Registration No.: | | | | | | | | | | |

Total Number of Pages: 02

Course: B.Tech
Sub_Code: REI6D001

6th Semester Regular/Back Examination: 2024-25
SUBJECT: Micro Electronic Mechanical Systems
BRANCH(S): AEIE, ECE, ETC
Time : 3 Hours
Max Marks: 100
Q.Code: S177

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Enlist two materials commonly used in MEMS fabrication.
b) Briefly enlist the difference between isotropic and anisotropic wet etching techniques.
c) Define surface micromachining.
d) What is DRIE in MEMS technology?
e) How many basic elements exist in case of a thermal system?
f) What is a phase shifter? Enlist the applications of phase shifters.
g) Explain the concept of System-on-a-Chip (SoC) technology.
h) State the function of a MEMS gyroscope?
i) What role does silicon play in MEMS devices?
j) Illustrate the basic principle of a MEMS accelerometer.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Define bulk micromachining and surface micromachining. Highlight their key differences.
b) Compare dry etching and wet etching processes. What are the advantages and limitations of each in MEMS fabrication?
c) Explain the role of photolithography in MEMS device fabrication. How do positive and negative photoresists differ?
d) What do you understand from microfluidic system? Enlist important building blocks of microfluidic systems.
e) Briefly explain about the sputtering based thin film deposition technique.
f) What is meant by a microactuator? Discuss the basic types of microactuators used in MEMS systems.
g) What do you mean by piezomechanics? How does it differ from piezoelectricity?
h) Explain the process of anodic bonding in MEMS fabrication with the help of a neat diagram.
i) Discuss the concept of a microelectromechanical switch (MEMS switch). What are its applications?

j) Define the term spring, damper, and mass of an elemental mechanical system.

k) What do you mean by a wafer? What kind of material is commonly used for wafer? Enlist various wafers for different applications.

l) Discuss in detail about different actuation mechanisms in MEMS switches.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 **a)** What is the role of spin-coating in thin film deposition and how is it performed. Discuss in detail using neat skteches. **(8 x 2)**

b) Enlist the functional units of a typical PECVD system and explain the functions of each unit using neat diagrams.

Q4 **a)** Define piezoelectric effect and explain how piezoelectric materials are used in MEMS actuators. Give examples of MEMS devices using this effect. **(8 x 2)**

b) Describe the Young's modulus (E), Bulk modulus (K), Shear modulus (G), Poisson's ratio and discuss about their relationship using suitable equations.

Q5 **a)** Discuss the principle of operation of an RF MEMS switch using suitable diagram. Write the relevant electrostatic force and restoring force equations involved. **(8 x 2)**

b) Illustrate and explain the pull-in voltage phenomenon for an RF MEMS capacitive switch with appropriate graphs.

Q6 Write short note on following **(8 x 2)**

a) MEMS micromirror
b) Electro wetting