UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

UPES
THE NATION BUILDERS UNIVERSITY

End Semester Examination, April, 2017

Program/course: B.Tech EE	**Semester – 8th**
Subject: Micro Electro Mechanical Systems (MEMS)	**Max. Marks : 100**
Code : ELEG 414	**Duration : 3 Hrs**
No. of page/s: 2	

Section A   (5Qx4 = 20 Marks)

Q1. Explain with block diagram the components of MEMS.

Q2. What is the principal difference between bulk micromachining and surface micromachining?

Q3. Why Non – Conventional machining process is better than conventional machining?

Q4. What are advantages and disadvantages of using (1) piezoresistors and (2) capacitors as signal transducer?

Q5. Comment on "silicon as a substrate material" for MEMS devices.

Section B (5Q x 8 = 40 Marks)

Q6. Describe the role of quantum physics in the design of MEMS and microsystems.

Q7. Describe the principles of electrophoresis and electro-osmosis in biosensors.

Q8. Diagrammatically explain DRIE process. Why it is necessary to have near perfectly vertical walls in microstructures?

Q9. Explain the working principle of chemical sensor. How electrical resistance is changed in metal oxide gas sensor?

Q10. Distinguish between top – down and bottom – up approach in nanotechnology. What is the phenomenon behind acting of gold nanoparticles as a catalyst?

Q11. Discuss the effect of following process parameters on Material Removal Rate (MRR)

a)   SOD on MRR

b)   Effect of abrasive grain size and flow on MRR

c)   Effect of exit gas velocity and abrasive particle density

d)   Effect of mixing ratio on MRR

Q12. Diagrammatically describe the three principle signal transduction methods for micropressure sensors. Why microactuation is produced more accurately and effectively by using shape memory alloys?

OR

Describe LIGA process. Why LIGA process for manufacturing MEMS is radically different from other manufacturing techniques?

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Section A (5Qx4 = 20 Marks)

Q1. Explain the difference between MEMS and microsystems.

Q2. Give at least two applications of MEMS in industry. What are the materials used as substrate in MEMS fabrication.

Q3. What are the basic requirements for photoresist materials for the LIGA process?

Q4. What are the factors affecting Water Jet Machining (WJM) performance?

Q5. "As particles get smaller, their surface to volume ratio gets larger" Comment on this statement.

Section B (5Q x 8 = 40 Marks)

Q6. What is the principle difference between Biomedical Sensor and Biosensor? Explain in detail working principle of biosensor.

Q7. How anodic bonding is different from fusion bonding? What are the factors which need to be taken care while bonding of two materials?

Q8. Why microactuation is produced more accurately and effectively by using shape memory alloys?

Q9. Explain "AJM nozzle is made of either circular or rectangular cross section". Which abrasive particles are used in AJM? On which factors selection of abrasives depends?

Q10. Distinguish between top – down and bottom – up approach in nanotechnology. How self-assemble monolayer formed on the substrate?

Section C (2Q x 20 = 40 Marks)

Q11. Explain why thermocouples are not ideal for microthermal sensors. Describe the working principle of microthermal sensors.

Q12. Give reasons for the following:

a) Micro pressure sensor using a vibrating beam for signal transduction is better that micro pressure sensor with pizoresistors and capacitors.
b) AJM nozzle is usually made of tungsten carbide or sapphire.
c) LIGA process in manufacturing MEMS is different from other manufacturing techniques.
d) Selection of materials for optical sensors is principally based on quantum efficiency.