

BT5130 Tissue Engineering
Take Home Final Exam
Exam Start Date: 27/12/2020; Due Date: 5/1/2021 or 10/1/2021

Instructions:

- i. You can use the class lecture notes, relevant reading materials, and the internet for answering the questions, unless there are specific instructions in the question.
- ii. This is an exam. Hence, you are not allowed to discuss with other students or the instructor. Discussion with another human being in person or through other modes of communication will be considered as a breach of academic integrity.
- iii. Submit the solution set as a .doc or .docx or .pdf in the Google Drive on or before the deadline.
- iv. Don't exceed the suggested page limits.
- v. Provide clear references for all the questions. List the references needed in the following format: Authors, Title, Journal, Year, Volume(Issue):Pages
- vi. Don't copy/paste text from any source. Write them in your own words. The reports will be verified on Turnitin. Plagiarism will be dealt with very seriously. Please refer to the course outline for policies regarding academic integrity.

Exam Questions

1. **(3 pages, 20 marks)** Read the original research article titled "Development of highly functional bioengineered human liver with perfusable vasculature" by Kim *et al.*, and answer the following questions:
 - a. Describe the principle behind process for developing the anti-CD31 aptamer that specifically binds to endothelial cells. How was the specificity confirmed?
 - b. What was the basis for the authors' hypothesis that aptamers would show an efficiency comparable to antibodies? Identify at least one application where this has been demonstrated earlier.
 - c. Describe the experimental techniques used for recellularization of the decellularized rat liver scaffold. Also, explain how this recellularization was confirmed.
 - d. What is the Akt signaling pathway and how is it involved in angiogenesis?
 - e. What is the principle of qRT-PCR? How was this tool used in this paper?
 - f. How was the functionality of the bioengineered liver evaluated? Describe the *in vitro* and *in vivo* studies used for confirming this.
2. **(3 pages, 20 marks)** Read the original research article titled "Toward a neurospheroid niche model optimizing embedded 3D bioprinting for fabrication of neurospheroid brain-like co-culture constructs" by Li *et al.*, and answer the following questions:
 - a. What is the overall goal of this work?
 - b. What was the basis for choosing the bioink composition for this work?
 - c. Explain the principle behind UV-crosslinking used for curing the bioink.
 - d. What rheological characterizations were performed? Explain the results.

- e. What is different information gathered from fluorescence microscopy and confocal microscopy? How have these tools been used in this paper?
 - f. How were the printing parameters optimized? What factors had to be considered for this optimization?
 - g. What was the role of the microenvironment on developing the neurospheroid niche model?
3. **(3 pages, 20 marks)** Read the original research article titled “Wnt-modified materials mediate asymmetric stem cell division to direct human osteogenic tissue formation for bone repair” by Okuchi *et al.* and write a critical review.
4. **(4 pages, 40 marks)** NIH RePORTER is a tool to search for projects that were funded by NIH. Using the NIH RePORTER website (<https://projectreporter.nih.gov/reporter.cfm>), identify an ongoing project on engineering a biomimetic cardiac tissue. Discuss the lacuna that is being addressed in the proposed work. Identify one publication that has come out of this project and describe the approach to address the problem identified. Identify another paper from the literature that addresses the same problem with a different approach. Compare the two strategies and the results obtained.