Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V1 SEMESTER BTECH DEGREE END SEMESTER EXAMINATION

AUG 2021

SUBJECT: MEMS TECHNOLOGY (ECE - 4306)

TIME: 2 HOURS **MAX. MARKS: 40M**

Instructions to candidates

- Answer **ANY FOUR COMPLETE** questions.
- Missing data may be suitably assumed.

1A.	Explain the construction of ISFET with neat sketch and mention its application for sensing devices.
1B.	With neat diagram explain any two wafer bonding techniques in MEMS.
	(5+5)
2A.	Anisotropic etching (KOH) is used to define a 200 µm thick hole in a <100> wafer. i) What should be the dimension on mask used for a) 400 µm thick wafer b) 600 µm wafer. ii) What would be the dimension of the microstructure if mask intended for the 400 µm thick wafer is used on the 600 µm thick wafer. Draw the cross section of the microstructure with dimensions.
2B.	The length, width, and thickness of a polysilicon microcantilever beam is 200 µm, 30 µm and 2 µm respectively: a) If the density of polysilicon is 2200 kg/m^3 and measured resonance frequency is 68 kHz, determine the young's modulus of the polysilicon. b) 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? Assume that on realizing the beam, the length and thickness of the beam reduces by 10%,By what percentage does the resonance frequency change.
	(5+5)
3A.	Discuss MTTF method for detection of E. coli in drinking water. What are the limitations of MTTF method and suggest MEMS bases sensor for testing for E. coli in water sample?
3B.	Explain the working principle of Biochip? What are the pros and cons of human Biochip Implantation?
	(5+5)
4A.	With the help of diagrams explain the different process steps involved in the surface micromachining technology for realizing a polysilicon microcantilever beam-based hydrogen sensor?
4B.	Discuss any one non-silicon technology for manufacturing MEMS. With neat diagram explain the steps involved in fabricating micro parts.

		(5+5)
5A.	Explain Polymerase chain reaction (PCR) with neat diagram. Discuss the limitations of PCR test for Covid 19 and suggest commercially available MEMS based sensor.	
5B.	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.	
		(5+5)
6A	What are surface Plasmon's? Explain with neat diagram how surface Plasmon resonance technique used for sensing application.	
6B	With simple diagrams discuss any 2 types of MEMS microstructures based microsensors? Explain with examples using any 4 measurands?	
		(5+5)