APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Scheme for Valuation/Answer Key

Scheme of evaluation (marks in brackets) and answers of problems/key

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: EC465

Course Name: MEMS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Linear and rotary motors: expln. (3 marks x 2) , figures (2 marks x 2) (10)

b) Explanation – 3 marks, Figure 2 marks (5)

2 a) Give one application of MEMS in automobiles (2 marks). Figure (3marks) (5)

b) Explanation of 3 three relevant points (2.5 marks x 3 = 7.5 marks), figures 2.5 marks (10)

3 a) Two types of sensing schemes used in inertial sensors and micro accelerometer. (Explanation with figures 5 x 2) (10)

b) Explanation (5 marks) (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derivation the Trimmer Force Scaling Vector (8 marks) Explanation of information provided by force scaling vector (2 marks) (10)

b) Two relevant advantages of use of polymers in micro systems (3 marks) Give two examples of Polymers (full chemical/commercial names) – 1 marks each (5)

5 a) Why electrostatic actuation is preferred over electromagnetic actuation in micro motors - explanation (5 marks) (5)

b) Explain the Langmuir- Blodgett process with relevant figures. What are the advantages of LB films? - explanation (5 marks), figures – 4 marks, advantages – 1 marks (10)

6 a) single crystal Silicon production - explanation (3 marks), figures – 2 marks (5)

b) (1) To find the dose:Rp = 307 nm = 307×10^{-7} cm and $\Delta Rp = 69 \times 10^{-7}$ cm at 100 KeVenergy level. (10)

Since we have the maximum concentration, Nmax = $30 \times 10^{18}/cm^3$ at x = Rp

$$N_{max} = \frac{Q}{\sqrt{2\pi}\Delta R_p}$$

from which, we have the dose:

$$Q = (2\pi)^{0.5}(\Delta R_p)N_{\max} = (6.28)^{0.5}(69\times10^{-7}\ cm)(30\times10^{18}\ cm^{-3}) = 5.2\times10^{14}\ /cm^2$$

(a) To find the dose:Rp = 307 nm = 307x10^{-7} cm and ΔRp = 69x10^{-7} cm at 100 KeVenergy level.

Since we have the maximum concentration, Nmax = 30 x 10^{18}/cm^3 at x = Rp

$$N_{\max} = \frac{Q}{\sqrt{2\pi}\Delta R_p}$$

from which, we have the dose:

$$Q = (2\pi)^{0.5}(\Delta R_p)N_{\max} = (6.28)^{0.5}(69\times10^{-7}\ cm)(30\times10^{18}\ cm^{-3}) = 5.2\times10^{14}\ /cm^2$$

(b) $N(0.15um)=N_{max} * e^{\left(\frac{(x-Rp)^2}{2\Delta Rp^2}\right)} = 30 \times 10^{18}\ cm^{-3} * e^{-\left(\frac{(0.15-0.307)^2}{2*0.060^2}\right)}$

= 2.27 x 10^{18} cm^{-3}

$$e^{-\left(\frac{(x-0.307)^2}{2*0.069^2}\right)} = 0.001$$

(c)

x= 0.5635µm

PART C

Answer any two full questions, each carries 20 marks.

7	a)	Two advantages of LIGA process (2 marks). Explanation of LIGA (4 marks , Block diagram (2marks). Commonly used chemical in each of the steps (0.5 x 4 = 2 marks).	(10)
	b)	Explanation (3 marks), figures – 2 marks	(5)
	c)	Explanation (3 marks), figures – 2 marks	(5)
8	a)	explanation (3 marks x 2 = 6 marks), figures – 2 marks x 2 = 4 marks	(10)
	b)	Role of sacrificial layers (expln - 2 marks, figures 2 marks). examples of two sacrificial materials (0.5 x 2 = 1 marks)	(5)
	c)	explanation (5 marks)	(5)
9	a)	Explanation (5 marks), figures – 3 marks. fabrication challenges associated with surface micromachining (2 marks).	(10)
	b)	explanation (3 marks x 2 = 6 marks), figures – 2marks x 2 = 4 marks	(10)

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