

### Course Description

<b>Course Code</b>	412 ()
<b>Course Title</b>	Medical Biotechnology
<b>Credit Hours</b>	3.00

One credit is defined as one hour of classroom or direct faculty instruction and a minimum of two hours of out-of-class student work each week of the semester. A credit hour means teaching a theory course for 50 minutes each week throughout the semester.

### Instructor Information

Name	Dr. Muhammad Mustafa
Email	<a href="mailto:muhammadmustafa@fccollege.edu.pk">muhammadmustafa@fccollege.edu.pk</a>
Website	<a href="https://sites.google.com/a/fccollege.edu.pk/drmustafa/home">https://sites.google.com/a/fccollege.edu.pk/drmustafa/home</a>
Office hours	MWF 2pm-3pm (Office Number: S346) Fall 2024

### Course Description

Biotechnology is delivering not only new products to diagnose, prevent, and treat human disease but entirely new approaches to a wide range of difficult biomedical challenges. Because of advances in biotechnology, hundreds of new therapeutic agents, diagnostic tests, and vaccines have been developed and are available in the marketplace. The course covers nanobiotechnology, cancer immunotherapy, gene therapy, stem cell biotechnology, knockout mice and gene inserts, siRNA, genetically engineered animals, infectious diseases, diagnostics and antibiotic resistance, biomaterials in regenerative medicine, vaccine technology, novel antimicrobial agents, their design and other future medical biotechnologies.

### Student Learning Objectives

On successful completion of this course, the students will:

- Learn the fundamental concepts in Medical Biotechnology
- Be able to understand the various techniques used in Medical Biotechnology

- Develop an understanding about the role and use of Medical Biotechnology techniques in research.
- Critically evaluate scientific literature and research findings related to Medical Biotechnology
- Apply knowledge of molecular biology, genetics, and bioinformatics to analyze and interpret biotechnological data.

## **Detailed Description of Course Contents**

### **Week 1-2**

**Cancer Immunotherapy:** Overview of Cancer and Immune system, Strategies of immunotherapies

*Out of Class work : Identify, study and note down the key points of two review papers (Cancer hallmarks and Immunotherapy ) in Nature, Science or Cell for*

### **Week 3**

**Gene Therapy :** Gene therapy vectors, Modalities, applications and ethical concerns

*Out of Class work : Study and discuss the ethical concerns and future prospects in Gene therapy*

### **Week 4-5**

**Stem Cell Biotechnology:** Sources and types of stem cells, Hematopoiesis, Yamanaka factors, Application of stem cells

*Out of Class work : Using internet resources, identify the recent advancements in tissue engineering using stem cells, therapeutics and organ farming.*

### **Week 6-7**

**Knock out mice and gene inserts, genetically engineered animals:** Loss and Gain of function studies, Uses of GMOs, Bioreactors, Strategies to create Gene knockout animals, Applications and ethical concerns

*Out of Class work : Discuss and debate about the good and bads of GMO, read about the companies creating gene knock out animals for research. Discuss ethical concerns*

## **Week 8**

**siRNA, Use and application:** Gene knockdown, Mechanisms of siRNA function, Designing of siRNA, Applications of siRNA, Non-coding RNA, and microRNA regulations

*Out of Class work : Study the work of Nobel laureate which lead to siRNA, Discuss its future. Read related research papers*

## **Week 9**

**Infectious diseases, diagnostics, and antibiotic resistance:** Diagnosis of infectious diseases, Biosafety, Antibiotics uses and repercussions.

*Out of Class work : Read mechanisms of antibiotic resistance and its state of research. Identify and read 4 papers showing advancement in antibiotic resistance.*

## **Week 10**

**Vaccine technology, antimicrobial agents:** SARS-CoV2, Types of Vaccines, Vaccine development during Pandemics

*Out of Class work : Study impact of covid-19 pandemic and discuss preparedness of world.*

## **Week 11**

**Targeted Genome Editing (ZFN and TALEN):** Historical perspective of targeted Genome editing, Homologous recombination, Development, Design and applications of ZFN and TALEN

*Out of Class work : Study the urge behind gene editing, how it has changed the life sciences, read related discoveries and their implications.*

## **Week 12-13**

**Target Genome Editing (Crispr/Cas9):** Development, design and application of Crispr/Cas9 system.

*Out of Class work : Study the current status of Crispr/Cas9 and its improved and advanced versions. Read papers and identify new emerging gene editing tools.*

## **Week 14-15**

**Bioinformatics tools:** NCBI, UCSC Genome browser, Handling of DNA and protein sequences, Mutation analysis

*Out of Class work : Practice sample data extracted from UCSC genome browser and NCBI, design primers for mutation analysis of gene of your own choice.*

**Future of medical biotechnology:** Open ended discussion sessions

*Out of Class work : Prepare an art poster*

## **List of Recommended Text Books**

- Bernard. R Glick. Terry L. Delovitch. Cheryl L. Patten : Medical Biotechnology
- Firdos A. Khan : Biotechnology in Medical Sciences.
- Medical Biotechnology by Bernard R. Glick, Cheryl L. Patten, Terry L. Delovitch

## **Attendance Policy**

Failure to attend the course regularly will have adverse repercussions. Inadequate attendance (<80%) may lead to disqualification from the Final Exam.

## **Plagarims policy and Use of Generative AI**

Students are expected to maintain high standards of academic honesty. Cheating and plagiarism will not be tolerated and will be referred to the disciplinary committee for appropriate action. There is a zero-tolerance policy for such cases. Students involved in any instances of plagiarism/cheating

should be aware of the consequences of it. Consult university policy of plagiarism.

Use of generative AI should be declared during assignments together with the purpose.

### **Grade Breakup**

Attendance	Quiz	Assignments	Midterm	Final Term
5	15	20	25	35

### **Grading and percentage**

A	4	93-100%
A-	3.7	90-92%
B+	3.3	87-89%
B	3	83-86%
B-	2.7	80-82%
C+	2.3	77-79%
C	2	73-76%
C-	1.7	70-72%
D+	1.3	67-69%
D	1	60-66%

### **Holidays and important dates for mid and final exam**

See academic calendar