## END SEMESTER EXAMINATIONS (JANUARY 2022) - QUESTION PAPER - PART A

COURSE CODE	: ICE-2155
COURSE NAME	: Sensors and Transducers
SEMESTER	: 111
DATE OF EXAM	: 31/01/2022
DURATION	: 45 + 5 minutes

#### Instructions for Students:

(1) ANSWER ALL THE QUESTIONS.
(2) EACH QUESTION CARRIES 1 MARK.
(3) YOU ARE INSTRUCTED TO INFORM THE INVIGILATOR AFTER SUBMISSION OF THIS FORM IN THE CHAT SECTION.

\* Required

\* This form will record your name, please fill your name.

#### 1. STUDENT NAME: \*

#### 2. REGISTRATION NUMBER: \*

- 3. The transducer that converts measurand into the form of pulse is called the \_\_\_\_\_ transducers \* (1 Point)
  - Digital
    Analog
    Pulse
    Active
- 4. A strain gauge with a resistance of 250  $\Omega$  undergoes a change of 0.150  $\Omega$  during a test. The strain is 1.5 × 10-4.Then the gauge factor is \* (1 Point)



- 5. Consider the following transducers:
  - 1. LVDT.2. Piezoelectric .3. Thermocouple 4. Photovoltaic cell
  - 5. Strain gauge

Which of these are active transducers? \* (1 Point)

- 2, 3 and 4
- 2, 3 and 5
- 1, 2 and 5
- 1, 3 and 4

6. In order to achieve high accuracy, the slide wire of a potentiometer should be .....

\* (1 Point)

- as short as possible
- ) neither too small nor too large
- ) as near as possible
- ) as long as possible

#### 7. In a measurement system,

#### \* (1 Point)

) Both the statement (A) & (B) are true

(B) A measurement system consists of several components with each component having separate errors

(A) A single measurement components may have both random errors and systematic errors

Neither statement (A) nor statement (B) is true

8. The measurand value of a resistance is 10.25  $\Omega$ , whereas its value is 10.22  $\Omega$ . Determine the absolute error of the measurement.

# \* (1 Point) 0.03Ω 0.0003Ω 0.003Ω

0.004Ω

- 9. Which of the following represents the correct relationship between frequency and angular frequency ?
  - \* (1 Point)
     w=2ωf
     ω= 2πf
     ω=2πθ
     f=2θμ

### 10. A modifying input to a measurement system can be defined as an input

- \* (1 Point)
- which changes the input–output relationship for desired inputs only
- ) which changes the input–output relationship for desired as well as interfering inputs
- ) none of the above
- ) which changes the input–output relationship for interfering inputs only

#### 11. Most of LVDTs consume power, which is less than



12. Which is the order of minimum displacement that can be measured with capacitive transducers ?

\* (1 Point)

- 1µm 1 x 10−12m
- ) 1mm

) 1 cm

- 13. For wire wound strain gauges the approximate value of gauge factor is\* (1 Point)
  - 1+2∆
    1+2θ
    1+2v
    1+2v
    1+3v

14. In a rotating cylinder viscometer, the viscosity is determining the\* (1 Point)

- Speed
- Both Torque and speed
- 🔵 Torque
- None of the other options

- 15. Strain is defined as \_\_\_\_\_
  - \* (1 Point)
  - change in weight per unit weight



- C change in height per unit height
- change in diameter per unit diameter
- 16. In a Saybolt viscometer, the viscosity can be measured to measuring the time to fill a flask with liquid volume equal to

* (	1 Point)
$\bigcirc$	100ml
$\bigcirc$	70ml
$\bigcirc$	60ml
$\bigcirc$	50ml

17. Resistive type hygrometer is also called as



- Crystal hygrometer
- Dunmore type of hygrometer.
- Galvanometric hygrometer

18. With reference to a robotic system, which of the following statements about sensors is incorrect:

#### \* (1 Point)

- Grippers comprise force and tactile sensors which are typically force sensitive resistors or piezo resistors.
- LIDAR which maps the space around the robot facilitating collision free navigation with minimal processing.
- The encoder provides feedback about motor shaft position, speed and acceleration with suitable conditioning.
- The gyroscope provides information about the orientation of the robot without any further processing
- 19. A typical point of care glucose monitoring system is an:

- An optical sensing system
- A piezoelectric sensing system
- A piezo resistive sensing system
- A magnetoelastic sensing system
- An electrochemical sensing system

- 20. Which of the following resistive sensor configurations offers the least noise immunity to lead wire resistance and ambient temperature flutuations?
  - \* (1 Point)
  - Three wire voltage divider configuration
  - Four wire configuration
  - Two wire bridge configuration
  - Two wire voltage divider configuration
  - None of the other options
  - Three wire bridge configuration

#### 21. Which of these is not PZT

- \* (1 Point)
- All except C
- All except B and C
- 🔵 C Barium Titanate
- All except A and C
- B Lead zirconium titanate
- All except B
- A Quartz
- All except A and B

- 22. Which of these phenomenon does not relate to the flow of electric current at a solid liquid interface:
  - \* (1 Point)
  - ( ) Mass transfer
  - Conservation of mass
  - A transition of electronic current to ionic current
  - ( ) The formation of a junction capacitance
  - The formation of a junction potential
  - Charge transfer
- 23. Which of the following statements is incorrect:

- An ideal non-polarizable electrode is immune to motion artifacts
- A perfectly non-polarizable electrode is typically used for measurements
- An ideal polarizable electrode behaves as a lossy capacitor
- A perfectly polarizable electrode is typically used for electrical stimulations
- () An ideal non-polarizable electrode is immune to concentration polarization.
- An ideal non-polarizable electrode behaves as a pure resistor

- 24. Which of the following statements is correct
  - \* (1 Point)
  - () A semi permeable membrane may be modelled as an RC element
  - A semi permeable membrane has an electrical double layer on both sides of it thereby enabling charge and mass transfer.
  - A semi permeable membrane may be modelled as an RC element in series with the half-cell potential across the membrane.
  - A semi permeable membrane may be modelled as an RLC element
  - A semi permeable membrane may be modelled as an RLC element in series with the half cell potential.
- 25. With reference to a perfectly polarizable electrode, which of these statements is incorrect

- Returns to its base value after being subjected to small currents
- () It is impossible to have an electrode with all of the said characteristics
- ) None of the above
- Exhibits a potential which is constant with respect to time
- ) It is perfectly reversible and obeys Nernst Equation.
- Exhibits minimal hysteresis with temperature cycling

26. A spectrophotometer with 12 bit ADC records 63% transmittance through a sample. If the dark noise and read noise for this measurement are 17 counts and 50 counts respectively, the signal to noise ratio for this measurement is:

\* (1 Point)

- 61:1
- 243:1
- 46:1
- 52:1
- 27. Which of the following is correct?

#### \* (1 Point)

A prism resolves light spectrally by refraction and is more efficient than a grating. A
 diffraction grating offers a lower spatial resolution in terms of angular dispersion of spectral components.

Holographic gratings do not suffer from the periodic errors that can occur in ruled gratings, and hence, ghosted images are non-existent. Particularly in applications like Raman spectroscopy, where signal to noise is critical, the inherent low stray light of holographic gratings is an advantage.

An LED is usually reverse biased while a photodiode may be forward or revers biased.

Transmission gratings allow for simple linear (source -> grating -> detector) optical designs that can be beneficial in making compact fixed grating applications such as

- A ruled grating of 600 lines/mm is illuminated normally with a sodium vapor lamp (589 nm and 589.59 nm). At what angle will the first order maxima occur. \* (1 Point)
  - 20.70 and 20.72 degrees respectively



- 31.01 and 32.03 degrees respectively
- 20.07 and 20.05 degrees respectively
- 29. A photomultiplier tube comprises six dynodes of secondary emission factor of 54. The gain of this tube is:

* (1 Point)		
$\bigcirc$	104976	
$\bigcirc$	24794911296	
$\bigcirc$	629856	
$\bigcirc$	324	
$\bigcirc$	Data insufficient	

30. If a 3N force acts on a quartz crystal along XY plane at an angle of 30° to X, then what is the charge developed in the X axis (Qxx)?

Given, d11 = 2.3 x 10-12 C/N, d14 = -0.67x 10 -12C/N

*	1 Point)
$\bigcirc$	9.42 pC
$\bigcirc$	2.52 pC
$\bigcirc$	6.9 pC

🔵 12.3 pC

- 31. The typical penetration depth of an evanescent wave generated due to TIR of a monochromatic visible light may be best determined by the following rule of thumb
  - \* (1 Point)
  - It is one tenth of the wavelength of light used
  - Ten times the wavelength of light used
  - 100 times the wavelength of light used
  - It is one hundredth of the wavelength of light used
- 32. Which of these is not an application of potentiometric sensing technique

# \* (1 Point) Measurement of biopotential Point of use measurement of

- Point of use measurement of glucose
- Measurement of membrane potential
- ) Ion Selective field effect transistor

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