Title of the Core Area: "Bioengineering strategies for regenerative medicine and disease treatment"

Participating disciplines/academic units/departments, and the names of up to three individuals responsible for leading and organizing the collaborative cluster or research area.

i. Center for Bioengineering and Science, Department of Mechanical Engineering and Engineering Science
   a. Ahmed El-Ghannam (Organizer of collaborative cluster)
   b. Gloria Elliott (Organizer of collaborative cluster)
   c. Harish Cherukuri

ii. Department of Biological Science
   a. Ian Marriott (Organizer of collaborative cluster)
   b. Didier Dréau

iii. Department of Physics and Optical Science
   a. Irina Nesmelova

Target category for the submission: Existing and Emerging Excellence

Key words: Cell delivery system, hard and soft tissue regeneration, Drug delivery system, cancer and infection treatment, resorbable biomaterial, Orthopedic and maxillofacial implants.

2. **Executive Summary**:

Synopsis:

The "Bioengineering strategies for Regenerative medicine and disease treatment" Core Area encompasses three main clusters: Biomaterials for delivery of cells and biological molecules, cryopreservation technology and Molecular biology. The objective of the core area is to carry out fundamental bioengineering research that advances understanding of cellular and biomolecular processes at the interface with biomaterials. The research program may lead to the development of enabling technology for advanced biomanufacturing in support of the therapeutic cell, biochemical, biopharmaceutical, and biotechnology industries. The team members of the core area have already participated collaborative research projects that aim at development of new strategies for disease treatment and tissue regeneration.

Evidence supporting nomination as an existing area of excellence/unique distinction

The 21st Century Cures Act aims to accelerate progress in the field of regenerative medicine by supporting clinical research on adult stem cells, while promoting scientific rigor and protecting patient safety. This initiative prompted the NIH to announce The Regenerative Medicine Innovation Project (RMIP), in coordination with the Food and Drug Administration (FDA).

A major strategy for regenerative medicine approach is to combine different types of biomaterials with cells such a mesenchymal stem cells to replace the structure and function of a tissue or promote tissue formation. The team members Drs. El-Ghannam, Elliott and Marriott have worked together in this research area, jointly supervised students and published several articles in peer reviewed journals. Tissue engineering approach to treat diseases is to use biomaterial as a carrier for biological molecules such as growth factors, RNA or peptides to signal cells in a given tissue, treat disease, treat trauma or restore organ function. The team members Drs: El-Ghannam, Cherukuri, Dreau, Nesmelova, and Marriott have worked together and published on sustained release of various anticancer drugs, antibiotics and growth factors from biomaterials and the cellular response to the released drug. These research projects attracted funds from biotech company and DOD. Undergraduate and graduate students have worked in all studies and got unique multidisciplinary training.

The research program of the "*"Bioengineering strategies for Regenerative medicine and disease treatment"*" core area will focus on the use of injectable resorbable bioceramic as a drug carrier for treatment of cancer and infection in soft and hard tissues. A second objective will target cryopreservation of porous matrix seeded with cells as a future graft for regeneration of bone and soft tissue. Cryopreservation of in vitro synthesized bone and cells in a porous resorbable bioceramic template is a new approach that has not been thoroughly investigated. If successful, preservation of cells on a bioceramic template will not only provide a steady supply for transplantation but can also facilitate FDA trials. The preserved engineered tissue and cells inside the bone bioceramic can impact storage, banking and transportation of engineered tissues, as well as expand the geographical regions that can be served by a native tissue pool, thereby treating more patients and reducing health care costs.