

Introduction to Biomaterials Quiz-1

1) A **biomaterial** is the substance used in or on the body, such as metals, polymers, or ceramics, to repair, replace, or enhance tissues and organs. A **biomedical device** is the complete instrument or system—which may incorporate biomaterials—used to diagnose, treat, or monitor a medical condition, such as a joint implant, heart valve, or cardiac rhythm stimulator. (20 points)

2) Please write 5 of the materials used in biomaterials in various forms: molded/machined parts, coatings, fibers, films, membranes, foams, fabrics, and particulates. (30 points)

- **Ceramics, Glasses, and Glass-Ceramics: Basic Principles**
- **Natural and Synthetic Hydroxyapatites**
- **Structural Ceramic Oxides**
- **Carbon Biomaterials**
- **Polymers: Basic Principles**
- **Polyurethanes**
- **Silicones**
- **Fluorinated Biomaterials**
- **The Organic Matrix of Restorative Composites and Adhesives**
- **Hydrogels**
- **Degradable and Resorbable Polymers**
- **Applications of "Smart Polymers" as Biomaterials**
- **Metals: Basic Principles**
- **Titanium Alloys, Including Nitinol**
- **Stainless Steels**
- **CoCr Alloys**
- **Biodegradable Metals**
- **Natural Materials**
- **Processed Tissues**
- **Use of Extracellular Matrix Proteins and Natural Materials in Bioengineering**
- **Composites**
- **Microparticles**

3) Why “World War II to Modern Era: Context Surgeon-Hero Era” term was important in the development of Biomaterials Science? (30 points)

This era was characterized by individual initiative and risk-taking.

After World War I, and particularly post-WWII, newly developed high-performance metal, ceramic, and polymeric materials became available. Materials originally manufactured for airplanes, automobiles, clocks, and radios were taken "off the shelf" by surgeons and applied to medical problems. Limited Collaboration: Just after WWII, there was little precedent for surgeons to collaborate with scientists and engineers. Necessity as Invention: Medical and dental practitioners invented and improvised when a patient's life or functionality was at stake.

Minimal Regulation: Government regulatory activity was minimal. Non-Existent Human Subject

Protections: The concept of human subject protections as known today did not exist. The "Surgeon-

Hero" Philosophy: Trust and Freedom: The physician was implicitly entrusted with the patient's

life and health, having much more freedom to take heroic action. Inspired by Materials Science:

Surgeons were aware of post-WWII material advancements and envisioned replacements for body

parts. High-Risk Trials: Many materials were tried on the spur of the moment, often when other

options were unavailable. Building the Foundation: Courageous, fiercely committed, and creative

individuals built the foundation of ideas and materials for the biomaterials field.

4) Please define “Biocompatibility of a biomaterial. (20 points)

Unique to biomaterials science, often defined by performance or success in a specific application rather than precise, universal measurements. The 'operational definition' (patient is doing well) provides little insight for new designs. Biocompatibility may need to be uniquely defined for each specific application (e.g., soft tissue, hard tissue, blood compatibility).