2006 Advanced Metrology and Computer Aided Inspection – Test 1

Max. Marks: 20 Time: 60 minutes

1. Define and distinguish between standard uncertainty and expanded uncertainty.

(2 marks)

2. During calibration of a pressure gauge, the following results were obtained:

Sl No	Standard pressure (bar)	Observed reading (bar)
1	50	51
2	150	155
3	100	103
4	150	152
5	100	104
6	50	52

Estimate the correct pressure and its expanded uncertainty if a reading of 91 bar is observed.

(10 marks)

3. A rope and pulley arrangement is used to measure the torque developed by an engine. The tensions on two sides of the pulley are 5.8N and 0.5N, when measured using spring balances with a calibration uncertainty of 0.15N(99%). The two readings are expected to have a positive correlation of 0.6. The pulley radius was measured as 49mm using a digital vernier of least count 0.1mm. Determine the torque developed and its expanded uncertainty.

(8 marks)

SOLUTION TO NUMERICAL PROBLEMS:

2.

x	y	xy	x^2	ycap	e
50	51	2550	2500	51.83333	-0.833333
150	155	23250	22500	153.8333	1.166667
100	103	10300	10000	102.8333	0.166667
150	152	22800	22500	153.8333	-1.833333
100	104	10400	10000	102.8333	1.166667
50	52	2600	2500	51.83333	0.166667
600	617	71900	70000		6.833333

Intercept	0.833333		MSE	1.708333
Slope	1.02		u(y)	1.307032
			u(x)	1.281404
91	88.39869		t	2.776451
	91.95645	bar	U(x)	3.557756
	84.84094	bar		

3.

Torque, T=(H-L)*R, where H is the High force, L the low force and R the radius.

$c_H = R \quad c_L = -R \quad c_R = (H - L)$

H	5.8	u(H)	0.05814	cH	49	uH(T)	2.848837
L	0.5	u(L)	0.05814	cL	-49	uL(T)	-2.848837
R	49	u(R	0.028868	cR	5.3	uR(T)	0.152998
T	259.7					uHL(T)	-9.739048
						u(T)	2.552667

OR Numerically,

	5.85814	5.74186		5.8	5.8		5.8	5.8		
	0.5	0.5		0.55814	0.44186		0.5	0.5		
	49	49		49	49		49.02887	48.97113		
	262.5488	256.8512		256.8512	262.5488		259.853	259.547		
uH(T)	2.848837		uL(T)	-2.84884		uR(T)	0.152998			
	8.115873			8.115873			0.023408		r*uH*uL	-9.73905
u(T)	2.552667									

U(T)	5.003227	
T+U	264.7032	Nmm
T-U	254.6968	Nmm