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**History of MEMS Final Assessment**

**Instructor Guide**

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|  | Note to Instructor |
|  | This is the assessment of the student's knowledge of MEMS history. There are 15 assessment questions.  The *History of MEMS Learning Module* consists of the following:   * History of MEMS Knowledge Probe (Pre-Quiz) * History of MEMS Primary Knowledge * History of MEMS Activity * New Innovations in MEMS Activity * **History of MEMS Final Assessment**   This companion Instructor Guide (IG) contains both the questions and answers for the assessment questions. |

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|  | Introduction |
|  | The purpose of this final assessment is to test your knowledge of MEMS history.  This material involves the understanding of the major milestones that have occurred so far to create MEMS technology as we know it today. The assessment also tests your knowledge of major MEMS technologies.  There are fifteen (15) assessment questions. |

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|  | The following MEMS structure was manufactured using which process? |
|  | 1. Surface Micromachining 2. LIGA 3. Bulk Micromachining 4. SCREAM |

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|  | | LIGA Gear |
|  | *Answer: b. LIGA* | | |
|  | *These MEMS structures were manufactured using the LIGA process.* | | |

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|  | Which of the following is NOT a micromachining method? |
|  | * 1. Bulk   2. Surface   3. MOEMS   4. LIGA |

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|  | *Answer: c. MOEMS* |
|  | *MOEMS is an acronym for Micro Opto Electromechanical System, not a process for manufacturing microsystems.* |

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|  | The following MEMS device is built using which of the following processes? |
|  | 1. Bulk 2. SUMMiT IV 3. MOEMS 4. DRIE |

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|  | SummitIV |
|  | *Answer: B - SUMMiT IV* |

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|  | What type of bulk etch takes advantage of the crystallographic orientation properties of silicon?  \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

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|  | *Answer: Anisotropic* |
|  | *Bulk micromachining an* ***anisotropic*** *etch.* |

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|  | The following is an example of what kind of pressure sensor?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

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|  | MTTCPS |

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|  | *Answer: Piezoresistive* |
|  | *The image is an example of a* ***piezoresistive*** *pressure sensor.* |

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|  | Which of the following is NOT a MEMS processing technique? |
|  | 1. Bulk Micromachining 2. Surface Micromachining 3. BioMEMS 4. LIGA |

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|  | *Answer: c. BioMEMS* |
|  | *BioMEMS is a type of MEMS device used in biological applications, NOT a MEMS processing technique.* |

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|  | HP micromachined the first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in 1979, a device used in both commercial and personal products. |
|  | * 1. Resonant gate transistor   2. Ink-jet nozzle   3. Crash or inertial sensor   4. Electrostatic drive motors |

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|  | *Answer: b. inkjet nozzle* |

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|  | Who wrote the famous speech entitled "There's Plenty of Room at the Bottom"? |
|  | 1. Harvey Nathanson 2. Kurt Petersen 3. H. A. Waggener 4. Richard Feynman |

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|  | *Answer: d. Richard Feynman* |
|  | *Richard Feynman wrote this speech which encouraged the research and development of micro devices.* |

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|  | Which of the following was the first batch fabricated MEMS device? |
|  | 1. Inkjet nozzle 2. Resonant gate transistor 3. Optical switch 4. Integrated circuit |

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|  | *Answer: b. Resonant gate transistor* |
|  | *The resonant gate transistor was the first batch fabricated MEMS device.* |

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|  | Which of the following is NOT a bioMEMS application? |
|  | 1. Cell Culture 2. DNA Arrays 3. Drug Delivery 4. Accelerometer |

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|  | *Answer: d. accelerometer* |
|  | *An accelerometer is a MEMS component used in a variety of MEMS and bioMEMS applications.* |

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|  | The attraction between molecules, atoms and surfaces is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. |
|  | 1. Van der Waals 2. Feynman 3. Coriolis 4. Atomic force |

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|  | *Answer: a. Van der Waals* |
|  | *Van der Waals attraction is the attraction between molecules, atoms and surfaces.* |

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|  | Dr. Richard Feynman thought that physicists could advance biology research by doing what? |
|  | 1. Developing microsurgical devices 2. Making the electron microscope 100 times better 3. Overcoming Van der Waals forces 4. Creating biological computers |

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|  | *Answer: b. Making the electron microscope 100 times better* |

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|  | At the end of his speech, how did Dr. Feynman encourage the exploration of "small" technology? |
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|  | *Answer:*  *By offering a $1000 prize for two achievements:*  *Putting the information from a page of a book on an area 1/25,000 smaller in linear scale*  *Making an operating electric motor which fits inside a 1/64 inch cube* |
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|  | Dr. Feynman felt that lubrication would most likely NOT be an issue for components in the micro-scale due to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the micro-scale.  . |
|  | 1. Minimal force and rapid heat loss 2. The types of forces 3. The interactive forces 4. The lack of inertia and friction |

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|  | *Answer: a. minimal force and rapid heat loss* |
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|  | Which device did Dr. Feynman think could not be miniaturized? |
|  | 1. Electron microscope 2. Servo motor 3. Internal combustion engine 4. Pantograph |

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|  | | *Answer: c. Internal combustion engine*  *He thought the internal combustion engine could not be made small.* | | |
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