FORMAN CHRISTIAN COLLEGE (A Chartered University)

### Department of Biological Sciences

**Dr. Muhammad Irfan**

**Professor**

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**BIOT 301: Analytical Techniques in Biology (2+1 credits)**

Lectures: Monday, Wednesday 09:00–09:50 Room S-424, Practical: Monday 14:00–15:50 Lab S-331

Office Hours: Thursday 09:00-11:50, Friday 09:00-09:50.

**University Policies:**

Students must follow/observe university policies related to health and wellbeing of their own and FCC community. The course content and mode of interaction is also subject to university policies due to Covid-19**.**

**Books and other consultation resources**

1. Microbiology: An Introduction by Tortora, Funke and Case. Pearson. (Book short name MAI)
2. Understanding Bio-analytical Chemistry: Principles and Applications (2009) V. A. Gault & N. H. McClenaghan, Willey Blackwell Publication.(Book short name GUBC)
3. Principals and Techniques of Biochemistry and Molecular Biology (2010). 7th edition by Keith Wilson and John Walker. Cambridge University Press. (Book short name PTBMb)
4. PCR (2006) M. J. McPherson & S. G. Moller, Taylors & Francis Publishing group.
5. **Introduction to Biochemistry and Biotechnology Techniques (2018), Fatima Akram. Paramount Books (pvt.) Ltd.**
6. GE Handbook 11-0012-69 AA, 18-1022-18 AL, Biorad, and other instruments manuals and theory bulletin.
7. Online videos and animations. Links copied in the end of content (Details will be share in class accordingly). Soft copies of all the material will be provided.

**Course Objectives**

The course will focus on:

1. Basic understanding of principle and working of various instruments and application of analytical techniques.
2. Introduce and familiarize with recent developments in instrumentation and analytical techniques.
3. Choose and apply the right technique and instrument for the analysis of biological materials.

**Learning Outcomes:**

After completing this course student should be able to:

1. Understand the principles of analytical techniques and instruments.
2. Familiar with the instruments used in analytical techniques.
3. Use techniques in research and diagnostics.
4. Help in getting a job in scientific industries and diagnostic centers.

**Course Evaluation:** Grading will be based on the following criteria:

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| --- | --- |
| **Activity to be Assessed** | **Weight age (% age)** |
| Final Exam | 30 |
| Lab Exam | 20 |
| Mid-Term Examination | 20 |
| Class quizzes | 20 |
| Attendance, Assignment, Presentation, Class Participation | 10 |
| Total | 100 |

**Grading Policy (As per FCC policy)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Grade** | **Marks (%)** | **Grade** | **Marks (%)** |
| A | 93 - 100 % | C | 73-76% |
| A- | 90 - 92% | C- | 70-72%, |
| B+ | 87-89% | D+ | 67- 69%, |
| B | 83- 86% | D | 60-66%, |
| B- | 80-82%, | F | 59 or below |
| C+ | 77-79% |  |  |

**Course Policies:**

**Attendance**

**80% attendance is required in lectures as well as in lab.** If a student fails to fulfill the requirement, he/she will not be allowed to appear in final examination.

**Quizzes, Presentations and Assignments**

To appear in quizzes and presentations at specified dates is necessary. In case of absence, zero grade will be given. Assignments will be assigned on the commencement of the class. If a student will submit assignment after due date one mark will be deducted for each day.

**Mobile Phone:** Students are advised to turn their mobiles “**off**” during lecture and lab.

**Distraction during the class:** Anything which distracts attention of class is not allowed. e.g Talking, gossiping with fellow students while lecture is going on. If there is any point related to lecture, ask permission to discuss with the class.

**Quizzes: Four** quizzes will be taken, two before midterm and two after midterm.

**Mid Term Exam**: 1st 5 weeks lectures and any relevant content from Lab

**Final Term Exam**: From week 6th to the last week lectures and any relevant content from Lab

**Lab Exam:** includes, solution preparation, calculations, practical performance (if possible), behavioral compliance and maintenance of an electronic notebook with turnitin report.

**Holidays**: as per FCC academic calendar

**Course Contents:**

|  |  |  |
| --- | --- | --- |
| **Wks** | **Contents** | **Labs** |
| 1 | Introduction, Units, pH, Buffers (Pages 3-7 and 11-15 PTBMb) | Introduction & Bio-safety precautions (Page 35 PTBMb. Safety in the laboratory) and Lab Tour |
| 2 | Working of a pH meter (Pages 11-15 PTBMb) | pH meter calibration, Micro pipetting, Lab Calculations. Solution Preparation |
| 3 | Microscopy (MAI pages 1-12) | Interactive simulation based SEM, session. |
| 4 | Microscopy (MAI pages 1-12) | Interactive simulation based TEM, session |
| 5 | Centrifugation; Types of centrifuges, principle, Significance and applications, Flow Cytometry (GUBC pages 123-133) | Lab tour for demonstration on micro-centrifuge and bench-top centrifuges; low and high-speed centrifuges. Students will be given protocol in which they have to demonstrate their pipetting, and centrifugation skills. |
| 6 | Spectroscopy: UV-visible, (GUBC pages 99-113) | Finding the ʎmax of different solutions by UV visible spectrophotometer. |
| **Mid Term Exam (7th week during lab)** | | |
| 7 | Electrophoretic Separation, types of electrophoresis (GUBC pages 165-180) | Gel electrophoresis, sample preparation, gel preparation, sample loading, data recording |
| 8 | Electrophoretic Separation, types of electrophoresis (GUBC pages 165-180) | Comparison of protein structures by PyMol  Students need to install and bring their laptops |
| 9 | Immunochemical techniques (GUBC 216). ELISA; Types of ELISA, principles and applications of ELISA (GUBC pages 285-290) | Interactive ELISA online practice |
| 10 | Immunochemical techniques (GUBC 216). ELISA; Types of ELISA, principles and applications of ELISA. (GUBC pages 285-290) | Demonstration on ELISA reader |
| 11 | Chromatography: gel filtration, HPLC, FPLC (Pages GUBC 147-160, GE manual) | FPLC Chromatogram and Protein; SDS-PAGE electrophoresis data analysis |
| 12 | Chromatography: gel filtration, HPLC, FPLC. (Pages GUBC 147-160, GE manual) | Demonstration on PCR machines: regular, Real time and gradient PCR machines. May do the PCR if reagents could be arranged. |
| 13 | Bio-analytical techniques, Types of PCR; RT-PCR, Real time PCR, Gradient PCR, etc and post PCR analysis. Pages 9-20 and 209-220 from PCR | Analysis of PCR data |
| 14 | Revision, Final, If academic calendar stays this way. Or according to updated calendar | Quantify the concentration of unknown DNA/Protein samples by densitometry |
|  |  | **Lab Exam** |
| **Final Exam** | | |
| Additional help can be taken by watching videos. Some of them will be shown in the class along the lecture. iBiology video lectures are also available for some of the topics.  <https://www.youtube.com/watch?v=P1wRXTl2L3I> -pH measurement with potentiometer  <https://www.youtube.com/watch?v=IoVzpL_heFo>    - western blot  <https://www.youtube.com/watch?v=q3fMqgT1do8>   -IEx  <https://www.youtube.com/watch?v=v6SPK6ZovgA>    -HIC  <https://www.youtube.com/watch?v=pnT587wUGyY>    - Affinity  <http://highered.mheducation.com/sites/0072556781/student_view0/chapter33/animation_quiz_1.html>  <http://star.mit.edu/CellBio/animations/index.html>  <https://www.youtube.com/watch?v=jUAvneBhDcQ>  <https://www.youtube.com/watch?v=TKTGgAQ2VEs>  <https://www.youtube.com/watch?v=PCJ13LjncMc>  <https://www.youtube.com/watch?v=BJKkC0W-6Qk>  <https://www.youtube.com/watch?v=GY9lfO-tVfE>  Other interactive demos links will be shared. | | |