

Kafrelsheikh University

Faculty of Engineering

Dept. of Mechanical Eng.

2nd Year (Curr. 2007)



Measurements (MEP2208)

قياسات

Date: 24 May, 2016

Time allowed: 3 hrs.

Full mark: 75

Final Exam: 3 Pages

أجب عن الاسئلة الآتية:

السؤال الأول: (١٥ درجة)

أ- ما المقصود بكل من: الدقة Accuracy - الحساسية الاستاتيكية Static Sensitivity - التخلفية Hysteresis - التمييز Resolution - الفترة الميتة Dead Time ؟

(b) A mercury thermometer has a capillary tube of 0.3 mm diameter and a sensitivity of 3 mm/°C. The thermometer time constant is 0.9 min. Assume that the bulb is made of zero-expansion material and the coefficient of volumetric thermal expansion for mercury = 1.8×10^{-4} /°C. If the operating temperature is 20°C, determine:

- the volume of the bulb.
- If the thermometer is suddenly subjected to a boiling water bath having a temperature of 100°C, what temperature will be indicated after 30 s?

السؤال الثاني: (١٢ درجة)

أ- ضع علامة صح امام العبارة الصحيحة وعلامة خطأ امام العبارة الخاطئة مع تصويب الخطأ

- المحولات الفعالة تحتاج لمصدر طاقة خارجي لاجراء عملية القياس او تحويل اشارة القياس.
- الضبطية Precision هي اقل تغير في القيمة الداخلة لجهاز القياس يمكن قياسها.
- المانومتر ذو الأنبوب المائل أقل حساسية من المانومتر حرف U.
- يمكن استخدام العناصر المرنة في قياس الضغوط القياسية و ضغوط التفريغ.
- يستخدم التوصيل على التوازي للإزدواج الحرارى لقياس درجات الحرارة المنخفضة نسبياً.

(b) The output power of a rotating shaft is measured by a dynamometer. The relationship for the output power is $P = \frac{2 \times \pi \times 9.81 \times FLR}{t \times 10^6}$ kW, where: F is the force at the end of the torque arm [kgf], L is the length of the torque arm [mm], R is the number of revolutions during time t , t is the time for test run [s]. The test data are:

$$F = 4.58 \pm 0.02 \text{ kgf}, L = 397 \pm 1.3 \text{ mm}, R = 1202 \pm 1.0 \text{ rev}, t = 60 \pm 0.5 \text{ s}$$

These errors are limiting (absolute) errors. **Determine** the magnitude of the output power and the limiting error (relative and absolute) in the computed power.

السؤال الثالث: (١٨ درجة)

١- اشرح مع الرسم طريقتان لتصحيح المدخلات الغير مرغوبة.

(b) A manometer inclined at an angle of 20° with the horizontal employs a fluid having a specific gravity of 0.82 and is used to measure a differential pressure of 5 cm H₂O. What displacement of fluid along the length of the manometer tube will be registered?

(c) A rotameter has an internal diameter of 15 mm at the bottom of its range. The float has a specific gravity of 2.6. It has a volume of 550 mm³, an effective diameter of 10 mm, and a vertical movement of 200 mm. The angle of taper of the tube is 5° . Assume coefficient of drag as unity.

- Derive an expression for average velocity of the fluid at the annulus area around float.
- Estimate the range of flow which can be measured using a liquid of specific gravity of 0.8.

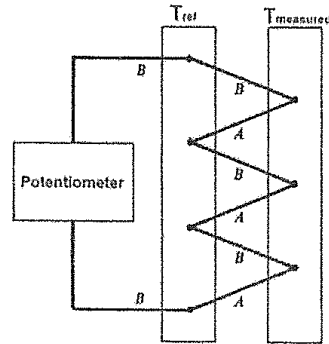
السؤال الرابع: (١٥ درجة)

١- اشرح مستعيناً بالرسم نظرية عمل وتركيب أجهزة القياس التالية:

- مقياس مكلود McLeod Gauge
- بيرومتر فيري للإشعاع الكلي Fery Total Radiation Pyrometer
- الأنيمومتر ذو السلك الساخن (بنوعيه) Hot Wire Anemometer

(b) A thermopile arrangement of copper-constantan thermocouple consists of three junction pairs and has the reference junction at 0°C . The output voltage of the potentiometer is 10.8 mV. And, the relation between temperature and volt for T - type thermocouple is as follows:-

Temp, °C	0	100	200
Volt, mV	0	4.22	9.23



Determine the temperature measured by the thermopile detecting junction.

السؤال الخامس: (١٥ درجات)

أ- أشرح موضحا بالرسم نظرية عمل مقياس معدل السريان باستخدام الموجات فوق الصوتية، وأذكر مميزاته.

(b) An orifice meter (figure Q 5.b) is to be calibrated for the measurement of the flow rate of a stream of liquid acetone. The differential manometer fluid has a specific gravity of 1.10. The calibration is accomplished by connecting the orifice meter in series with a rotameter that has previously been calibrated for acetone, adjusting a valve to set the flow rate, and recording the flow rate (determined from the rotameter reading) and the differential manometer reading, h . The procedure is repeated for several valve settings to generate an orifice meter calibration curve of flow rate versus h . The following data are taken.

Manometer Reading h (mm)	Flow Rate Q (mL/s)
0	0
5	62
10	87
15	107
20	123
25	138
30	151

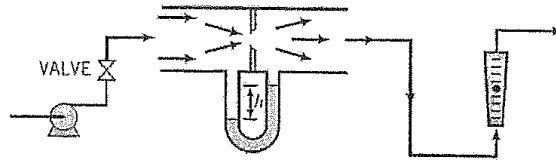


Figure Q 5.b

- State the design considerations for:
 - proper orifice-meter installation.
 - pressure tapping location and sizing.
- For each of the given readings, calculate the pressure drop ΔP across the orifice, (mm Hg).
- The flow rate through an orifice should be related to the pressure drop across the orifice by the formula:

$$Q = k \Delta P^n$$

Verify graphically that the given orifice calibration data are correlated by this relationship, and determine the values of k and n that best fit the data.

مع أطيب التمنيات بالنجاح والتوفيق.....

د/ محمد أسامة السمدوني

محمد أسامة السمدوني