



D. Y. Patil University

D.Y. PATIL EDUCATION SOCIETY KOLHAPUR DEEMED UNIVERSITY

(Declared under section 3 of the UGC act 1956)

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POST GRADUATE DIPLOMA PROGRAM IN STEM CELLS & REGENERATIVE MEDICINE

COURSE CURRICULUM

***P.G. Dip. (Stem cell & Regenerative Medicine)
(PGDSCRIM)***

Credit System



BL-PGDSCRM-01: Introduction

With a bright future seen in the upcoming field of stem cell and regenerative medicine, Dept. of Stem cell and Regenerative Medicine has initiated a weekend Post Graduate Diploma in stem cells and Regenerative Medicine, for giving most potential benefits in student's career by adding light to the existing career without any waste of time.

BL-PGDSCRM-02: Vision, Mission and Goal

Mission

The mission of the course is to impart in-depth knowledge on different types of stem cells and its in-vitro and in-vivo applications, scope and hope of stem cells and so on in a short period of time effectively. Besides, the syllabus is set in such a way, students gets well equipped with not only stem cells but also other interdisciplinary subjects with a strong base for success in life.

Vision and Goal

- To cultivate a broad range of interdisciplinary stem cell research (i.e., basic and translational stem cell biology research)
- To train future leaders for education, research and delivery of novel therapies using stem cells.
- Develop experimental models for use of stem cells to alter physiological and developmental characteristics of tissues and organ systems involved in disease processes.
- To seek a leadership role in basic and translational stem cell research through developing innovative, multidisciplinary collaborative approaches.

Learning outcome:

- Additional qualification helps to built a strong career path
- Extensive theoretical and practical knowledge on Stem cells and Regenerative medicine in a short period of time
- Exposure to sophisticated instruments
- Wide Job opportunities in industries, companies, universities and other laboratories
- Increases the opportunities to pursue higher studies in foreign countries



BL-PGDSCRM-03: Syllabus

Theory Papers	Theory paper marks	Internal marks	Total marks
(Paper I) PGDSCRM 1: Molecular Cell Biology	80	20	100
(Paper II) PGDSCRM 2: Developmental Biology	80	20	100
(Paper III) PGDSCRM 3: Embryonic and adult stem cells	80	20	100
(Paper IV) PGDSCRM 4: Disease and applications of stem cells	80	20	100
Practicals	Marks		
(Practical I) PGDSCRM P-1 Molecular cell biology and developmental biology	100	-	100
(Practical II) PGDSCRM P- 2 Stem cell technology	100	-	100
Total			600

PGDSCRM = Post Graduate Diploma in Stem Cell & Regenerative Medicine

(PAPER I) PGDSCRM 1: MOLECULAR CELL BIOLOGY (60 h)

Unit I: Cell structure and Membrane Transport (15h)

Evolution, Prokaryotes, Eukaryotes & their organelles, Cytoskeleton, the self assembly and dynamic structure of cytoskeletal filaments, regulation of cytoskeletal filaments, molecular motors. Cell Polarity & Membrane Transport, Introduction to cell polarity, Cell-cell adhesion, Cell junction proteins, Cell-matrix adhesion, Extracellular matrix.

Unit II: Molecular cell physiology and central dogma (15h)

Cell Cycle; Cell cycle regulation and check points; Cell apoptosis; Storage of mRNA and Chaperons; Nucleic acids; DNA topology; Nucleic acid binding proteins; Mutations; promoters, enhancers and silencers. DNA replication: Initiation, elongation and termination in prokaryotes and eukaryotes, Regulation of transcription, Translation: Universal genetic code, degeneracy of codons, termination codons, wobble hypothesis. Mechanism of initiation, elongation and termination.

Unit III: Cell-Cell Communication (15h)

Cell Signaling, feedback & crosstalk, signaling molecules & their receptors, functions of cell surface receptors: G Proteins – coupled receptors, tyrosine kinase, enzyme linked receptors, pathways of Intracellular signal transduction : C-AMP pathway, Cyclic GMP, PI3-Kinase , RAS/ RAF & MAP kinase, JAK /STAT & TGF – β /Smad pathways, NF- κ B signaling, Wnt pathway, signaling based on pro-cleavage pathway (Hedgehog, Notch & SHP-2- ER signaling).



Unit IV: Molecular Biology of Cancer

(15h)

Introduction to cancer, oncogenes, tumor suppressor genes, Molecular biology of Cancer – Activation of oncogenes, Inactivation of tumor suppressor genes, Inappropriate expression of cancer genes and pathways, micro RNAs in cancer, Chromosomal rearrangements and cancer, Viruses and cancer, Chemical carcinogenesis.

Text/Reference Books

1. Bruce Alberts, Alexander Johnson, Julian Lewis, Keith Roberts, Peter Walter - Molecular Biology of the Cell, 5th edition (2007), Garland science, New York.
2. Harvey Lodish- Molecular Cell biology, 5th edition (2003), Freeman W. H. and company
3. Gerald Karp - Cell Biology, 7th edition (2013), Wiley publications.

(PAPER II) PGDCSRM 2: DEVELOPMENTAL BIOLOGY (60 h)

Unit 1: Developmental Biology and clinical embryology

(15h)

Introduction of animal development, Scope of development biology. Introduction to physiology of human reproduction, Spermatogenesis and Oogenesis, differentiation of germ cells and gametogenesis, Fertilization and implantation Stages of human embryonic development, Congenital malformations and teratogenesis

Unit II: Female reproductive system and menstrual cycle

(15h)

Introduction, ovarian hormones, endometrium, fallopian tube, Hypothalamus-pituitary-ovarian axis, fertilization, implantation, formation of placenta, blastula and gastrulation, corpus leuteum- development and role, human chorionic gonadotrophin role, menstrual cycle: phases, implantation in endometrium, abnormalities in endometrium conception and menstruation, reproductive failure and infertility and assisted reproduction, in-vitro fertilization.

Unit III: Late Embryonic development I

(15h)

Formation of neural tube; Differentiation of neural tube- Brain and spinal cord Derivatives of Neural crest cells, extra embryonic membranes: placenta and fetal membrane, hematopoiesis, development of heart and vessels, Myogenesis, Osteogenesis, Kidney formation, Limb development and other germ layer developments.



Unit IV: Fate mapping And regeneration

(15h)

Fate Mapping, Autonomous cell specification by cytoplasmic determinants, Specification of cell fate by progressive cell-cell interactions Establishment of body axis in mammals. Regeneration, aging and metamorphosis.

Text/Reference Books

1. Molecular biology of cell – 5th Ed. – Bruce Alberts. (2008).
2. Scott F Gilbert and J. F. Beressi- Developmental biology, 11th edition (2016), Sinauer publishers
3. Endometrial stem cells and its therapeutic applications, Indumathi Somasundaram, Springer Brief, Springer verlag, UK

(PAPER III) PGDCRM 3: EMBRYONIC AND ADULT STEM CELLS (60 h)

Unit 1: Overview of Stem Cells

(15h)

Stemness basic, Type of stem cells: Embryonic stem cells, adult stem cells, Stem cell markers, Stem cell niches, Trans-differentiation, Growth Factors and Paracrine mechanism and action of stem cells, and trans-differentiation of stem cells, regulation of stem cell niche in different adult tissues.

Unit II: Molecular Concepts of Stem Cells and cancer stem cells

(15h)

Molecular facets of pluripotency, mechanism of self renewal and differentiation, ES cell cycle control, Somatic cell nuclear transfer technology, Induced pluripotent stem cells, Stem cell origin of cancer, Cancer stem cells, Pathways involved in stem cells and cancer stem cells.

Unit III: Embryonic and adult stem cells

(15h)

Embryonic stem cells: Isolation, properties, test for pluripotency, and differentiation. Embryonic carcinoma cells: Teratomas and Teratocarcinoma. Adult stem cells: Different types of adult stem cells based on source (cord blood, bone marrow, adipose, endometrium etc) and lineages (hematopoietic stem cells, mesenchymal stem cells side population, endothelial progenitor cells), stem cell banking.



Unit IV: Hematopoietic and non-hematopoietic stem cells and their differentiation (15h)

Bone marrow microenvironment, Hematopoietic stem cell mobilization and differentiation, mesenchymal stem cells and their properties, Hematopoietic and mesenchymal stem cells: Isoalton, ex vivo expansion, characterization, transcription regulation and differentiation, Side population phenotypes, endothelial progenitor cells, Multipotent adult progenitor cells, Differentiation of stem cells in-vivo and ex-vivo, Differentiation of mesenchymal stem cells in to osteoblast, adipocyte, chondrocyte lineages, Transdifferentiation of mesenchymal stem cell into various lineages, differentiation into endothelial cells and stem cell mediated angiogenesis.

Text/Reference Books

1. "Stem cell basics and application" Ed. By K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
2. "Hand book of Stem Cells" Edited by RoberLanza, Elsevier, Academic Press, 2011.
3. "Stem Cells Handbook", Edited by Stewart Sell, Human Press, 2010.
4. "Human embryonic stem cells", Edited by Arlene Y. Chiu, MahendraRao, Human
5. Press, 2011.
6. "Stem cell therapy for organ failures", Edited by S. Indumathi, Springer Verlag, 2015

(PAPER IV) PGDCSRM 4: DISEASE AND APPLICATIONS OF STEM CELLS (60 h)

Unit I: Application of Stem cells: Introduction (15h)

Stem cells in treating various diseases, Mechanism of treatment and their regenerative ability, Pre-clinical and clinical applications of stem cells, chemokine reactions, cause of success and failure in treatment, stem cells and tissue engineering: Its applications.

Unit II: Stem cells and Diabetes (15h)

Structure of pancreas, Mechanism of insulin secretion and its action, Types of diabetes and its pathophysiology, Differentiation of ESC and adult stem cells to insulin secreting beta islet cells, pre-clinical models of diabetes and stem cell treatment, clinical applications in diabetes.



Unit III: Stem cells, vascular diseases and cancer

(15h)

Pathology of acute myocardial infarction and chronic ischemic heart disease, Role of stem cells in acute myocardial infarction and dilated cardiomyopathy, Use of regenerative therapy, Role of endothelial cells and VEGF in healing, acute and chronic ischemia, its pathophysiology and treatments, stem cell therapy for ischemia, pathophysiology of cancer, role of cancer stem cells in causing cancer, and stem cell therapy for cancers.

Unit IV: Stem cells in neurologic disease, aging and genetic diseases

(15h)

Therapeutic applications of various tissue-derived adult stem cells in neurological disorders: spinal cord injury, stroke and other neuronal diseases, stem cells and anti-aging treatment, role of stem cells in aging, stem cells in treating genetic diseases such as thalassemia, hemolytic anemia etc.

Text/Reference books:

- “Stem cell basics and application” Ed. By K. D. Deb and S. M. Totey, Tata McGraw Hill Pvt. Ltd, 2011.
- “Stem cell therapy for organ failure”, Edited by, Indumathi Somasundaram, Springer Verlag, UK, 2015.
- “Hand book of Stem Cells” Edited by RoberLanza, Elsevier, Academic Press, 2011.
- “Stem Cells Handbook”, Edited by Stewart Sell, Human Press, 2010.

Practical -1

PGDCSRM P-I: Molecular cell biology and Developmental biology (60 h)

1. Development of chick embryo: CAM assay
2. Characterization of chick embryo
3. In-vitro fertilization techniques
4. DNA and RNA extraction
5. Estimation of DNA and RNA
6. Agarose gel electrophoresis
7. PCR techniques



D. Y. Patil University

Practical-2

PGDSCR M P-2: Stem cell Techniques (60 h)

1. Preparation of media for cell culture
2. Isolation of stem cells from blood sources
3. Isolation of stem cells from tissue sources
4. Culturing & sub-culturing of stem cells, passaging.
5. Cell counting and cell viability testing
6. Stem cell differentiation
7. Characterization of stem cells

BL-PGDSCR M-05: Course structure and distribution of credits

Post Graduate Diploma in Stem cell and Regenerative Medicine is one year weekend course with a total of 360 hours and on credit based system. It consists of total 4 theory courses, 2 practical lab courses. Each theory course will be of 4 (four) credits, a practical lab course will be of 4 (four) credits, with a total of 24 credits.

BL- PGDSCR M-06: Scheme of Examination and Standard of passing:

Scheme of examination:

1. This course will have 20 % Term Work (TW)/ Internal Assessment (IA) and 80% external (University written examination of 3 hours duration for each course paper and practical examination of 3 hours duration for each practical). All external examinations will be held at the end of each semester and will be conducted by the University as per the existing norms.
2. Term work/ Internal assessment- IA (20%) and University examination (80%) - shall have separate heads of passing (i.e. 8 Marks for passing in IA and 32 Marks for passing in University examination). For Theory courses, internal assessment shall carry 20 marks and semester-end examination shall carry 80 marks for each theory course.
3. To pass, a student has to obtain minimum grade point E, and above separately in the IA and external examination.
4. The University (external) examination for Theory and Practical shall be conducted at the end of each Semester.
5. The candidates shall appear for the external examination of 4 Theory courses each carrying 80 marks of 3 hours duration and 2 practical courses each carrying 100 marks at the end of each semester.
6. The candidate shall prepare and submit for the practical examination a certified journal based on the practical course carried out under the guidance of a faculty member with minimum number of experiments as specified in the syllabus for each group.



D. Y. Patil University

Examination pattern (External):

Theory (80M)

Section I: 16X1 =16 (MCQs)

Section II: 3X16= 48 (Long answers)

Section III: 4x4=16 (Short answers)

Practicals (100M)

I. Major Practical: 30M

II. Minor practical: 20M

III. Spotters: 30 M

IV. Journal: 10M

V. Viva: 10M

Examination pattern (Internal: 20 M)

MCQs and Short answers

Standard of Passing:

As per ordinances and regulations prescribed by the University for semester based credit and grading system.

Standard point scale for grading:

Grade	Marks	Grade Points
O	70 & above	7
A	60-69.99	6
B	55-59.99	5
C	50-54.99	4
D	45-49.99	3
E	40-44.99	2
F(Fail)	39.99 & below	1