

Regenerative Medicine (MMD-990)

Credit Hours 3 (3-0)

Course Description

Regenerative medicine is a way of helping to promote healing of damaged tissue by enabling the body to regenerate new tissue to replace what has been damaged or lost. It is distinctly different in that it promotes actual healing rather than simply treating the symptoms of injury or disease through medication and medical devices.

Regenerative medicine is not a new concept. Every day, more doctors and medical clinics are coming to realize that regenerative medicine is not only helpful for all sorts of diseases, congenital issues and trauma, but it also promises to be an important part of the future of medicine globally.

Educational Objective

The course aims to provide an insight into the current knowledge, future potential use and development of regenerative medicine.

- This course will introduce interdisciplinary training in the field of stem cell research, regeneration biology, tissue engineering and clinically human biology and pathology with the aim to perform research/work on regulatory Regenerative Medicine.
- The contents will elaborate the different principles of Regenerative Medicine and tissue engineering.
- The contents will elaborate about current applications and methods of analysis and modification of stem cells and model organisms, human cell technologies, tissue engineering, current and potential applications in clinical diseases as well as regulatory aspects in the development of regenerative therapies.

Course Outcomes

After completing this course the students would be able to:

- Acquire advanced knowledge in stem cell biology, cellular regeneration, biomaterials and describe methods to engineer, replace damaged or destroyed cells
- Account for regenerative medicine applications to human diseases
- Account for and evaluate current theories, methods and techniques within the research field, their practical execution and application

Course Contents

1. Introduction to Regenerative Medicine and Tissue Engineering (Definition, History)
2. Human development (From embryo to cell lineage; cleavage, cell diversity, germ layers and gastrulation, axial organization, organogenesis)
3. Cellular Programming, Reprogramming and Regenerative Medicine
4. Cellular aspects of Regenerative Medicine, Biology and concept of Stem Cells, Stem cells in organ maintenance and Injury Repair, Stem cells engineering and their clinical applications like
 - Induced Pluripotent Stem Cells
 - Embryonic Stem Cells
 - Adult Stem Cells
 - Hematopoietic Stem Cells
 - Bio banking of stem cells and the ethical considerations
5. Biomaterials and tissue bioengineering
 - Overview and Chemistry of biomaterials
 - Extra Cellular Matrix Scaffolds (Natural origin materials processing, modifications and performance, Synthetic polymers, collagen based scaffold materials, Hydrogels)
 - Regeneration of liver tissues/organ
 - Degeneration and Regeneration of the Nervous System
 - Cardiac, skin and Cartilage tissue Regeneration
 - Cell therapies for blood substitutes
 - In vivo Regeneration of Tissues by cell transplantation, Use of stem cells in burns and wounds, ocular diseases, diabetes etc

6. Regenerative Nano medicine
7. Techniques used in Regenerative Medicine
 - Cell harvest, cell culture, expansion, cell transplantation (autologous and allogeneic)
 - Cell Culture Models (3-D Culture/model in bioreactor system), coculture, vascularization, Barrier models in Regenerative Medicine and Tissue Engineering
 - Flow Cytometry and Imaging System
8. Regenerative Medicine (Current Therapies and future directions)
9. Advances in Regenerative Medicine
10. Ethical concerns/issues in Regenerative medicine

Recommended Books

1. Atala, A., Lanza, R., Mikos, T., & Nerem, R. (Eds.). (2018). *Principles of regenerative medicine*. Academic press.
2. Lanza, R., Langer, R., Vacanti, J. P., & Atala, A. (Eds.). (2020). *Principles of tissue engineering*. Academic press.
3. Steinhoff, G. (Ed.). (2016). *Regenerative Medicine-from Protocol to Patient: 1. Biology of Tissue Regeneration* (Vol. 1). Springer.
4. Vertes, A. A., Qureshi, N., Caplan, A. I., & Babiss, L. E. (2015). *Stem Cells in Regenerative Medicine*. Wiley-Blackwell.