USN | | | | | | | | | | |

23MEOE323

MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

Model Question Paper

Sixth Semester B.E Degree Examination

Micro-Electro-Mechanical Systems

Time: 3 Hours (180 Minutes) **Max. Marks: 100**

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M: Marks, L: RBT (Revised Bloom's Taxonomy) level, C: Course outcomes.

		Module -1	M	L	C
Q1	a.	Describe MEMS and explain its intrinsic characteristics.	06	L2	CO1
	b.	A cube with a side length of 8 mm is miniaturized by a factor of 0.2. Determine the change in the surface area to volume ratio. Discuss the results using scaling laws.	08	L3	CO2
	c.	Discuss the advantages and challenges of MEMS.	06	L2	CO1
		OR			
Q2	a.	Explain micro and nano-scale systems with examples.	06	L2	CO1
	b.	Determine the new surface area and volume of a cube with an initial side length of 10 mm when it is miniaturized by a factor of 0.1. Discuss the results using scaling laws.	08	L3	CO2
	c.	Explain the multidisciplinary nature of MEMS.	06	L2	CO1
		Module- 2			
Q3	a.	Explain silicon and quartz as MEMS materials.	06	L2	CO1
	b.	Describe photolithography with neat sketches.	08	L2	CO1
	c.	Distinguish between wet and dry etching.	06	L2	CO1
		OR			
Q4	a.	Explain thin-film deposition techniques used in MEMS	06	L2	CO1
	b.	Describe bulk micromachining with diagrams.	08	L2	CO1
	c.	With a neat sketch, briefly explain the LIGA process.	06	L2	CO1
		Module - 3			
Q5	a.	Explain pressure sensors used in MEMS.	06	L2	CO1
	b.	A polysilicon thermal micro-actuator beam of length 600 µm, cross-sectional area of 25 µm², coefficient of thermal expansion of 2.6×10^{-6} /°C, and Young's modulus of 160 GPa is subjected to a temperature rise of 200 °C and is fully constrained. Determine (i) the thermal displacement and (ii) the thermal force developed.	08	L3	CO3
	c.	Discuss the applications of micro actuators.	06	L2	CO1
		OR			
Q6	a.	Explain biomedical MEMS sensors.	06	L2	CO1
	b.	A NiTi SMA micro-wire actuator of length 12 mm, recoverable strain of 5%, Young's modulus in the austenite phase of 35 GPa, and cross-sectional area of 0.018 mm² is given. Determine: (i) the actuation displacement, and (ii) the maximum recovery force.	08	L3	CO3

	c.	Describe piezoelectric actuation with a neat diagram.	06	L2	CO1
Module - 4					
Q7	a.	Explain design constraints in MEMS.	06	L2	CO4
	b.	Describe the process design steps in MEMS fabrication.	08	L2	CO4
	c.	Write a short note on material selection for MEMS.	06	L2	CO4
OR					
Q8	a.	Explain photolithography in MEMS design.	06	L2	CO4
	b.	Describe mechanical packaging of microelectronics.	08	L2	CO4
	c.	Briefly explain the general considerations involved in MEMS packaging.	06	L2	CO4
Module - 5					
Q9	a.	Explain MEMS accelerometers used in airbag deployment.	06	L2	CO5
	b.	Describe gyroscopes used in automobile navigation systems.	08	L2	CO5
	c.	Discuss the commercial applications of MEMS.	06	L2	CO5
OR					
Q10	a.	Explain the working of inkjet printers using MEMS.	06	L2	CO5
	b.	Describe digital micro-mirror devices with applications.	08	L2	CO5
	c.	Write a short note on radio-frequency MEMS switches.	06	L2	CO5

-*****-