

M.E. ELECTRICAL ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION, 2017

TRANSDUCER TECHNOLOGY

Full Marks 100

Time: Three hours

(50 marks for each part)

Use a separate Answer-Script for each part

No. of Questions	PART I	Marks
Answer any TWO questions		
1. (a)	<p>A thermistor with negative temperature coefficient (NTC) of resistance has a nominal resistance of 4.7 kΩ at 25 °C, and a β constant of 3500 K. The sensor is placed in series with a resistance r, and the combination is supplied from a constant voltage dc source. The voltage across r is the output. Determine the value of r to quasi-linearize the output versus temperature (sensed by the thermistor) characteristic over 30°C to 120 °C. Derive the expression used.</p> <p>If it is desired that the output voltage be taken to a processor based system, give a neat labeled sketch of the relevant arrangement. Give special attention to the elimination of the problem of supply voltage variation.</p>	12 +4
(b)	<p>An electrical resistance strain gauge is placed in on arm of a Wheatstone bridge. It it is intended that by measuring the output voltage of the unbalanced bridge circuit, the mechanical strain will be measured. Explain how the nonlinearity introduced by the bridge circuit can be eliminated with the help of an analog multiplier. Does this guarantee a linear relation between the output voltage and the strain under measurement?</p>	9
2. (a)	<p>Explain the bit-switching problem encountered in absolute electro-optic position encoders. Indicate how the indication ambiguity due to this problem can be minimized by using appropriate monostrophic binary code.</p>	15
(b)	<p>Explore, with the help of relevant sketches and mathematical expressions, the possibility of using a transistor as a temperature sensor. What is a "Complementary To Absolute Temperature" (CTAT) sensor? How can the CTAT sensor be upgraded to the "Proportional To Absolute Temperature" (PTAT) sensor? Elaborate.</p>	10

No. of Questions	PART I	Marks
3. (a)	Elucidate the principle of current measurement using Hall effect transducers of the open-loop variety. Point out clearly the evolution in the sensing arrangement with change in the order of the current value being measured.	10
(b)	Explain an appropriate null method of measuring magnetic field using hall transducer.	5
(c)	Give the block diagram representation of a force-balance accelerometer, showing the different subsystems. Derive the expression for the frequency response, and hence, point out their advantages over the open-loop counterparts. Give relevant sketches.	10
4.	Write short notes on any <i>two</i> of the following.	
	(a) Hall sensors for tilt measurement and on-axis and off-axis rotation angle measurement.	12 ½
	(b) Electro-optic incremental shaft encoders.	+
	(c) Linearizing arrangement for thermocouples using dual – input temperature compensated opamp based log amplifier.	12 ½

**M. E. Electrical Engineering First Year Second Semester Examination,
2017**

Transducer Technology

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(50 Marks for each part)

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PART-II

Answer Any Two Questions

- Q1a). Mention the different processes used to make complete microstructure. Discuss briefly the chemical vapour deposition (CVD) process. 3+5
- Q1b). Explain the different process steps in transferring patterns on to the silicon wafer. 7
- Q.1c) How damping ratio can be increased by compensation in a second order system? 10
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- Q.2a) What is meant by acoustic emission testing? How acoustic emission testing differs from other non-destructive testing methods ? Discuss AE (acoustic emission) source location technique. 2+3+3
- Q.2b) What is meant by dispersion in optical fiber? Explain the different kinds of dispersion mechanisms in the optical fiber. 3+4
- Q.2c) What is meant by isotropic and anisotropic wet chemical etching of silicon? Mention the reaction schemes. 4+1
- Explain the dry oxidation and wet oxidation processes for growing oxide on silicon. 5
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- Q.3a) What is controller-area-network 5
- Q.3b) Explain the different process steps involved in the surface micromachining technology for realizing pressure transducer. 8

Q.3c) What is wave division multiplexing (WDM)? 6

Q. 3d) How the nature of defects affects liquid penetrant inspection non-destructive testing ?

6

Q4. Write short notes on :

i) Magnetic Particle Testing.

ii) Lithography

(12.5×2)