BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
SECOND SEMESTER 2019-20

Course handout Part-II

Date: 07.01.2020

Course No : **BIOG515**

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

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

Instructors : Pragya Komal, NagaMohan

1. **Course Description**:

Introduction to stem cells and regenerative biology; embryonic stem cells, adult stem cells, manipulation of stem cells for replacing cells in diseased tissues; transplantation of embryonic and adult stem cells, replacing congenitally defective organs and damaged organs, tissue engineering, biodegradable and biocompatible materials, nano-devices, and regulatory perspectives.

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, 2nd edition**

4. **Reference Books:**

(i) Walter C. Low. 2008. Stem Cells and Regenerative Medicine. World scientific, 1st edition.

(ii) Deb & Totey. 2009. Stem Cells; Basics and Applications. Tata Mc Graw Hill, 1st ed ition.

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,	Part-1 TB

		Origin, Culture, growth and maintenance of ES cells	
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 *in-vitro*	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)	4/3 , 9:00 – 10:30 AM	CB
2	Mid-Sem	90 Min.	20 (40M)		CB
3	Assignments	-----	10 (20M)		OB

4	Presentation	-----	15 (30M)		OB
5	Comprehensive	3 Hrs.	20 (40M) 15 (30M)	06/05 AN	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. Chamber Consultation Hours:

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 on 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

BIO G515