

## Course handout Part-II

Date: 10.04.2020

Course No : **BIOG515**

Course Title : **Stem Cell and Regenerative Biology**

Instructor -in-charge : **PRAGYA KOMAL**

Instructors : Pragma Komal, NagaMohan, Pranay Amruth and Minali Singh

### 1. Course Description:

This course is intended to provide a comprehensive overview of current understanding of stem cells, including their basic properties and interactions. The lectures will be organized into 3 sections. The first section will give an overview of embryonic & adult stem cells and their basic characteristics. This area will discuss general methods and unifying features and lay foundation for subsequent sections. The 2nd section will focus on Stem Cells in Tissues and Organ Development (Regenerative Medicine). The final section will focus on iPSCs, stem cell isolation methods, immunologic properties & potential therapeutic use of stem cells.

### 2. Scope and Objective of the Course:

The aim of this course is to provide an introduction to the subject of stem cells and approaches to regenerative biology. Stem cells have generated considerable interest recently in the scientific, clinical, and public arenas. It is essential that we gain a broader understanding of the factors that regulate the biology of stem cells: their ability for self-renewal, differentiation and plasticity, as well as the differences between embryonic and adult stem cells, and whether stem cells can be manipulated to replace cells in diseased tissues. Stem cells will also be discussed in the context of cancer and neurological disorders.

### 3. Text Book:

- (i) **Robert Lanza. Essentials of Stem Cell Biology. 2006. Elsevier's, 2<sup>nd</sup> edition**

### 4. Reference Books:

- (i) Walter C. Low. 2008. Stem Cells and Regenerative Medicine. World scientific, 1<sup>st</sup> edition.
- (ii) Deb & Totey. 2009. Stem Cells; Basics and Applications. Tata Mc Graw Hill, 1<sup>st</sup> edition.

### 5. Course Plan (Text Book- TB; Reference Book- RB; Chapter-Ch; Hand Out- Research articles &/or reviews):

Lect. #	Learning Objectives	Topics to be Covered	Reference
SECTION I			

1-2	Prelude and Introduction	Overview of the Course, Definitions, Types, Characteristics, ES-Like Cells, Origin, Culture, growth and maintenance of ES cells	Part-1 TB
3-4	Adult Stem Cells	Types, Plasticity, Trans-differentiation, Characteristics, Multi-drug resistance	Ch-3 TB
5-7	Pluripotency-Molecular Control and Stem Cell Niche	Signal Transduction- Extracellular Factors and Cytokines	Part I and Part II TB (Ch 4)
8-10	Transcriptional Regulation of Stem Cells	Oct4, Sox2, Nanog- Regulation and Function; p53 & stem cells,	Part IV TB, Hand Out
11-13	Stem Cells for Nervous System	Neural Stem Cells and their Differentiation and Therapeutic Perspectives; NSCs growth and maintenance <i>in-vitro</i>	Ch- 8 TB Reviews and articles
14-15	Stem Cell Renewal and Niche	Homeostasis, Metabolism, Types of Niche	Ch-5,6 TB Reviews and articles
16-17	Mesenchymal Stem Cells (MSCs)	MSCs Origin, Property, Immunogenicity, Application in Neurodegenerative Diseases	Part II TB Ch-8, 23 RBiii; Hand Out; Case studies Reviews
18-19	Embryonic Stem Cells (ESCs)	Cell Differentiation in Embryo, Amniotic Fluid and Cord Blood Derived Stem Cells; ESCs differentiation into Embryoid bodies	Part II and III TB, (Ch 12-13, 15-16) Ch-6 RBiii
20-21	Primordial Germ Cells (PGCs)	Fragilis, Stella, Molecular Control of Migration of PGCs	Ch 12 RBi, Hand Out; Articles
SECTION II			
22-23	Haematopoietic Stem Cells	Evidence, Property, Source, Genetic Control; Growth Factor & Regulation	Ch-22-23 TB, Articles

24-25	Cancer Stem Cells (CSCs)	Cancer Clonality, CSC Origin, CSC & Metastasis, Therapeutic Implications	Ch-12 TB; Ch-24 RBiii Hand Out
26-27	Cardiac Stem Cells, Hepatic Oval Cells and Gastro-intestinal Stem Cells	Cardiac Stem Cells and Regeneration; Renal Stem Cell, Oval Cells and Repopulating Cell, GI-Stem Cells	Ch 29, 32, 34 TB
28-29	Epigenetic Control over Stem Cells	Histone, Bivalent Structure, PCG, NuRD Complex and miRNA & stem cells	Part IV TB (Ch 18-19)
30-31	Cell Cycle Control of Stem Cells and Senescence	Stem Cell Quiescence, Cyclin-CDKs, Rb, p53 Chromatin Modifications, Ageing	Part III and IV TB; (Ch 26-27, 29, 31-32) Ch17-18 RBiii Ch
32	Multipotent Adult Progenitor Cells (MAPCs)	MAPCs and its Advantages in Therapy	Hand Out
SECTION III			
33	Induced Pluripotent Stem Cells (iPSCs)	Properties & Methods to derive iPSCs, A Visit to Yamanaka's Experiment	Part IV and V TB; Hand Out
34-37	ESCs in Diabetes Therapy	B-Cell Replacement; Drug Discovery & Development.	Part IV and V TB Ch-9, 15 RBiii
37-38	Potential Uses of Stem Cells, Obstacles and Gene Therapy	Heart, Vascular System, Neurons, Skin & Spinal Cord, Bioprinting	Part IV and V TB
39-40	Characterization, Isolation and Maintenance of Stem Cells	Human & Murine Embryonic Stem Cells; Matrigel, Serum & Feeder Free Culture, Surface markers.	Ch 35-36; 38, 40-42, 45, 47;48 TB
41	Stem Cell Current Perspectives and Conclusion	Mostly Review of Current Status of Stem Cell Research	Part VI TB

## 6. Evaluation Scheme:

EC No.	Evaluation Component	Duration	Weightage %	Date, Time & Venue	Remarks
1	Announced Quizzes	Variable	20 (40M)	<b>Premid-sem quiz (20M) were conducted on 4<sup>th</sup> and 27<sup>th</sup> Feb 2020</b>	CB
2	Mid-Sem	90 Min.	20 (40M)	<b>4.03.20; 9-10:30a.m; F202</b>	CB
3	Assignments	-----	10 (20M)	Received and marked using Turnitin Software	OB
4	Presentation	-----	15 (30M)		OB
5	Comprehensive	3 Hrs.	20 (40M)  15 (30M)	<b>06.05.20 (AN)</b>	CB  OB

## 7. Grading Policy:

Award of grades would be guided by the histogram of marks. Decision for cases on borderline of two grades will be based on the student's promptness and participation in classroom activities as well as satisfactory attendance in lecture and tutorial classes. If a student misses even a single component entirely or does not give sufficient opportunity for being assessed, he/she may be awarded 'NC' report regardless of his/her final total score in the course (see Clause 4.19 of *BITS Academic Regulations*).

## 8. Office Consultation:

By prior appointment obtained in person or by email (pragya@hyderabad.bits-pilani.ac.in).

**9. Make-up Policy:**

Make-up for Mid-Sem and Compre will be granted only if candidate is sick and hospitalized with appropriate evidence of illness. No make-up will be granted for Quizzes, assignments and presentation under any circumstances.

**10. Course Announcements and Notices:**

Announcements pertaining to the course will be made in the CMS. In some cases, printed notices shall be displayed in the notice board of only the Department of Biological Sciences.

**11. Academic Honesty and Integrity Policy:**

Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-in-Charge**

**BIOG515**