



Notes: a) Exam in two parts

b) Answer each part in separate section

### Part one

#### Question (1)

(20 Marks)

- 1.1 Explain how can wind speed be measured by Eolian method? (1 Marks)  
1.2 Explain with sketch the Propeller-type anemometer? (3 Marks)  
1.3 How can laser anemometer be used for measuring wind speed? (3 Marks)  
1.4 How can pressure tube anemometer be used for measuring wind speed? (3 Marks)  
1.5 Explain with sketch how can the rotational movement of wind vane be transformed to digital output? (3 Marks)  
1.6 What is the main field of application of hot wire anemometer and why? (2 Marks)  
1.7 A pressure tube anemometer contains five perpendicular pairs of tubes. The pressure difference for each pair is recorded as follows:

Pair number	1	2	3	4	5
Pressure difference, $N/m^2$	22	18	27	30	13

- a) Which pair is in correct position and why?  
b) Find the wind speed in location at this moment.  
You can make any suitable assumptions for the missed data.

(5 Marks)

#### Question (2)

(30 Marks)

- 2.1 Drive an expression to determine the volume of gas required in the bulb of a gas filled system thermometers related to the lowest and highest temperature and pressure on the scale? (5 Marks)  
2.2 Explain why is the scale in liquid vapour filled system thermometers has wider graduations at higher temperatures and is cramped at the lower temperatures? (3 Marks)  
2.3 Explain with sketch how can platinum resistance thermometer be constructed? (4 Marks)  
2.4 Show with sketch how can temperature difference between two points be measured by using series connection of thermocouples? (4 Marks)  
2.5 Explain with sketch the components and the operation of disappearing filament optical type pyrometer? (4 Marks)  
2.6 When is it necessary to use pyrometers for temperature measurement? What are their main types? (2 Marks)  
2.7 A bimetallic strip element has one end fixed and other free, with the length of cantilever being 40 mm. The thickness of each metal is 1 mm, and the element is initially straight at 20°C. Calculate the radius of curvature when the temperature is raised to 180°C. One of the metals is Invar with a negligible thermal expansion coefficient while the second is a nickel chrome alloy with an expansion coefficient of  $12.5 \times 10^{-6}/^{\circ}C$ . (8 Marks)

End of part one, with best wishes

Dr. A. A. El-Haroun

## Part two

### Question (3)

**(20 Marks)**

- 3.1. What are the advantages of electrical transducers? (3 Marks)
- 3.2. Mention and explain 6 factors influencing the choice of a transducer for measurement of a physical quantity. (3 Marks)
- 3.3. Explain in details, the operational theory, wire characteristics, and advantages of Bridgman gauge. (6 Marks)
- 3.4. How can the tube transmitting signal to the transducer affect the dynamic response of a pressure measuring system? (5 Marks)
- 3.5. What is meant by correlation coefficient? What is its importance? (3 Marks)

### Question (4)

**(30 Marks)**

- 4.1. What do you understand by transducer non-conformity? (2 Marks)
- 4.2. What is meant by, primary and secondary transducers? (2 Marks)
- 4.3. Describe the following: (3 Marks)  
*i) Data acquisition ii) signal conditioning filters iii) signal conditioning amplifiers.*
- 4.4. Explain with sketch, the operational theory of inductive transducers, and mention its main advantages. (5 Marks)
- 4.5. Describe the use of photoelectric transducers for measurement of pressure. Describe their advantages and disadvantages. (5 Marks)
- 4.6. Explain with sketch the operation of one device used to measure vacuum pressure. (5 Marks)
- 4.7. At what condition, the frequency predicted by the measuring system is not presenting the original signal frequency? (2 Marks)
- 4.8. A 100 Hz sine wave is to be measured by a pressure transducer. What should be the sample rate? If the signal is sampled at 100, 150, 200, 250, and 300 Hz, find the corresponding alias frequencies. (6 Marks)

-----  
*With best wishes*

This exam measures the following ILOs			
Question No	Knowledge & Understanding Skills	Intellectual Skills	Professional Skills
1	KU1, KU3, KU5	I1, I5, I6	PP1, PP5
2	KU1, KU3, KU5	I1, I5, I6	PP1, PP5
3	KU1, KU5	I2, I6	PP1
4	KU1	I1, I2, I5	PP1, PP5