

UNIVERSITY OF GREATER MANCHESTER
SCHOOL OF ENGINEERING
BENG (HONS) BIOMEDICAL ENGINEERING
SEMESTER TWO EXAMINATION 2024/25
MOLECULAR AND SYNTHETIC BIOENGINEERING
MODULE NO: BME6010

Date: Thursday 15 May 2025

Time: 10:00 – 12:30

INSTRUCTIONS TO CANDIDATES:

Candidates are advised that the examiners attach importance to legibility of writing and clarity of expression. **YOU ARE STRONGLY ADVISED TO PLAN YOUR ANSWERS.**

There are **TWO** sections.

In section A, answer **ANY TWO** questions.

In section B, answer **ANY ONE** question.

The examination paper carries a total of 100 marks.

This examination is **TWO** hours and 30 minutes long.

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Module No. BME6010

SECTION A

Answer TWO from the following three questions.

A total of 50 marks are available in this section.

1. You are tasked to develop a microfluidic system to model a combinational cell therapy system. The system requires you to have a closed loop on your biological samples. Outline the steps that would be required to model such a system in detail. While answering this keep in mind the concepts discussed by Dr. Antonella in her lecture.

[25 marks]

2. How would you model a biological circuit that has two inputs, red and blue transcription factors. The output of such a biological circuit is a green fluorescence protein (GFP). The circuit works as an 'AND' gate. Take help of a truth table as discussed in the class to model this circuit.

[25 marks]

3. Control modalities in cybernetics are divided into three types. Define these control modalities and identify the differences between them. Based on these differences, which control modality would you choose if the application required you to control single cells independently?

[25 marks]

END OF SECTION A

PLEASE TURN PAGE FOR SECTION B

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SECTION B

Answer ONE from the following two questions.

A total of 50 marks are available.

4. Erythropoietin is a hormone produced in humans, primarily by the kidneys. In some disease states, such as chronic kidney disease, erythropoietin production is impaired leading to issues such as anaemia and low red blood cell counts. Molecular cloning techniques can be used to produce synthetic versions of proteins like erythropoietin for medicinal use. In as much detail as possible, design a step-by-step process that would enable you to express and purify erythropoietin on a large scale. You should include as much information as possible at each stage of your process, including a justification of the different methods/systems you choose to use.

[50 marks]

5. Define the four main sectors of Biotechnology (Green, Red, Blue and White). For each sector, critically evaluate its role in addressing global health challenges. As part of your answer, you may want to consider how different sectors tackle issues such as public health, food security and environmental issues. You should provide specific examples where possible.

[50 marks]

END OF SECTION B

**END OF QUESTIONS
END OF PAPER**