Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

V11 SEMESTER BTECH. (E & C) DEGREE END SEMESTER EXAMINATION
MAY -JUNE 2022
SUBJECT: MEMS TECHNOLOGY (ECE -4306)

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

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

Q. No.	Questions	M*	C*	A*	B*
1A.	Explain Polymerase chain reaction (PCR) with neat diagram. Discuss Covid 19 ELISA based antibody test.	5	CO 5		2
1B.	Explain the construction of E-nose system with a neat diagram and elaborate on the benefit of having arrayed devices in an e-nose sensor?	3	CO 3		2
1C.	A plane intercepts the X, Y, and Z-axis at 2,3,4 respectively. Obtain the equation for the plane. Write down the miller indices for this plane.	2	CO 1		3
2A.	Realize resonance-based microcantilever chemical sensor for the following specifications: L=200 µm, t=4 µm, w=10 µm. Assume the density of polysilicon =2200 kg/m^3. Find the resonance frequency of the beam. Assume E= 1.78x10^{11} .	5	CO 2		5
2B.	If the fluid has a viscosity of 0.4 Ns/m^2 and relative density of 900 Kg/m^3 through a pipe of 20 mm with a velocity of 2.5 m. Justify whether the flow mechanism is laminar or turbulent.	3	CO 4		5
2C.	If a silicon wafer goes through an ideal isotropic wet etching process with an etching rate of 1.6 µm/min for 22 seconds, what will the vertical depth of the etch be in the silicon wafer? What will be the width of etching?	2	CO 2		5
3A.	With neat microstructure explain an anyone case study of MEMS commercial products with background, design considerations, and application.	5	CO 3		2
3B.	Discuss the surface plasmon Resonance technique used for sensing applications. with a neat diagram.	3	CO 3		6
3C.	Explain any one non-silicon technology for manufacturing MEMS?	2	CO 2		6
4A.	Find the Reynolds number associated with two cases: i) a person swimming in a swimming pool filled with molases with a kinematic viscosity of 10,000	5	CO 4		6

	centisrokes and 1.8 m and swims at a woeful velocity of 0.1 m/s in the thick liquid and ii) a 1.8 mm long tadepole moving in water (with kinematic viscosity of 1 centistroke at a velocity of 1 cm/s.				
4B	What is RF-MEMS? Mention the frequency range of operation. Compare MEMS-based devices with GaAs FFT's and other PIN diodes.	3	CO 3		2
4C.	Compare and contrast wet chemical etching with the dry etching techniques used in MEMS Technology.	2	CO 2		4
5A.	Discuss the traditional approach of the MTTF technique for the detection of E. coli in drinking water. What are the limitations of this approach and suggest alternative advanced technology for the same?	5	CO 5		6
5B.	A 30µm thick membrane is needed for a pressure sensor application. Calculate the size of the mask opening W needed for the V-groove structure if the full wafer thickness is 600µm	3	CO 2		6
5C.	What are the purposes of having wafer, sacrificial material, and structural material in typical MEMS fabrication?	2	CO 1		2

M*--Marks, C*--CLO, A*--AHEP LO, B* Blooms Taxonomy Level