BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, Pilani
Pilani Campus
Instruction Division
SECOND SEMESTER 2015-2016 (Course Handout)

In addition to part-I (General Handout for all courses) printed on page 1 of the Timetable book, this portion gives further specific details regarding the course.

Course No : **BIOG515**
Course Title : **Stem Cell and Regenerative Biology**
Instructor -in-charge : **Rajdeep Chowdhury**
Instructors : **Sudeshna Mukherjee**

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. The final section will focus on iPSCs, stem cell isolation methods, immunologic properties & potential therapeutic use of stem cells.

1. 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 the use of stem cells for cancer therapies.

2. Text Book:
(i) Stem cells; Potten, C.S., ed. 1st ed., 1997 printed in India in 2006.

3. Reference Books:
(i) Robert Lanza. Essentials of Stem Cell Biology. 2006. Elseviers.
(ii) Walter C. Low. 2008. Stem Cells and Regenerative Medicine. World scientific
(iii) Deb & Totey. 2009. Stem Cells; Basics and Applications. Tata Mc Graw Hill.

4. 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.	Ch-**1** TB; Ch-**1** RBi
3-4	Adult Stem Cells	Types, Plasticity, Trans-differentiation, Characteristics, Multi-drug resistance	Ch-**3** RBi
5-7	Pluripotency- Molecular Control and Stem Cell Niche	Signal Transduction- Extracellular Factors and Cytokines	Ch **4** RBi

8-10	Transcriptional Regulation of Stem Cells	Oct4, Sox2, Nanog- Regulation and Function; p53 & stem cells,	Hand Out
11-13	Epigenetic Control over Stem Cells	Histone, Bivalent Structure, PCG, NuRD Complex and miRNA & stem cells	Ch- **8** RBi; Ch-**8**, **23** RBiii, Hand Out
14-15	Stem Cell Renewal and Niche	Homeostasis, Metabolism, Types of Niche	Ch-**5,6** RBi
16-17	Cell Cycle Control of Stem Cells and Senescence	Stem Cell Quiescence, Cyclin-CDKs, Rb, p53 Chromatin Modifications, Ageing	Ch- **7-8** RBi; Ch-**8**, **23** RBiii; Hand Out
18-19	Embryonic Stem Cells (ESCs)	Cell Differentiation in Embryo, Amniotic Fluid and Cord Blood Derived Stem Cells	Ch **12, 15-16** RBi; Ch-**6** RBiii
20-21	Primordial Germ Cells (PGCs)	Fragilis, Stella, Molecular Control of Migration of PGCs	Ch **12** RBi, Hand Out
	SECTION II		
22-23	Haematopoietic Stem Cells	Evidence, Property, Source, Genetic Control; Growth Factor & Regulation	Ch-**13-14** TB; Ch-**21**RBiii; Ch-**22-23** RBi
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** RBi
28-29	Stem Cells for Nervous System	Neural Stem Cells and their Differentiation and Therapeutic Perspectives	Ch **18-19** RBi
30-31	Mesenchymal Stem Cells (MSCs)	MSCs Origin, Property, Immunogenicity, Application in Neurodegenerative Diseases	Ch **26-27** RBi; Ch**17-18** RBiii Ch **29, 31-32** RBi
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	Hand Out
34	ESCs in Diabetes Therapy	B-Cell Replacement; Drug Discovery & Development.	Ch-**9, 15** RBiii
35-36	Potential Uses of Stem Cells, Obstacles and Gene Therapy	Heart, Vascular System, Neurons, Skin & Spinal Cord	Ch **52, 53, 54, 56, 61-63** RBi
37-38	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** RBi
39	Stem Cell Current Perspectives and Conclusion	Mostly Review of Current Status of Stem Cell Research	Hand Out

5. Evaluation Scheme:

Component	Duration	Weight	Date and Time	Venue (Rm. #)	Remarks
Mid-term	90 min.	30%	18/3 4:00- 5:30 PM	NB*	-
Quizzes	Variable	20%	To be announced in class		Several quizzes, some pre-announced
Assignments and Journal Club (research paper presentation)	-	10%	Presentation date and topic to be announced a week in advance		
Comprehensive Examination	3 hours	40%	13/5 AN	NB	Partly open-book type

6. 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*).

7. Office Consultation:
By prior appointment obtained in person or by email (rajdeep.chowdhury@pilani.bits-pilani.ac.in).

8. Make-up Policy:
For a foreseen absence, make-up request should be made *in person* to the Instructor-in-Charge, well before the scheduled evaluation component. Reasons for unanticipated absence that qualify a student to apply for make-up include medical or similar personal emergencies only; in such an event, the student should contact the Instructor-in-Charge as soon as practically possible. Make-ups for journal club presentations and quizzes/assignments are not usually given. For regulations about the make-up flexibility, students are advised to refer to Clause 4.07 of *BITS Academic Regulations*

9. Course Announcements and Notices:
Announcements pertaining to the course will be made in the lecture/tutorial class. In some cases, printed notices shall be displayed in the notice board of only the Department of Biological Sciences.

Instructor-in-Charge
BIOG515