0.26
0.46	0.2
0.64	0.18
0.98	0.34
Average	0.245

17.

Centre (50, 50), Radius 50

21.

Since the hole is +0.04, tolerance on distance gets increased to +0.09, hence still rejected.