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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2014

BIOMEDICAL ENGINEERING

VIII Semester

BM9026 & BioMEMS

(Regulations-2008)

Time: 3 Hours

Answer ALL Questions

Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. Why silicon is used as a seed material for MEMS manufacturing?
2. Name the two types of etching available for shaping the geometry of MEMS components.
3. What is creep deformation? State its relationship with temperature.
4. A thermal resistor is made of doped p-type single crystal silicon, with the nominal resistance (R_0) of $2K\Omega$. Assume the TCR of the material is $100\text{ppm}/^\circ\text{C}$. Predict the resistance of the device at a temperature 50°C above the ambient.
5. List few passive MEMS optical components.
6. State the advantages of GLV technology.
7. Calculate Reynolds number for a minute stream of alcohol flowing through a tube with diameter of the tube is $75\mu\text{m}$ and average velocity between the entrance and exit of the tube, $V=1.5 \times 10^{-3}\text{m/s}$. The mass density of alcohol is 789.6 Kg/m^3 and the dynamic viscosity of alcohol is $\mu= 1199.87 \times 10^{-6}\text{N-s/m}^2$
8. Differentiate In-plane Si microneedle and Out of plane metallic microneedle.
9. Mention the applications of MEMS in drug delivery.
10. Name the disadvantage of conventional PCR and advantage of PCR biochip.

Part – B (5 x 16 = 80 marks)

11. (i) Discuss the general steps involved in the photolithography with positive and negative photo resist. (8)
- (ii) Describe the fabrication procedure of a square tube using LIGA. (8)
12. a) Draw the structure of an accelerometer at macro scale. Explain with justification, the modifications to be done to achieve the same at micro scale. Also discuss how this setup can be converted into a piezo resistor based sensor. (16)

(OR)

- b) (i) Describe the construction and working of inchworm motor. (10)
- (ii) Explain the working of comb drive actuator. (6)

13. a) (i) Explain the light valve and also grating technique used in it. (8)
(ii) Describe the construction and working of beam splitter. (8)

(OR)

- b) (i) Brief the digital micro-mirror device and DLP technology. (10)
(ii) Detail the function of micro-lens and its various applications. (6)
14. a) (i) Determine the pressure drop using Bernoulli equation in a minute stream of alcohol flowing through a section of a tapered tube 20cm in length. The inlet velocity is $500\mu\text{m/s}$. The mass density of alcohol is 786.6 kg/m^3 . The tube is inclined 30° from the horizontal plane. The inlet diameter is $200\mu\text{m}$ and the outlet diameter is $100\mu\text{m}$. (10)
(ii) Derive the momentum equation for a moving fluid in a stream tube. (6)

(OR)

- b) (i) Explain the working of droplet based electro wetting actuation system. (8)
(ii) Describe the working of micro pump based on suction principle. (8)
15. a) (i) Design a micro reservoir which can be used for drug delivery. (8)
(ii) Describe the working of chemoresistor and chemo capacitor. (8)

(OR)

- b) Explain in detail the different DNA hybridization techniques. (16)