

ID No.: _____

Enrollment No.: _____

Kadi Sarva Vishwavidyalaya
LDRP Institute of Technology and Research, Gandhinagar
Mechanical Engineering Department
M. E. 1st Semester Final Examination 2013

29/5/13

Subject: Instrumentation for Engineers

Total Marks: 70

Time: 10:30 AM – 13:30 PM

Date: 29/05/2013

Instructions:

1. Attempt all questions as directed and answer each section in separate main answer sheets.
2. Figures to the right indicate full marks.
3. Make suitable assumptions.
4. Please don't carry any type of Communication Gadgets, Programmable Calculators, etc., with you during the examination except Scientific Calculators.
5. Please don't write anything on this question paper except your Enrollment and ID Number.
6. Please keep your Identity Cards and Hall Tickets on your desk during the examination.
7. Please follow all the instructions provided by authorized university and institute personnel.

Section - I

Q. 1

Total: 15

A. Explain the terms "Measurements" and "Instruments and Instrumentation" with its significance and explain primary, secondary & tertiary modes of measurement. 5

B. Explain any five from the list given below: 5

1. Standards of measurement
2. Systems of measurements
3. Self contained & indicating instruments
4. Manual and automatic instruments
5. Bourdon tube pressure gauge
6. Functions of instruments
7. Drift, threshold and hysteresis
8. Electrical, mechanical & electronics instruments

C. Explain factors relating of selection of instruments and functions of instruments such as indicating, recording & controlling functions. 5

OR

C. Explain generalized input-output configurations of measuring instruments and measuring systems with block diagram. 5

Q. 2

Total: 10

A. Explain the term "Dynamic Analysis" of a measurement system with time 5

domain and frequency domain analysis and various test signals / inputs.

- B. What is "Zero, First and Second Order Systems"? 5

Find the transfer operator for the equation given as per below:

$$\frac{dI_0}{dt} = C(I_i - I_0)$$

Where, I_0 = Indicated Temperature

I_i = Input Temperature

C = A numerical Constant

Also, find the order of the system.

OR

Q. 2

Total: 10

- A. What is "Transfer Function"? Explain properties of a transfer function along with advantages and disadvantages. 5

- B. 1. Explain modeling of "Mechanical Systems" for "Translational Systems" which comprises of mass, spring and damper elements. 5
2. Find the input x, output y and differential equation for given transfer function of $G(s) = \frac{2s+1}{s^2+s+1}$

Q. 3

Total: 10

- A. Enlist and explain limiting errors (guarantee errors) occurring during the experiment and their causes with suitable mathematical forms in %. 5

- B. A wattmeter having a range of 500 W has an error of $\pm 1.5\%$ of full scale deflection. If the power measured is 50 W, what would be the range of readings?

If the error is specified as % of a true value, what would be the range of the readings?

OR

Q. 3

Total: 10

- A. Explain "Types of Errors" and "Sources of Errors" with suitable examples. 5

- B. 1. Explain significance of statistical analysis of test data with single sample test and multi sample test. 5
2. Explain any two from below:
- "Average Deviation"
 - "Standard Deviation"
 - "Environmental Errors"
 - "Observational Errors"
 - "Variance"

Section - II

Q. 4

Total: 15

A. What are functions of a transducer in an electronic instrumentation system? 5

B. Explain any two from the list given below: 5

1. Electromagnetic type transducer
2. Capacitive strain gauges
3. Piezo – electric transducer
4. Foil type strain gauges

OR

1. Wire wound strain gauges
2. LVDT
3. Semi conductor strain gauges
4. Photo electric transducer

C. Explain dynamic response of "Second order system" with all types of inputs including mathematical derivations and graphs. 5

OR

C. The final result of a measurement depends on two measurements in series, each having values of 100 and 200 units with errors of $\pm 4\%$ and $\pm 2\%$, such that the final result is sum of both. Determine the error of a final result if errors are considered as

- a. Limiting errors
- b. Standard deviations

Q. 5

Total: 10

A. What is "DAQ"? Explain components of basic DAQ system with their functions in brief. 5

B. Explain signal conditioning with functions of signal conditioning equipments with D. C. signal conditioning & A. C. signal conditioning systems. 5

OR

Q. 5

Total: 10

A. Explain with examples: 5

1. DAQ hardware
2. DAQ application software

B. Fill up the blank cells of following table: 5

Phenomena	Transducer type	Signal type
Temperature	1. 2. 3.	mV Ω Ω
Level	Capacitance level meter	
Flow	1. Electromagnetic flow meter 2. Paddle wheel	

Pressure	Piezoresistive gauge	
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OR

Explain any five from below:

- a. Mechanical Amplifiers
- b. Fluid Amplifiers
- c. Optical Amplifiers
- d. Electrical or Electronic Amplifiers
- e. Telemetring
- f. Filters

Q. 6

Total: 10

- A. What is "Thermistors"? Explain in details with advantages and disadvantages. 5

Explain thermocouple thermometers with principle of operation and neat sketch.

- B. Explain the pitot static tube with neat sketch, principle of operation and mathematical derivation for flow measurement of Compressible fluid flow considering natural gas 5

OR

Non compressible fluid flow considering water ($\rho = 1013 \frac{kg}{m^3}$)

OR

Q. 6

Total: 10

- A. Explain radiation pyrometer with types, principle of operation and suitable example with neat sketches. 5

- B. What is electromagnetic flow meter? Explain in brief with neat sketch, working principle, advantages and disadvantages. 5

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Kadi Sarva Vishwavidyalaya
LDRP Institute of Technology and Research, Gandhinagar
Mechanical Engineering Department
• M. E. 1st Semester Final Examination 2012 - 2013

Subject: Instrumentation for Engineers

Total Marks: 70

Time: 10:00 AM – 13:00 PM

Date: 23/01/2013

Instructions:

1. Attempt all questions as directed and answer each section in separate main answer sheets.
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Section - I

Q. 1

Total: 15

- A. Explain the terms "Instruments" and "Instrumentation" with its significance and functional stages of measurement systems including block diagram. 5
- B. Explain any five from the list given below: 5
1. Analog and digital inputs and instruments
 2. Mechanical, electrical and electronics instruments
 3. Deflection and null point instruments
 4. Absolute and secondary instruments
 5. Self operated and power operated instruments
 6. Indicators, recorders and controlling instruments
 7. Drift, threshold and hysteresis
 8. Speed of response, fidelity, measuring lag and dynamic error
- C. Classify various instruments based on principle of operation with suitable examples. (Types of measurement systems) 5
- OR
- C. Describe the terms Measurement, measurand and measurement standards with suitable examples. 5

Q. 2

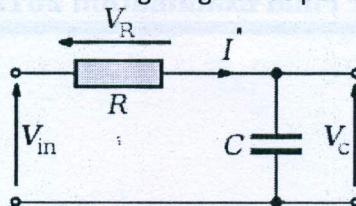
Total: 10

- A. Explain the term "Dynamic Response" of a measurement system with various test inputs along with suitable mathematical forms and graphs. 5

Q1

B. What is "Transfer Function"? 5

Find the transfer function for the figure given as per below:



Also, draw the block diagram for the same.

OR

Q. 2

Total: 10

A. List the properties of transfer function along with advantages and disadvantages. 5

B. 1. Explain poles and zeros of transfer function along with poles and zeros plot. 5

2. Find the transfer function for $\frac{dy}{dt} + 2y = \frac{dx}{dt} + x$

Q. 3

Total: 10

A. Enlist and explain various types of errors occurring during the experiment and their causes with suitable examples. 5

B. The data given below are expected to follow a linear relationship: 5

$$v = u + ab$$

u	0.9	2.4	3.4	4.5	5.8	6.8
v	1.2	1.8	2.8	3.5	4.6	5.8

Using least square analysis obtain:

1. The best linear relation
2. Standard deviation

OR

Q. 3

Total: 10

A. Explain "Systematic Errors" and "Random Errors" with suitable examples. 5

B. 1. Explain significance of selection of alternative test methods for experiments. 5

2. Explain any two from below:
- a. "T - Test"
 - b. "Chi Square Test"
 - c. "Environmental Errors"
 - d. "Observational Errors"
 - e. "Z- Test"

Section - II

Q. 4

Total: 15

A. Explain "Transducer" with detailed classification with suitable examples. 5

B. Explain any two from the list given below: 5

1. Electromagnetic type transducer
2. Capacitive strain gauges
3. Variable reluctance transducer
4. Foil type strain gauges

OR

1. Wire wound strain gauges
2. LVDT
3. Semiconductor strain gauges
4. Mutual reluctance transducer

C. Explain dynamic response of "First order system" with all types of inputs including mathematical derivations and graphs. 5

OR

C. The final result of a measurement depends on two measurements in series, each having values of 50 and 100 units with errors of $\pm 2\%$ and $\pm 1\%$, such that the final result is sum of both. Determine the error of a final result if errors are considered as 5

- a. Limiting errors
- b. Standard deviations

Q. 5

Total: 10

A. Explain the term "DAQ". 5

List the components of basic DAQ system and explain their functions in brief.

B. Explain signal conditioning with various signal conditioning accessories. 5

OR

Q. 5

Total: 10

A. Explain with examples: 5

1. DAQ hardware
2. DAQ application software

B. Fill up the blank cells of following table: 5

Phenomena	Transducer type	Signal type
Temperature	1. Thermistor 2. Resistor 3. Radiation Probe	mV Ω Ω
Level	Capacitance level meter	
	1. Electromagnetic flow meter 2. Paddle wheel	mA mA
Pressure	Piezoresistive gauge	

OR

Explain below with sketches and graphs:

1. Analog signals:

- a. Level
- b. Shape
- c. Frequency

2. Digital signals:

- a. State
- b. Rate

Q. 6

Total: 10

A. What is "RTD"? Enlist various types of RTD.

5

Explain Wheatstone bridge circuit construction with principle of operation and neat sketch.

B. Explain the pitot static tube with neat sketch, principle of operation and

5

mathematical derivation for flow measurement of
Compressible fluid flow considering general gas

OR

Non compressible fluid flow considering diesel ($\rho = 823.6 \frac{kg}{m^3}$)

OR

Q. 6

Total: 10

A. Explain pyrometer with types, principle of operation and suitable example with neat sketches.

5

B. What is anemometer? Explain hot wire anemometer in brief.

5

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