

1 - Introduction Concept Check

1 Multiple Choice 2 points

What are the primary types of radiation environments that can affect microelectronic devices?

- ☐ Only nuclear power environments due to the highly energetic particles
- ☐ Only automotive environments due to the high risk to humans
- ☐ Only terrestrial environments due to cosmic ray scattering
- ☐ Space, nuclear, medical, and terrestrial environments due to varied radiation types and intensities

2 Multiple Choice 2 points

Why is understanding **transistor structure and material composition** critical when evaluating radiation effects in microelectronics?

- ☐ Because radiation only impacts packaging, not internal device structures
- ☐ Because different materials (semiconductors, insulators, conductors) respond differently to radiation, influencing device behavior
- ☐ Because conductors are the only materials affected by radiation

3

Multiple Choice 2 points

Which of the following best describes a **Single-Event Upset (SEU)**?

- ☐ A gradual degradation of device performance due to ionizing dose
- ☐ A permanent failure in a transistor due to displacement damage
- ☐ A transient or permanent change in the state of a memory cell caused by a single energetic particle
- ☐ A packaging defect that causes alpha particle emission

4

Multiple Choice 2 points

What is **Total Ionizing Dose (TID)**, and how does it impact MOSFET devices?

- ☐ TID causes immediate burnout of the gate oxide
- ☐ TID improves device performance by enhancing conductivity in the semiconductor material
- ☐ TID results in trapped charge in insulators, leading to threshold voltage shifts and increased leakage
- ☐ TID results in trapped charge in conductors, leading to changes in resistivity

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Multiple Choice 2 points

What are the key differences between **Hardened by Design (HBD)** and **Hardened by Process (HBP)** approaches to radiation mitigation?

- ☐ There is no difference; both refer to system-level error correction
- ☐ HBD involves layout and circuit strategies; HBP involves material and structural changes
- ☐ HBD modifies materials, while HBP changes circuit topology
- ☐ HBD uses shielding; HBP uses redundancy