MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
*(A constituent unit of MAHE, Manipal)*

**DEPARTMENT OF MECHATRONICS ENGINEERING**

**VII SEMESTER B.TECH. (MECHATRONICS)**

**END SEMESTER EXAMINATIONS, December 2023**

**SUBJECT: SOFT ROBOTICS [MTE 4062]**

**02/12/2023**

**Time: 3 Hours** **MAX. MARKS: 50**

**Instructions to Candidates:**

- Answer **ALL** the questions.

| Q. No | | M | CO | PO | LO | BL |
|---|---|---|---|---|---|---|
| 1A. | With neat diagrams, illustrate the materials used, construction and working principle of PneuNets (pneumatic networks) the bending Actuators. | 5 | 1 | 1, 2 | 1, 2 | 4 |
| 1B. | Examine how can existing soft robots be classified based on basic bio-functions learned from creatures, and how does this classification help in applying robots in a targeted way? | 3 | 1 | 1, 2 | 1, 2 | 4 |
| 1C. | Analyze have deep-sea creatures like octopuses as to how they have influenced the design of soft robots endowed with mechanical intelligence? | 2 | 1 | 1, 2 | 1, 2 | 4 |
| 2A. | Explain the features that represent the model of a mechanical system. Based on these features explain hyper elasticity of soft materials. | 5 | 2 | 1, 2 | 1, 2 | 4 |
| 2B. | Illustrate with clear schematic diagrams the tactile sensing strategies which enable soft robots to perform intelligent tasks with feedback in the deep sea? | 2 | 2 | 1, 2 | 1, 2 | 4 |
| 2C. | Explain with neat diagrams the working principle, the material used for fabrication for HASEL Artificial Muscles. | 3 | 2 | 1, 2 | 1, 2 | 4 |
| 3A. | Illustrate how shape memory alloys (SMAs) work as an actuation mechanism in soft robots, and what are some examples of SMA-based soft robots? | 5 | 3 | 1, 2 | 1, 2 | 4 |
| 3B. | Illustrate the edible Actuator for Ingestible Robots. | 2 | 3 | 1, 2 | 1, 2 | 4 |
| 3C. | Illustrate with an example of Soft Fluidic Actuation. | 3 | 3 | 1, 2 | 1, 2 | 4 |

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|---|---|---|---|---|---|---|
| **4A.** | Discuss the mechanisms and properties of electrically responsive, thermally responsive, magnetically responsive, and photoresponsive actuators used in soft robots? | **5** | **3** | **1, 2** | **1, 2** | **4** |
| **4B.** | Discuss the different material used for fabricating textile strain sensors along with the working principle. | **2** | **3** | **1, 2** | **1, 2** | **4** |
| **4C.** | Explain with relevant schematic diagrams the working principle, materials used to fabricate chemical actuators used in soft robots. | **3** | **3** | **1, 2** | **1, 2** | **4** |
| **5A.** | Compare the different types of materials that can be patterned using ink-based printing methods?<br>How can 3D printing technology be used to produce a robotic hand with bones, ligaments, and tendons? | **4** | **4** | **1, 2** | **1, 2** | **4** |
| **5B.** | Present a meticulous design of soft robotic locomotion such as locomotion applications including<br>(i) flying,<br>(ii) swimming,<br>(iii) legged locomotion | **3** | **4** | **1, 2** | **1, 2** | **4** |
| **5C.** | For each locomotion mode mentioned in Q (5B), elaborate on the fundamental aspects of<br>(i) actuation type,<br>(ii) locomotion gaits,<br>(iii) control type | **3** | **4** | **1, 2** | **1, 2** | **4** |