New Course EFD Template

PURDUE UNIVERSITY | College of Engineering

Engineering Faculty Document No.: 50-17
June 30, 2022

TO: The Engineering Faculty

FROM: The Faculty of the Davidson School of Chemical Engineering

RE: New graduate course – CHE 52400 Stem Cell Engineering

The Faculty of the Davidson School of Chemical Engineering has approved the following new graduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM (IF ALREADY OFFERED WITH TEMPORARY NUMBER): CHE 59700 - Stem Cell Engineering

Fall and Spring

3 total credits;

No prerequisites

Fall 2020 - 7, Fall 2021 - 5, Spring 2025 - 13

TO: CHE 52400 - Stem Cell Engineering

Spring and fall

3 total credits;

This course provides an introduction to the cutting-edge stem cell and immuno-engineering technologies. Stem cell-based regenerative medicine and immunotherapies are rapidly expanding research fields, and considerable hope is placed on the use of human stem cells in medicine to repair tissue for diseases that are currently incurable and treat

RATIONALE:

The objective of this course is to provide students with the background, theory, and techniques of pluripotent stem cell engineering and immuno-engineering. Topics will include the generation of induced pluripotent stem cells, the directed differentiation of pluripotent stem cells, the genome editing of human pluripotent stem cells, RNA-seq analysis of the stem cells and their derivatives, disease modeling, organoids, and therapies with stem cells, stem cell processing, biomaterials and 3D culture systems, and immune T and NK cell engineering for targeted cancer immunotherapies. It will also highlight the challenges during the translation of stem cell products from laboratory to clinics and opportunities for engineers and chemists. Students will also be trained on scientific cancers. literature search, writing and presentation.

Head/Director of the [school or committee]

Link to Curriculog entry: https://purdue.curriculog.com/proposal:33556/form

Tentative Syllabus
HAMP2102
Monday, Wednesday, Friday – 10:30 - 11:20 AM
Fridays are reserved for lectures (mostly zoom talks) from guest speakers

Instructor: Xiaoping Bao, Ph.D.
Office: FRNY 1158
Office Hours: By appointment as necessary
Contact: bao61@purdue.edu

Course Description and Goals
This course provides an introduction to the cutting-edge stem cell and immuno-engineering technologies. Stem cell-based regenerative medicine and immunotherapies are rapidly expanding research fields, and considerable hope is placed on the use of human stem cells in medicine to repair tissue for diseases that are currently incurable and treat cancers. **The objective of this course** is to provide students with the background, theory, and techniques of pluripotent stem cell engineering and immuno-engineering. Topics will include the generation of induced pluripotent stem cells, the directed differentiation of pluripotent stem cells, the genome editing of human pluripotent stem cells, RNA-seq analysis of the stem cells and their derivatives, disease modeling, organoids, and therapies with stem cells, stem cell processing, biomaterials and 3D culture systems, and immune T and NK cell engineering for targeted cancer immunotherapies. It will also highlight the challenges during the translation of stem cell products from laboratory to clinics and opportunities for engineers and chemists. Students will also be trained on scientific literature search, writing and presentation.

Recommended (NOT REQUIRED) Textbooks
1. *Stem Cell Engineering: Principle and Practices,* David V. Schaffer, Joseph D. Bronzino and Donald R. Peterson, CRC Press, Inc., 2012, ISBN: 978-1439872048
2. *Developmental Biology*, Scott F. Gilbert and Michael J.F. Barresi, Sinauer, 2016, ISBN: 978-1-605-35470-5.
3. *Basic Immunology: Functions and Disorders of the Immune System*, Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai, 2023. Paper ISBN: 9780443105197. eBook ISBN: 9780443105500.

Grading
Participation (interactions with instructors)– 10%
Review/Proposal – 40%
Presentation– 20%
Homework- 30%

The grading scale will be as follows.

A: 100 – 85% of the weighted points
B: 84.9 – 75% of the weighted points
C: 74.9 – 65% of the weighted points
D: 64.9 – 55% of the weighted points
F: Less than 55% of the weighted points

Semester Manuscript/Proposal

Each student will be required to turn in **either** a review paper **or** proposal by the end of the semester (i.e., prior to 5p (Eastern) on **May 8, 2025**) regarding a topic within the realm of "stem cell engineering" of his/her choice.

For the review paper, the text of the document will include a review of the relevant literature and open discussion of future research that the student believes could lead to interesting results in the field. Exact details of the assignment will follow the format of Current Opinion in Chemical Engineering (see Guide for Authors: https://www.elsevier.com/journals/current-opinion-in-chemical-engineering/2211-3398/guide-for-authors), but the manuscript will not be longer than 8 pages (double-spaced, 12 point, Times New Roman font, with 1-inch margins), excluding references. For the proposal, a paper formatted as an NIH grant proposal on stem cell engineering and regenerative medicine containing a one-page summary outlining the hypothesis and specific aims followed by a research strategy (8 pages single spaced) containing three sections: Significance, Innovation and Approach (see example in Brightspace). References are expected and are separate from the 8-page limit of the Research Strategy. The due date will be **May 8**.

Before beginning work on this manuscript, it is highly recommended that the student meet with the instructor in order to outline a planned topic of study. The presentation will be 20 minutes followed by 5-10 minutes of questions and will detail your grant proposal or review.

Week 1	**Monday, January 13** **Wednesday, January 15**	Introduction: Genome, Cells, and Tissues
Week 2	Monday,January 20 (**MLK Day**) Wednesday, January 22 Friday, January 24	Mouse Embryonic Stem Cells, Gene Targeting and Transgenic Animals
Week 3	**Monday, January 27** **Wednesday, January 29**	Regenerative Medicine: Human Embryonic Stem Cells
Week 4	Monday, February 3 Wednesday, February 5	Directed Differentiation - 1
Week 5	**Monday, February 10** **Wednesday, February 12**	Directed Differentiation - 2
Week 6	Monday, February 17 Wednesday, February 19	Bioinformatives: RNA-seq and single cell RNA-seq
Week 7	**Monday, February 24** **Wednesday, February 26**	Nuclear Transfer and Cellular Reprogramming
Week 8	Monday, March 3 Wednesday, March 5	Induced Pluripotent Stem Cells, Disease Modeling, Organoids
Week 9	**Monday, March 10** **Wednesday, March 12**	Direct Reprogramming / Transdifferentiation
Week 10	Monday, March 17 Wednesday, March 19	**Spring Break**
Week 11	**Monday, March 24** **Wednesday, March 26**	ZFN and TALEN Strategies for Genome Editing and Disease Modeling
Week 12	Monday, March 31 Wednesday, April 2	CRISPR/Cas9 Strategies for Genome Editing and Disease Modeling
Week 13	**Monday, April 7** **Wednesday, April 9**	CAR-T, NK, Macrophage, Neutrophils from Stem Cells & Other Immunoengineering Approaches
Week 14	Monday, April 14 Wednesday, April 16	

Week 15	**Monday, April 21** **Wednesday, April 23**	Presentations & Final Project Writing
Week 16	Monday, April 28 Wednesday, April 30	