Register Number:……..

KUMARAGURU
college of technology
character is life

B.E DEGREE EXAMINATIONS: MAY 2018

(Regulation 2015)

Sixth Semester

MECHATRONICS

U15MCE204**:** Micro Electro Mechanical System

COURSE OUTCOMES

CO1: Explain the evolution of micro and smart system.
CO2: Illustrate about various sensors and actuating system.
CO3: Classify the Micro machining techniques in MEMS.
CO4: Evaluate a proper scaling method.
CO5: Determine packaging techniques in MEMS and smart system.
CO6: Discuss various applications of MEMS.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Match the items in List I with List II: CO2 [K_2]

List I	List II
A. Acoustic sensors	i. input photon energy by light
B. Biomedical sensors	ii. chemical compositions
C. Biosensors	iii. biomolecules
D. Optical sensors	iv. medical diagnosis

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	ii	iv

2. A major problem in microchannel flow is CO2 [K_2]

a) friction effect b) capillary effect
c) pressure distribution d) force distribution

3. Which one of the following statements are not true for polymers? CO6 [K_2]

1. Photoresist polymers are used to produce masks for creating unwanted patterns on substrates by photolithography.
2. Polymers are widely used for electromagnetic interference (EMI) and radio-frequency interference (RFI) shielding in microsystems.
3. Polymers are ideal materials for the encapsulation of microsensors and packaging of other microsystems.
4. Thin polymer films are used as electric insulators in microcapacitors and as a dielectric substances in microdevices.

a) 1,3 b) 1,4

c) 1,2 d) 2,3

4. For order 1 scaling such as surface-to-volume scaling, the acceleration varies CO4 [K_2]

a) linearly b) to the cubic power

c) inversely d) to the square power

5. Assertion (A): No microsystem can function without electric power. CO1 [K_2]

Reason (R): Electrical circuitry that provides the flow of electric current, is an integrated part of the system.

a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

6. One critical design consideration for microsystems is TTM, which stands for CO1 [K_2]

a) time to market b) total time management

c) targeted time market d) targeted time management

7. Identify the correct order of fabrication steps to be followed in LIGA process: CO3 [K_2]

1. Metal molds
2. Deep X-ray lithography
3. Photoresist with patterns
4. Electroplating of metal on patterns

a) 2-3-4-1 b) 1-3-2-4

c) 3-4-2-1 d) 4-1-3-2

8. Bulk manufacturing involves primarily — CO5 [K_2]

a) adding portions of material from the substrate
b) subtracting portions of material from the substrate
c) dividing portions of material from the substrate
d) both adding and subtracting portions of material from the substrate

9. Assertion (A): Silicon dioxide is used as an electric insulator as well as for etching masks for silicon and sacrificial layers in surface micromachining. — CO6 [K_2]

Reason (R): The least expensive way to produce silicon dioxide film on the silicon substrate.

a) Both A and R are Individually true and R is the correct explanation of A
b) Both A and R are Individually true but R is not the correct explanation of A
c) A is true but R is false
d) A is false but R is true

10. Common light sources used in photolithographic process have wavelengths in the range of — CO3 [K_2]

a) 100 to 300 nm
b) 500 to 700 nm
c) 300 to 500 nm
d) 700 to 900 nm

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. List out the components of a microsystem. — CO1 [K_2]
12. What are the two types of scaling laws that are applicable to the design of microsystems? — CO4 [K_2]
13. Why silicon is used as a substrate material for MEMS? — CO6 [K_2]
14. What are the uses of micro accelerometers? — CO2 [K_2]
15. Differentiate between positive resists and negative resists. — CO3 [K_2]
16. Name some parameters that affect the rate of chemical vapor deposition. — CO3 [K_2]
17. Give one advantage and one disadvantage of using surface micromachining. — CO5 [K_2]
18. Write a note on “Plasma etching”. — CO5 [K_2]
19. What are the design constraints to be considered for micro systems? — CO1 [K_2]
20. Define piezoelectric effect. — CO2 [K_1]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. Discuss in detail about the steps involved in the photolithography process for fabrication of micro devices. — CO3 [K_2]

22.	(i) Summarize the steps involved in LIGA process with a neat sketch.	(7)	CO5	[K_2]
	(ii) Explain any three applications of MEMS in automotive industry.	(7)	CO6	[K_2]
23.	(i) Describe how the scaling of power supply systems in MEMS can be affected by the increase in resistivity?	(7)	CO4	[K_3]
	(ii) Explain the working of micro grippers with a neat sketch.	(7)	CO2	[K_2]
24.	Explain the use of silicon compounds and polymers in the manufacture of MEMS devices.		CO3	[K_2]
25.	Discuss in detail about the different methods of actuating motions of micro devices.		CO2	[K_2]
26.	(i) Compare Microsystems and Microelectronics with examples.	(7)	CO1	[K_2]
	(ii) With the help of block diagram, describe the components needed to develop an intelligent microsystems.	(7)	CO1	[K_2]
27.	What are the general considerations in microsystem packaging design? Explain the three levels of microsystem packaging with a neat sketch.		CO5	[K_2]

****