

MEV214 Metrology and Computer Aided Inspection – Test 1, Feb 2009

Max. Marks: 20

Time: 50 minutes

All questions carry 2 marks each unless mentioned otherwise.

1. Define and differentiate between "True quantity value" and "Conventional quantity value".
2. An old clock has stopped working at 10:15 AM. Discuss its precision and accuracy.
3. The resistance of a coil R in Ω depends upon temperature T °C according to the relationship $R=100[1+0.004(T-20)+0.00002(T-20)^2]$. Determine the sensitivity of resistance to temperature at 40°C.
4. A pressure of 4.0 MPa was applied to a pressure gauge of range 0-5 MPa. The reading of the gauge was 4.2 MPa when the pressure was increased and 4.4 MPa when the pressure was decreased. Determine the hysteresis error at the measured pressure as a percentage of the full scale output.
5. Discuss the evolution in the definition of the SI unit of time.
6. Explain the difference between repetition and replication with an example.
7. The average strength of a material was calculated from 50 samples as 250 MPa with standard deviation 12 MPa. Determine a 99% expanded uncertainty interval for the strength.
8. An LVDT based height measuring device was calibrated using slip gauges with data as given below. Determine the least squares calibration equation and the standard uncertainty of the y intercept.

Slip gauge reading x	0	6	12	18	12	0	18	6
Device reading y	-9.92	-5.94	1.81	7.59	1.62	-9.86	7.73	-5.82

(4 marks)

9. A generator when subjected to a pure resistive load develops 1.5 kW with standard uncertainty 50 W at 230 V with standard uncertainty 5 V. Determine the current through the load and its standard uncertainty.

(4 marks)

SOLUTIONS TO NUMERICAL PROBLEMS:

3.

$$R=100[1+0.004(T-20)+0.00002(T-20)^2]$$

$$dR/dT = 0.4 + 0.004(T-20)$$

When T= 40, dR/dT = 0.48 Ω/°C

4.

FS	5
eh	<u>0.2</u>
%eh	<u><u>4</u></u>

7.

xbar	250
s	12
n	50
U	1.697056
<u>245.6216</u>	<u>254.3784</u>

8.

x	y	ycap	e
0	-9.92	-10.6355	0.7155
6	-5.94	-4.611	-1.329
12	1.81	1.4135	0.3965
18	7.59	7.438	0.152
12	1.62	1.4135	0.2065
0	-9.86	-10.6355	0.7755
18	7.73	7.438	0.292
6	-5.82	-4.611	-1.209
-10.6355	1.004083	MSE	0.774914
Sigma xsq	1008		
Sigma x	72	xbar	9
CSxx	360		
se(Intcpt)	<u><u>0.520788</u></u>		

9.

$$I = \frac{P}{V} = 6.52 A$$

$$c_P = \frac{1}{V} = \frac{1}{230} = 0.004348; \quad c_V = \frac{-P}{V^2} = \frac{-1500}{230^2} = -0.02836$$

cP	0.004348	50	0.217391
cV	-0.028355	5	<u>-0.141777</u>
			<u><u>0.259537</u></u>

Numerical approach:

		u	P+	P-	V+	V-
P	1500	50	1550	1450	1500	1500
V	230	5	230	230	235	225
I	6.521739		6.73913	6.304348	6.382979	6.666667
			uP	0.217391	uV	-0.14184
			uc	<u><u>0.259574</u></u>		