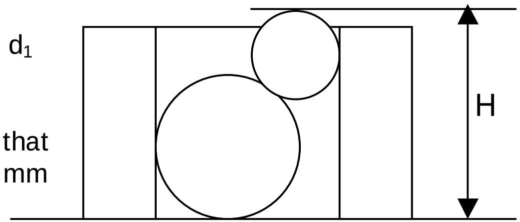
2013 ME3112 Metrology And Instrumentation – Test 2

Max. Marks: 20 Approved tables are permitted Time: 60 minutes

All questions carry 2 marks each unless otherwise mentioned

1. The inner diameter of a ring D was determined by measuring the height H over two balls, as shown. The diameter of the bigger ball d_1 was measured as 30.34 mm using a digital vernier caliper of least count 0.02 mm and repated measurements did not show any difference. The small ball has a calibration certificate which states that its diameter d_2 is 19.96 mm with an expanded uncertainty of 0.02 mm at a 99% confidence level. The height H was measured five times and the readings obtained as 45.1, 45.3, 45.25, 45.215 and 45.22. Determine the diameter of the ring and its 99% expanded uncertainty.



(1.5+3+1.5=6 marks)

2. The length and breadth of a rectangular ground was measured using a tape and found as 10.0 m and 5.0 m. The standard uncertainty in the measurement of each length is triangularly distributed between +/-0.05 m. Since the same tape was used for length measurements, they have a correlation of 0.6. Calculate the perimeter of the ground and its combined standard uncertainty.

(0.5+1.0+1.0+0.5=3 marks)

3. Explain the effect of the cut-off value selected on the value of Ra calulated from a profile.
4. Determine Ra for the data:from a surface profilometer, neglecting slope of the mean line.

x (mm)	0	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8
y' (μm)	4	1	2	6	1	5	1	7	5	3	1	2	5	3	2

5. Explain with a neat sketch, how a sine bar can be used to measure angles.
6. What is ITS-90? Explain its necessity and use.
7. Sketch the construction of a platinum RTD and explain its working.
8. Describe the working of a total radiation pyrometer with a neat sketch.

SOLUTIONS TO NUMERICALS:

$$D = \left(\frac{d_1 + d_2}{2}\right) + \sqrt{2\left(\frac{d_1 + d_2}{2}\right)H - H^2}$$

$$\frac{\partial D}{\partial d_1} = \frac{1}{2} + \frac{H}{2\sqrt{2\left(\frac{d_1 + d_2}{2}\right)H - H^2}}$$

$$\frac{\partial D}{\partial d_2} = \frac{1}{2} + \frac{H}{2\sqrt{2\left(\frac{d_1 + d_2}{2}\right)H - H^2}}$$

$$\frac{\partial D}{\partial H} = \frac{\left(\frac{d_1 + d_2}{2}\right) - H}{\sqrt{2\left(\frac{d_1 + d_2}{2}\right)H - H^2}}$$