

STEM CELL TECHNOLOGY

Programme Structure-2018

Course Code	Course Title	Lecture (L) Hours /Week	Tutorial (T) Hours /Week	Total Credits
SCT2151	Introduction to Stem Cell Technology	3	-	3
SCT2251	Fundamental Human Embryology & Developmental Biology	3	-	3
SCT2351	Fundamental Cell Biology and Human Anatomy & Physiology	3	-	3
SCT2451	Human Pluripotent Stem Cell Culture & Differentiation Methods	3	-	3
SCT2551	Therapeutic Applications of Human Pluripotent Stem Cells	3	-	3
SCT2651	Project & Paper Presentation	-	-	3
	TOTAL			18

STEM CELL TECHNOLOGY

Syllabus - Semester First

INTRODUCTION TO STEM CELL TECHNOLOGY

Course Code: SCT2151

Credit Units: 03

Course Objective: The objective of this paper is to familiarize the students with stem cell technology and its applications for betterment of the society. The course is designed to give a broad view of mammalian stem cells, reviewing where they are found in the body, the different types and how they are cultured. The topics will cover the basic biology of these stem cells as well as bioengineering and application of these stem cells to potential treatments of human diseases.

Course Contents:

Module I: Introduction to stem cells

Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.

Module II: Types of stem cells.

Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology

Module III: Therapeutic applications of stem cells

Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, **Gene Delivery** methods: Viral vectors and Non-viral Vectors

Module IV: Ethical Issues associated with stem cell-based regenerative medicine field

Regulatory and Ethical Considerations of stem cell and Gene Therapy, Assessing Human Stem Cell Safety, Use of Genetically Modified Stem Cells in Experimental Gene Therapies.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Stem Cell Biology, Daniel Marshak, Richard L. Gardner and David Gottlieb, Cold Spring Harbour Laboratory Press
- Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press
- Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, *Alexander Battler, Jonathan Leo*, Springer,

References:

- Stem Cell Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. (£65.00.) Wiley, 1998.
- Progress in gene therapy, Volume 2, Pioneering stem cell/gene therapy trials, Roger Bertolotti, Keiya Ozawa and H. Kirk Hammond, VSP international science publishers
- Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003,
- Human Embryonic Stem Cells: The Practical Handbook by Stephen Sullivan and Chad A Cowan.

Syllabus - Semester Second

FUNDAMENTAL HUMAN EMBRYOLOGY AND DEVELOPMENTAL BIOLOGY

Course Code: SCT2251

Credit Units: 03

Course Objective: The objective of this course is to familiarize students with fundamental process of human embryology and developmental biology and progression of pluripotent stem cells through different phases of development.

Course Contents:

Module-I: Basics principles of human embryogenesis--gametogenesis, fertilization and embryo development.

Module-II:

Ectoderm, mesoderm and endoderm development and process of organogenesis during human development.

Module-III:

Molecular regulation of embryogenesis and organogenesis processes during human development.

Module-IV:

Different types of stem cells, process and mechanism of stem cell subset development and their spatial organization during human development.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Human embryology and developmental biology 5th Edition by Bruce M. Carson.
- Larsen's Human Embryology (Schoenwolf,Larsen's Human Embryology) 4th Edition
- Atlas of Human Anatomy (Netter Basic Science) 7th Edition
- Developmental Biology, S.F. Gilbert, Sinauer Associates Inc.
- Gray's Anatomy for Students 3rd Edition by Richard Drake, Wayne Vogl and Adam W. M. Mitchell.

References:

- The Developing Human: Clinically Oriented Embryology 10th Edition by Keith L. Moore, T. V. N. Persaud MD and Mark G. Torchia.
- Developmental Biology, Tenth Edition 11th Edition by Scott F. Gilbert.
- Molecular Developmental Biology 2nd Edition by T. Subramoniam.

Syllabus - Semester Third

FUNDAMENTAL CELL BIOLOGY, HUMAN ANATOMY AND PHYSIOLOGY

Course Code: SCT2351

Credit Units: 03

Course Objective: The objective of this course is to familiarize students with basic organization of adult somatic cells, human anatomy and normal physiology. Students will learn basic principles and mechanisms that dictate maintenance of pluripotency in pluripotent stem cells and their differentiation into adult stem cells, somatic cells, tissues and organs.

Course Contents:

Module-I:

Cell anatomy, organizational components, cell division mechanisms in normal adult cells and in pluripotent stem cells.

Module-II:

Introduction to epigenetics and its role in maintenance of pluripotency and differentiation of pluripotent stem cells into different somatic cell lineages.

Module-III:

Basics of Human anatomy & physiology and role of pluripotent stem cells and adult stem cells in maintenance of normal

Module-IV:

Effect of breach in normal cellular physiology and homeostasis on human development.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Molecular Biology of the Cell. B. Alberts, D. Bray, J. Lewis, M. Raff, K. Roberts and J.D. Watson, Garland Publishing
- Cell Biology, Thomas D. Pollard MD
- Atlas of Human Anatomy (Netter Basic Science) 7th Edition
- Gray's Anatomy for Students 3rd Edition by Richard Drake, Wayne Vogl and Adam W. M. Mitchell.

References:

- The Developing Human: Clinically Oriented Embryology 10th Edition by Keith L. Moore, T. V. N. Persaud MD and Mark G. Torchia.
- Gene VIII, Benjamin Lewin 2005, Oxford University Press
- Cell and Molecular Biology, Gerald Karp, John Wiley and Sons Inc.
- Cell and Molecular Biology, DeRobertis, B.I. Publication Pvt. Ltd.

Syllabus - Semester Fourth

HUMAN PLURIPOTENT STEM CELL CULTURE & DIFFERENTIATION METHODS

Course Code: SCT2451

Credit Units: 03

Course Objective: The objective of this paper is to provide students greater understanding of different types of stem cells.

Course Contents:

Module-I:

Isolation of human Embryonic stem cells, generation of human induced pluripotent stem cells. History of human pluripotent stem cell development.

Module-II:

Methodologies for pluripotent stem cell culture, characterization of pluripotency and differentiation into different lineages.

Module-III:

Methods to engineer pluripotent stem cells for treatment of genetically impaired conditions/diseases.

Module-IV:

Ethical and regulatory issues affective pluripotent stem cell-based cell replacement therapies. Technological challenges towards development of pluripotent stem cell-based cell replacement therapies.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

- Human Pluripotent Stem Cells: Methods and Protocols (Methods in Molecular Biology) 2011th Edition by Philip H. Schwartz (Editor), Robin L. Wesselschmidt.
- Atlas of Human Pluripotent Stem Cells: Derivation and Culturing (Stem Cell Biology and Regenerative Medicine) 2011 by Michal Amit and Joseph Itskovitz-Eldor.
- Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, *Alexander Battler, Jonathan Leo*, Springer,

References:

- Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press
- Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press

Syllabus - Semester Fifth

THERAPEUTIC APPLICATIONS OF HUMAN PLURIPOTENT STEM CELLS

Course Code: SCT2551

Credit Units: 03

Course Objective: The objective of this paper is to familiarize students with different therapeutic areas that can benefit with pluripotent stem cell-based cell replacement therapies.

Course Contents:

Module-I:

Principles of cell replacement therapy and application of pluripotent stem cells in cell replacement therapy.

Module-II:

Application of pluripotent stem cells in neuronal disease management and treatment.

Module-III:

Application of pluripotent stem cells in ocular and cardiovascular diseases management and treatment.

Module-IV:

Application of pluripotent stem cells in treatment of autoimmune complications and cancer management and treatment.

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	15	5	10	70

Text & References:

Text:

- Frontiers in Pluripotent Stem Cells Research and Therapeutic Potentials Bench-To-Bedside, 2018, by Kuldip S. Sidhu.
- Patient-Specific Induced Pluripotent Stem Cell Models: Generation and Characterization (Methods in Molecular Biology) 1st ed. by Andras Nagy (Editor) and Kursad Turksen (Editor)
- Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, *Alexander Battler, Jonathan Leo*, Springer.

References:

- Stem Cell Biology and Gene Therapy. Quesenberry PJ, Stein GS, eds. (£65.00.) Wiley, 1998.
- Stem Cells Handbook: Stewart Sell, Humana Press; Totowa NJ, USA; Oct. 2003.
- Frontiers in Pluripotent Stem Cells Research and Therapeutic Potentials Bench-To-Bedside, 2018, by Kuldip S. Sidhu.

Syllabus - Semester Sixth

PROJECT & PAPER PRESENTATION

Course Code: SCT2651

Credit Units: 03

Course Objective: The objective of this course is to help students acquire scientific skills to formulate research hypothesis and design research projects to test those hypotheses. The course will also help students to acquire/improve research presentation skills.

Course Contents:

Examination Scheme:

Components	CT	Attendance	Assignment/ Project/Seminar/Quiz	EE
Weightage (%)	-	-	100	-