ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E /B. Tech /B. Arch (Full Time/Part Time) - END SEMESTER EXAMINATIONS, NOV/DEC 2024

B.E BIOMEDICAL ENGINEERING
V Semester
BM5014 MEMS AND ITS BIOMEDICAL APPLICATIONS
(Regulation 2019)

Time: 3hrs

Max.Marks: 100

CO 1	Discuss various MEMS fabrication techniques.
CO 2	Explain different types of sensors and actuators and their principles of operation at the micro scale level.
CO 3	Comprehend the characteristics of fluid flow and actuation through micro channels.
CO 4	Explain the need and use of CAD for MEMS design.
CO 5	Design MEMS devices for different medical applications.

BL – Bloom's Taxonomy Levels
(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)
(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	Write any four differences between surface microelectronics and microfabrication.	2	1	1
2	What is class room 10?	2	1	2
3	Draw the different types mechanical beams.	2	2	2
4	Name some of materials that are used as a thermal resistor.	2	2	2
5	Mention few merits and demerits of electrostatic based sensing and actuation.	2	2	1
6	What is poling in piezoelectric transducers?	2	2	1
7	List the properties of micro channels.	2	3	2
8	What is electro osmosis?	2	3	1
9	What is 3D printing? Mention its application in MEMS.	2	4	2
10	Write some name of CAD tools available for MEMS design.	2	4	1

PART- B (5 x 13 = 65 Marks)
(Restrict to a maximum of 2 subdivisions)

Q. No	Questions	Marks	CO	BL
11 (a)	With detailed explanations write the steps involved in photolithography process with suitable diagrams.	13	1	3
OR				

11 (b)	Explain the following in detail:
	   a) Deep Reactive Ion Etching
	   b) Chemical Vapor Deposition
		7
		
		6
			1	3

Q. No	Questions	Marks	CO	BL
12 (a)	Design an accelerometer with necessary equations and discuss the concept of damping frequency and quality factor of accelerometer.	13	2	4
	OR			
12 (b)	Discuss any two sensing and actuation based on thermal principle with illustrative examples.	13	2	4
13 (a) i)	Describe the working principle of micro gripper using comb drive actuation.	7	2	4
ii)	Assess the step-by-step process of actuation of inch worm motor with neat schematic.	6	2	4
	OR			
13 (b)	Design a straight actuated electrostatic sensor with its necessary derivations. Derive Pullin voltage and Pullin distance.	13	2	4
14 (a) i)	Derive the equation to find flow rate in micro fluidic channel.	6	3	3
ii)	Derive equation for momentum and equation of motion of fluid.	7	3	3
	OR			
14 (b) i)	Discuss the working principles of micro pumps and micro valves in micro fluids with suitable illustrative example.	7	3	3
ii)	Define Droplet based Micro actuation mechanism and discuss any one in detail.	6	3	3
15 (a)	Discuss the concept of DNA hybridization in PCR and explain how MEMS is used in PCR.	13	5	3
	OR			
15 (b) i)	Draw the block diagram of drug delivery system using MEMS and Explain microneedles and its types.	10	5	3
ii)	List the applications of micro total analysis system.	3	5	3

PART- C (1 x 15 = 15 Marks)
(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16. i)	Derive equations for calculation of pressure drop in a micro conduit of circular cross section under laminar flow condition considering frictional and surface tension forces.	10	3	5
ii)	Explain the basic principle of dielectrophoresis method of fluid actuation.	5	3	5