Instrumentation and Data Acquisition

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Other Disciplines FE Specifications

Instrumentation and Data Acquisition 4–6 Problems	Exam Problem Numbers
A. Sensors (e.g., temperature, pressure, motion, pH, chemical constituents)	1-5
B. Data acquisition (e.g., logging, sampling rate, sampling range, filtering, amplification, signal interface)	6-9
C. Data processing (e.g., flow charts, loops, branches)	9-16

We are grateful to NCEES for granting us permission to copy short sections from the FE Handbook to show students how to use Handbook information in solving problems. This information will normally appear in these videos as white boxes.

1. What does a manometer measure?

(A) humidity (B)toxicity (C)pressure (D)resistance

2. In the Wheatstone Bridge shown, if R_1=2kΩ, R_2=6kΩ, and R_3 =5kΩ. When the bridge is balanced, what is R_4?

(A) 5 Ω (B) 6Ω (C) 8Ω (D) 15Ω

3. In the Wheatstone Bridge shown, if V_{IN}=1 volt, R_1= R_2= R_3 =1kΩ and R_4=1,012 Ω, then V_0 is approximately:

(A) 2 mV (B) 3 mV (C) 4mV (D) 5 mV

4. A certain resistance temperature detector measures a resistance to be R_0=100Ω at 0^0C. The temperature coefficient of the resistance is α =.005C^{-1}. If the temperature increases to T=6^0C the resulting resistance is:

(A) 105 Ω (B) 104 Ω (C)103 Ω (D)102 Ω

5. What type of chemical sensor can be used to measure O_2 and H_2 ?Circle all that apply:

Semiconducting oxide Electrochemical ISE

Piezoelectric Optical Solid electrode

6. An analog to digital converter has a sampling rate of 10 thousand samples per sec. In order for the converter to faithfully record the input, the input signal should contain no frequencies greater than:

(A)2 MHz (B)5MHZ (D)5kHZ (E)20kHz

7. A certain sensor output contains electrical signals with frequencies from 1 to 2000 radians/sec. The lowest number of samples per second needed to completely represent all signals from this sensor is most nearly?

(A) 335 (B)435 (C)535 (D) 635

8. An A/D converter is input to a data acquisition system. The converter has a sampling rate of 1000 samples per second. If each sample value is to represented by one of 128 levels, what would be the mimum bit rate of the output of the converter?

(A)4 kb (B) 5 kb (C) 6 kb (D) 7 kb

9. An analog signal is first filtered by a low pass filter and then fed into a digital converter which samples its input every 2 μsec. To capture the highest frequency present in the input, what should be the cutoff frequency of the low pass filter.

(A)25 kHz (B)250 kHz (C)2.5 MHz (D)25 MHz

10. A computer program contains the following code

```
X=1
IF X<6 THEN X=X+2
OTHERWISE EXIT LOOP
LOOP TO IF
```

The value of X at the conclusion of this routine is:

(A) 3 (B) 5 (C) 7 (D) 9

11. In a spreadsheet program what cell is directly below cell AC7?

(A) AB7 (B) AC8 (C) BC7 (D) AB8

12. The number 7 is typed into cell B4 of a spreadsheet. Next B5 is set to B4 + B4 where $ means the absolute cell address. Then the contents of B5 are copied into cells B6 through B12. The number contained in cell B7 is:

(A) 7 (B) 14 (C) 21 (D) 28

13. Row 1 in a spread sheet contains the odd numbers 1, 3, 5,…21 in columns A-K. Row 2 in this spreadsheet contains the even numbers 2,4,6,…22 in columns A-K. Cell B3 contains the formula B1 + B$1*B2. This formula is copied into cells B4 and B5. The number in cell B4 is:

(A) 49 (B) 43 (C) 39 (D) 33

14. After the following code is executed, the quantity R is:

```
INPUT  X , M
V=1
R=1
FOR K=1 TO M
V=V*X/K
R=R+V
NEXT K,
```

(A) $R = 1 + \frac{X}{1} + \frac{X^2}{2} + \frac{X^3}{3} + \ldots + \frac{X^M}{M}$

(B) $R = 1 + \frac{X}{1!} + \frac{X^2}{2!} + \frac{X^3}{3!} + \ldots + \frac{X^M}{M!}$

(C) $R = 1 + \frac{X}{1} + \frac{X^2}{2} + \frac{X^3}{3} + \ldots + \frac{X^K}{K!}$

(D) $R = 1 + X + X^2 + X^3 + \ldots + X^M$

15. A certain control system has the following closed loop transfer function with an undamped natural frequency $\omega_n = 5$:

$$\frac{100}{s^2 + 3s + 25}$$

It's damping ratio, ζ, is most nearly:

(A) .1 (B).3 (C)1 (D) 3

16. The system in problem 15 has a damping ratio, ζ=0.3.

This system is:

(A) underdamped (B) critically damped

(B) overdamped (D) has damping factor 0