Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

SIXTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
APRIL/MAY 2017
SUBJECT: MEMS TECHNOLOGY (OPEN ELECTIVE) (ECE -348)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** questions.
- Missing data may be suitably assumed.

1A. Explain proximity and projection printing mechanisms used to obtain high resolution of contact printing without the defects.

1B. A silicon wafer has been etched through square window opening of size 10umx10um in the oxide layer. Draw cross section profiles and mark all dimensions of etched silicon for the following cases.

a) Isotropic chemical etchant ,wafer is <100> silicon,etch depth is 5um

b) Etchant is KOH solution,wafer is <100> silicon, etch depth is 5um.

1C. A plane intercepts the x,y and z axis at 2,3,4 respectively. Obtain an equation for the plane. Write down the miller indices for this plane.

(5+3+2)

2A. With the help of diagrams explain the different process steps involved in the surface micromachining technology for realizing a polysilicon cantilever beam.

2B. The length, width and thickness of a polysilicon cantilever beam is 200um, 30um and 2um respectively:

i) If the density of polysilicon is 2200 kg/m^3 and measured resonance frequency is 68kHz, determine the youngs modulus of the polysilicon

ii) This beam is used for detection of deposited mass by measuring the resonance frequency of the beam before and after deposition of mass. The least count of frequency measurement is 1KHz. What is the least count in terms of mass?

iii) Assume that on realizing the beam , the length and thickness of the beam reduces by 10%,By what percentage does the resonance frequency change?

2C. If a wafer goes through an ideal isotropic wet etching process with an etching rate of 1.6um/ min for 22 seconds, what will the vertical depth of the etch be in the silicon wafer? What will be the width of etch?

(5+3+2)

3A. Explain the construction of ISFET with neat sketch and mention its application for sensing devices.

3B. What is LIGA process. Explain the steps involved in fabricating microparts by means of the LIGA Process.

3C. Compare and contrast surface micromachining with bulk micromachining.

(5+3+2)

4A. What is phase shifter? Explain the principle of operation of a switched line phase shifter. What are the advantages of MEMS phase shifters over GaAs MMIC Phase shifters.

4B. Design a switched line phase shifter with a 22.5 degree phase shift at 4Ghz, on a substrate with a dielectric constant of 9.9.

4C. A proximity aligner is used to expose 1um aperture .The gap is 25um and the separation between the mask and g line source is 0.5m , what is the condition of diffraction?

(5+3+2)

5A. With neat diagram explain the working principle of diaphragm based micropump and model this micropump in order to express the volume rate or pumping speed at the atmospheric pressure.

5B. What are RF MEMS ? Mention the frequency range of operation? Compare MEMS based devices with GaAs FET's and other PIN diodes.

5C. What are the possible wafer bonding techniques?

(5+3+2)

6A. What are surface Plasmon's? Explain with neat diagram how surface Plasmon resonance technique used for sensing application.

6B. How does a MEMS gyroscope work? Explain coriolis force with a bicycle.

6C. The camera of spy satellite orbiting at 200km has a diameter of 25cm. What is the smallest distance this camera can resolve on the surface of the earth? Assume a wavelength of 500nm.

(5+3+2)