INDUSTRIAL INSTRUMENTATION – I (SEMESTER - 4)

CS/B.TECH (EIE-NEW)/SEM-4/EI-403/09

1. .....
Signature of Invigilator

2. .....
Signature of the Officer-in-Charge

Reg. No. | | | | | | | | | | | | | | |

Roll No. of the Candidate | | | | | | | | | | | | | | |

CS/B.TECH (EIE-NEW)/SEM-4/EI-403/09
ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009
INDUSTRIAL INSTRUMENTATION – I (SEMESTER - 4)

Time : 3 Hours] [Full Marks : 70

INSTRUCTIONS TO THE CANDIDATES :

1. This Booklet is a Question-cum-Answer Booklet. The Booklet consists of **32 pages**. The questions of this concerned subject commence from Page No. 3.
2. a) In **Group – A**, Questions are of Multiple Choice type. You have to write the correct choice in the box provided **against each question**.
   b) For **Groups – B** & **C** you have to answer the questions in the space provided marked 'Answer Sheet'. Questions of **Group – B** are Short answer type. Questions of **Group – C** are Long answer type. Write on both sides of the paper.
3. **Fill in your Roll No. in the box** provided as in your Admit Card before answering the questions.
4. Read the instructions given inside carefully before answering.
5. You should not forget to write the corresponding question numbers while answering.
6. Do not write your name or put any special mark in the booklet that may disclose your identity, which will render you liable to disqualification. Any candidate found copying will be subject to Disciplinary Action under the relevant rules.
7. **Use of Mobile Phone and Programmable Calculator is totally prohibited in the examination hall.**
8. You should return the booklet to the invigilator at the end of the examination and should not take any page of this booklet with you outside the examination hall, **which will lead to disqualification**.
9. Rough work, if necessary is to be done in this booklet only and cross it through.

No additional sheets are to be used and no loose paper will be provided

---

FOR OFFICE USE / EVALUATION ONLY

Marks Obtained

	Group – A										Group – B			Group – C			***Total Marks***	***Examiner's Signature***
Question Number																		
Marks Obtained																		

.....
Head-Examiner/Co-Ordinator/Scrutineer

4527 (10/06)

DO NOT WRITE ON THIS PAGE

ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE – 2009

INDUSTRIAL INSTRUMENTATION – I

SEMESTER - 4

Time : 3 Hours] [Full Marks : 70

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) Dummy strain gauge is used to

a) increase the efficiency

b) increase the range

c) compensate for temperature changes

d) make the bridge self-balancing. ☐

ii) Transducer for measurement of rotational displacement is

a) shaft encoder b) differential capacitor

c) LVDT d) strain gauge. ☐

iii) A second-order underdamped system has a damping factor of 0·8. It is subjected to a sinusoidal input of unit ampitude. It has reasonant peak of

a) 108% b) 92%

c) 20% d) it has no resonance peak. ☐

iv) Two strain gauges are used to measure strain in a cantilever. One gauge is mounted on the top of the cantilever and the other is placed at the bottom. The two strain gauges form two arms of a voltage sensitive Wheatstone bridge. This bridge configuration is called

a) a quarter bridge b) a half bridge

c) a full bridge d) a null bridge. ☐

v) A 0 – 10A ammeter is guaranteed for 2% accuracy for full scale reading. What will be the percentage limiting error when the meter is measuring 5A ?

a) 4% b) 1%

c) 5% d) 10%. ☐

vi) Statistical analysis of measurement data are done to reduce

a) offset error b) gross error

c) random error d) relative error. ☐

vii) The main source of error in an accelerometer is the presence of

a) gravitational force b) electromagnetic force

c) centrifugal force d) all of these. ☐

viii) MTTF stands for

a) maximum time to fail b) minimum time to fail

c) mean time to fail d) mean time between failures. ☐

ix) The measurement of mass flow-rate in weighfeeder is independent of

a) belt slip b) belt stiffness

c) materials in feed hopper d) alignments of the idlers. ☐

x) The measured value of a resistances 111 Ω whereas its true value is 110 Ω. What is the absolute error ?

a) 1 Ω b) 1%

c) 10 Ω d) 11 Ω . ☐

xi) Pneumatic relays are not used to perform

a) arithmetic operation b) logarithmic operation

c) boosting of input signal d) integration. ☐

xii) Which arera is classified by 'Grain elevators' ?

a) Class I b) Class II

c) Class III d) None of these. ☐

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following questions. 3 × 5 = 15

2. Discuss each type of Systematic Error as classified, giving suitable examples. Explain the measures taken to minimize these errors. 5

3. What are the different standard inputs given to the measuring system for evaluation of its parameters ? Derive the equation and curve for time response of a first order system when subjeced to unit step input. 1 + 4

4. a) Write down a mathematical expression for 'standard deviation', explaining all the terms used therein.

   b) A large number of 230 Ω resistors are obtained by combining 120 Ω resistors with a standard deviation of 4·0 Ω and 110 Ω resistors with a standard deviation of 3·0 Ω. What is the standard deviation of 230 Ω resistors thus formed ? 2 + 3

5. What do optical absolute encoders usually generate a gray coded binary coded output ? Distinguish between absolute rotary encoder an incremental encoder. 3 + 2

6. What is a pneumatic relay ? Describe with a neat sketch, the bleed type pneumatic relay. 1 + 4

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following questions. 3 × 15 = 45

7. a) What is Gaussian distribution ?

   b) What are the properties of Gaussian distribution ?

   c) Successive measure of 1 kg each (of high accuracy) were added at the hook at the lower end of a vertically hanging wire. The position of a mark at the lower end was measured using an ordinary scale. The following results are obtained :

Load X in kg	1	2	3	4	5	6	7	8	9	10
Position of Mark Y	6·05	6·20	6·25	6·35	6·40	6·50	6·55	6·60	6·70	6·75

   Determine the equation of the best fitting straight line using the method of sequential difference.

   d) What are the criteria for goodness of fit ? 2 + 3 + 7 + 3

8. a) Show that in a seismic accelerometer the amplitude of the relative displacement between the proof mass and the spring-damper assembly varies linearly with the acceleration.

b) The seismic mass of a spring-mass accelerometer is 50 g and the spring constant is 5000 N/m. The amplitude of the relative displacement is ± 2 cm. If $\zeta = 0{\cdot}7$ and $\omega / \omega_n < 0{\cdot}4$, where symbols have their usual meaning, calculate

i) the maximum measurable acceleration in g where g is the acceleration due to gravity, and

ii) the natural frequency of oscillation of the system.

c) Four strain gauges are used to measure the torque of a cylindrical shaft.

i) Draw a labelled diagram showing the arrangement of gauges on the shaft and the bridge configuration.

ii) Calculate the maximum bridge output for a strain of 500×10^{-6}. The gauges have resistance of 120 Ω each, and a gauge factor of 2·1. The maximum permissible gauge current is 50 mA. 4 + (3 + 3) + (2 + 3)

9. What is mass flow-rate ? What is basic difference between a belt weighing system and a weighfeeder ? What is weigh length of a belt weighing system ? Explain the principle of operation of a weighfeeder with a schematic representation. Explain how bridge circuit is used for multiplication of two signals from load-cell and tacho-generator in weighfeeder ? 1 + 2 + 1 + 7 + 4

10. a) Draw a basic Zener-barrier circuit used in a hazardous are to limit the amount of electrical energy produced under any possible fault condition and explain its mode of operation.

dia

b) Figure shows an equivalent circuit of a Zener-barrier used for the measurement of temperature by a thermocouple in a hydrogen-air atmosphere. The symbols used for the sensor, cable network and the Zener-barrier are self-explanatory.

If V_z = 10 V, R_1 = 50 Ω, C = 1·85 nF, L = 60 μH and the minimum ignition energy for hydrogen-air is 19 μJ, examine from the calculation of maximum total energy stored in the circuit if the instrumentation is safe or not.

c) i) List the advantages of a 4 – 20 mA two-wire live zero loop.

ii) What is its disadvantage when used to interconnect, say, chart recorders ? 5 + 5 + (3 + 2)

11. a) What is the working principle of Stroboscope ?

b) What do you mean by proximity measurement ? Describe the working principle of a magnetic proximity sensor ?

c) Describe the working principle and derive the necessary expression of a seismic displacement transducer. 4 + 2 + 3 + 6

END