



Prince of Songkla University

Faculty of Engineering

Midterm Examination, 2nd Semester

Academic year 2007

Exam. date : December 30, 2007

Time 9:00-12:00

215-611 Theory of Engineering Experimentation

Room A200

Instructions

1. Write the answers on this examination sheet. (6 problems and 7 pages excluding the front page)
2. The necessarily information, which were not specified, could be found in the text books, study materials or lecture notes. Otherwise, it should be assumed properly.
3. Books, lecture notes and calculator are not restriction.

Thanansak Theppaya

Instructor

Problem	Point	Score
1	10	
2	15	
3	10	
4	15	
5	10	
6	10	
Total	70 (35%)	

NameStd. ID.

1. What is meant by sensitivity, accuracy, precision, error and types of errors and uncertainty?
Explain comprehensively.

NameStd. ID.

2. What are necessary considerations in experimental design by the way of systematically scientific research? Also give an example related with your thesis topic.

NameStd. ID.

3. A pneumatic displacement gage like the one shown in figure below has $d_1 = 0.030$ in and $l_2 = 0.062$ in. The supply pressure is 10.0 psig, and the differential pressure $p_2 - p_a$ is measured with a water manometer which may be read with an uncertainty of 0.05 inH₂O. Calculate the displacement range for which equation, $r = \frac{p_2 - p_a}{p_1 - p_a} = 1.10 - 2.00 \left(\frac{d_2}{d_1} \right) x$ for $0.4 < r < 0.9$, applies and the uncertainty in this measurement, assuming that the supply pressure remains constant. Also explain in the results of calculation.

NameStd. ID.

4. A guarded hot-plate apparatus is used to measure the thermal conductivity of a metal having $k = 50 \text{ Btu/h.ft.}^\circ\text{F}$. The thickness of the specimen is $0.125 \pm 0.002 \text{ in}$, and the heat flux may be measured within 1 percent. Calculate the accuracy necessary on the ΔT measurement in order to ensure an overall uncertainty in the measurement of k of 5 percent. If one of the plate temperatures is nominally 300°F , calculate the nominal value of the other plate temperature and tolerable uncertainty in each temperature measurement, assuming a nominal heat flux of 20000 Btu/ft^2 .

$$(q = -kA \left[\frac{dT}{dx} \right])$$

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5. The length of a production part is sampled twice with the following results :

Sample 1 : $\bar{x}_{m1} = 3.632$ cm, $\sigma_1 = 0.06$ cm, $n_1 = 17$

Sample 2 : $\bar{x}_{m2} = 3.611$ cm, $\sigma_2 = 0.02$ cm, $n_2 = 24$

Examine these data to determine if they yield the same results with a confidence level of 90 percent. And determine the new sample size of production part sample 1 for the mean length measure will be ± 0.04 cm with 5 percent of significance level.

NameStd. ID.

6. How can statistical analysis be used to determine the number of measurements needed for a required level of confidence? How to check the validity of various distributions of statistical data?