

Republic of Yemen  
Ministry of Higher Education & Scientific Research  
**21 SEPTEMBER UNIVERSITY of MEDICALS &  
APPLIEED SCIENCES**



Faculty of Laboratory Medicine  
Department of Microbiology & Immunology  
Course Specification of Advanced Molecular Microbiology  
Course No. (03.12. 311)  
**2022/2023**

| Prepared by:                              | Reviewed by:                   | Head of the Department:        | Vice Dean for Quality affairs  | Dean of College:                  |
|---|--------------------------------|--------------------------------|--------------------------------|-----------------------------------|
| - Assistant Prof. Dr<br>Ghamdan Al-Tahish | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Ass.Pr. Dr.<br>Ebtessam Al-Zabedi |

| I. Course Identification and General Information: |  |  |          |           |              |
|---|--|--|----------|-----------|--------------|
| 1   | Course Title:  | Advanced Molecular Microbiology            |          |           |              |
| 2   | Course Code & Number:                                  | 03.12. 311                                 |          |           |              |
| 3   | Credit Hours:  | Theory Hours                               |          |           |              |
|   |  | Lecture                                    | Exercise | Practical | Credit Hours |
|   |  | 3  | 0        | 0         | 3            |
| 4   | Study Level/ Semester at which this Course is offered: | 1st Level / 1st Semester                   |          |           |              |
| 5   | Pre –Requisite (if any):                               | None                                       |          |           |              |
| 6   | Co –Requisite (if any):                                | None                                       |          |           |              |
| 7   | Program (s) in which the Course is Offered:            | Master degree of Microbiology & Immunology |          |           |              |
| 8   | Language of Teaching the Course:                       | English                                    |          |           |              |
| 9   | Study System:  | Semester                                   |          |           |              |
| 10  | Mode of Delivery:                                      | Presentations and exercises                |          |           |              |
| 11  | Location of Teaching the Course:                       | University Campus                          |          |           |              |
| 12  | Prepared by:   | Dr. Ghamdan Al-Tahish                      |          |           |              |
| 13  | Date of Approval:                                      | 2022-2023                                  |          |           |              |

|   |                                |                                |                                |                                   |
|---|--------------------------------|--------------------------------|--------------------------------|-----------------------------------|
| Prepared by:                              | Reviewed by:                   | Head of the Department:        | Vice Dean for Quality affairs  | Dean of College:                  |
| - Assistant Prof. Dr<br>Ghamdan Al-Tahish | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Ass.Pr. Dr.<br>Ebtessam Al-Zabedi |

## II. Course Description:

This course provides an in-depth study of the molecular biology of microorganisms. Topics include DNA replication, transcription, translation, regulation of gene expression, and molecular genetics of pathogens

## III. Alignment Course Intended Learning Outcomes with program outcomes

| III. Course Intended Learning Outcomes (CILOs)  |   | Referenced PILOs |
|---|---|------------------|
| <b>A. Knowledge and Understanding:</b><br>Upon successful completion of the course, students will be able to:       |   |                  |
| a1  | Explain foundational concepts in molecular microbiology, including microbial genetics, DNA technology, and molecular pathogenesis                 | A1               |
| a2  | Describe the structure and function of microbial chromosomes and genes, and their role in microbial adaptability and pathogenicity                | A1, A2.          |
| a3  | Explain DNA replication, repair, and recombination mechanisms and their implications for microbial survival and evolution                         | A1, A2           |
| a4  | Discuss laboratory techniques for microbial identification, including nucleic acid-based methods (PCR, sequencing) and recombinant DNA technology | A4               |
| <b>B. Intellectual Skills:</b><br>Upon successful completion of the course, students will be able to:               |   |                  |
| b1  | Illustrate the molecular mechanisms of microbial pathogenesis, including gene expression, mutation, and antibiotic resistance                     | B2               |
| b2  | Design strategies for infection control and antibiotic therapy based on microbial genetics and resistance mechanisms                              | B3               |
| b3  | Interpret laboratory data to link microbial molecular features to clinical outcomes   | B1, B2           |
| <b>C. Professional and Practical Skills:</b><br>Upon successful completion of the course, students will be able to: |   |                  |
| <b>D. Transferable Skills:</b><br>Upon successful completion of the course, students will be able to:               |   |                  |
| d1  | Communicate scientific concepts effectively through written reports, oral presentations, and data visualization                                   | D1               |
| d2  | Write structured scientific articles following research ethics and formatting guidelines  | D3               |

|  |                             |                             |                               |                                |
|--|-----------------------------|-----------------------------|-------------------------------|--------------------------------|
| Prepared by:                           | Reviewed by:                | Head of the Department:     | Vice Dean for Quality affairs | Dean of College:               |
| - Assistant Prof. Dr Ghamdan Al-Tahish | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni   | Ass.Pr. Dr. Ebtessam Al-Zabedi |

IV. Alignment Course Intended Learning Outcomes with Teaching Strategies and Assessment methods :

(A) Alignment Course Intended Learning Outcomes of Knowledge and Understanding to Teaching Strategies and Assessment Strategies:

|    | Course Intended Learning Outcomes   | Teaching strategies                                       | Assessment Strategies |
|----|---|---|-----------------------|
| a1 | Explain foundational concepts in molecular microbiology, including microbial genetics, DNA technology, and molecular pathogenesis                 | Lectures, seminar and student presentations, case studies | Exam                  |
| a2 | Describe the structure and function of microbial chromosomes and genes, and their role in microbial adaptability and pathogenicity                | Lectures, seminar and student presentations, case studies | Exam                  |
| a3 | Explain DNA replication, repair, and recombination mechanisms and their implications for microbial survival and evolution                         | Lectures, seminar and student presentations               | Exam                  |
| a4 | Discuss laboratory techniques for microbial identification, including nucleic acid-based methods (PCR, sequencing) and recombinant DNA technology | Lectures, seminar and student presentations, case studies | Exam                  |

(B) Alignment Course Intended Learning Outcomes of Intellectual Skills to Teaching Strategies and Assessment Strategies:

|    | Course Intended Learning Outcomes   | Teaching strategies                                | Assessment Strategies |
|----|---|--|-----------------------|
| b1 | Illustrate the molecular mechanisms of microbial pathogenesis, including gene expression, mutation, and antibiotic resistance | Lectures, small group for discussion. case studies | Exam                  |
| b2 | Design strategies for infection control and antibiotic therapy based on microbial genetics and resistance mechanisms          | Lectures, small group for discussion, case studies | Exam                  |
| b3 | Interpret laboratory data to link microbial molecular features to clinical outcomes   | Lectures, small group for discussion, case studies | Exam                  |

C Alignment Course Intended Learning Outcomes of Professional and Practical Skills to Teaching Strategies and Assessment Strategies:

|  | Course Intended Learning Outcomes | Teaching strategies | Assessment Strategies |
|--|-----------------------------------|---------------------|-----------------------|
|--|-----------------------------------|---------------------|-----------------------|

|   |  |   |   |   |
|---|--|---|---|---|
| Prepared by:<br>- Assistant Prof. Dr<br>Ghamdan Al-Tahish | Reviewed by:<br>Dr Gamil Taher<br>Abdul Mughni | Head of the Department:<br>Dr Gamil Taher<br>Abdul Mughni | Vice Dean for Quality affairs<br>Dr Gamil Taher<br>Abdul Mughni | Dean of College:<br>Ass.Pr. Dr.<br>Ebtessam Al-Zabedi |
|---|--|---|---|---|

| (D) Alignment Course Intended Learning Outcomes of Transferable Skills to Teaching Strategies and Assessment Strategies: |   |   |                       |
|--|---|---|-----------------------|
|  | Course Intended Learning Outcomes   | Teaching strategies                               | Assessment Strategies |
| d1   | Communicate scientific concepts effectively through written reports, oral presentations, and data visualization | seminar and small group for discussion            | Exam                  |
| d2   | Write structured scientific articles following research ethics and formatting guidelines                        | seminar and practical, small group for discussion | Exam                  |

| IV. Course Contents:                   |   |  |                             |                               |                               |
|--|---|--|-----------------------------|-------------------------------|-------------------------------|
| A. Theoretical Aspect:                 |   |  |                             |                               |                               |
| No.                                    | Units/Topics List                             | Sub Topics List  | Number of Weeks             | Contact Hours                 | Learning Outcomes (CILOs)     |
| 1                                      | <b>Introduction to molecular microbiology</b> | <ul style="list-style-type: none"> <li>- Basic molecular biology: Nucleic acid structure, denaturation and re-pairing of DNA</li> <li>- replication, transcription, translation, DNA damage, mutagenesis.....</li> </ul> | 1                           | 2                             | a1, d2                        |
| 2                                      | <b>Chromosome structure</b>                   | <ul style="list-style-type: none"> <li>- histone and DNA interactome; Structure and assembly of prokaryotic and eukaryotic DNA polymerases;...</li> </ul>  | 1                           | 2                             | a2                            |
| 3                                      | <b>DNA Replication and repair</b>             | <ul style="list-style-type: none"> <li>- ... Patterns of replication</li> <li>- Initiation of replication</li> <li>- Elongation of replication</li> <li>- Termination of replication</li> </ul>                          | 1                           | 2                             | a3                            |
| Prepared by:                           |   | Reviewed by:   | Head of the Department:     | Vice Dean for Quality affairs | Dean of College:              |
| - Assistant Prof. Dr Ghamdan Al-Tahish |   | Dr Gamil Taher Abdul Mughni  | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni   | Ass.Pr. Dr. Ebtesam Al-Zabedi |



|   |                               |   |   |   |        |
|---|-------------------------------|---|---|---|--------|
|   |                               | <ul style="list-style-type: none"> <li>- Proofreading and DNA repair</li> <li>- Difference DNA replication</li> </ul>   |   |   |        |
| 4 | Gene structure                | <ul style="list-style-type: none"> <li>- Gene definition</li> <li>- Gene structure</li> <li>- Gene function</li> <li>- Difference gene structure in prokaryotes and Eukaryotes</li> </ul>   | 1 | 2 | a2     |
| 5 | Gene expression-transcription | <ul style="list-style-type: none"> <li>- Initiation of translation</li> <li>- Elongation of translation</li> <li>- Termination of translation</li> <li>- mRNA processing (for eukaryotes)</li> </ul>  |   |   | b1     |
| 6 | Gene expression-translation   | <ul style="list-style-type: none"> <li>- Terminology: Cistrons, Coding Sequences and Open Reading Frames. genetic code, The Start Codon</li> <li>- Initiation of Translation</li> <li>- Elongation of Translation</li> <li>- Termination of Translation</li> </ul> <p>protein processing<br/>Control of gene expression at transcription and translation level<br/>of Regulation of gene expression in viruses, prokaryotic and eukaryotic genes,</p> |   |   | b1     |
| 7 | mutation                      | <p>Definition<br/>Types of Mutations<br/>Gene Mutations.<br/><b>silent, missense, or nonsense mutations</b><br/><b>frame shift mutations</b><br/>Effects of gene mutations<br/>Chromosomal mutations and types<br/>Mutagens<br/><i>Teratogen:</i></p>   | 1 |   | b1, b2 |

|  |                             |                             |                               |                                |
|--|-----------------------------|-----------------------------|-------------------------------|--------------------------------|
| Prepared by:                           | Reviewed by:                | Head of the Department:     | Vice Dean for Quality affairs | Dean of College:               |
| - Assistant Prof. Dr Ghamdan Al-Tahish | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni   | Ass.Pr. Dr. Ebtessam Al-Zabedi |

|    |                              |  |   |   |                     |
|----|------------------------------|--|---|---|---------------------|
|    |                              | Identification and selection of mutants; ...   |   |   |                     |
| 8  | DNA repair and recombination | General classes of DNA damage<br>single base changes,<br>structural distortion, and<br>DNA backbone damage.<br>Cellular response to DNA damage<br>Recombination definition<br>Types of Recombination<br>Biological Roles for Recombination<br>...  | 1 |   | a3, b1              |
| 9  | Mid tem exam                 |  |   | 2 | a1-a4,b1-b3, ,d1,d2 |
| 10 | Bacterial genetics           | Plasmids - types, replication,<br>partitioning, copy-number control;<br>Methods of gene transfer in<br>Bacteria - Transformation: natural<br>transformation systems.<br>Transposable elements may be :<br>Insertion sequence elements (IS)<br>and<br><br>Transposons<br>Phage genetics: lytic and<br>lysogenic switch; Virulent and<br>temperate phage.<br>Transduction: Generalized<br>and specialized transduction | 1 | 2 | a1, b1, b2,         |
| 11 | gene expression              | Definition<br>Types<br>Regulation of Bacterial Gene<br>Expression<br>House keeping gene in<br>bacteria<br>Inductive and repressive gene<br>expression<br>Gene expression in Bacteriophage<br>...   | 1 | 2 | b1                  |

|   |                                |                                |                                |                                   |
|---|--------------------------------|--------------------------------|--------------------------------|-----------------------------------|
| Prepared by:                              | Reviewed by:                   | Head of the Department:        | Vice Dean for Quality affairs  | Dean of College:                  |
| - Assistant Prof. Dr<br>Ghamdan Al-Tahish | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Ass.Pr. Dr.<br>Ebtessam Al-Zabedi |

|  |  |  |           |           |                         |
|--|--|--|-----------|-----------|-------------------------|
| 12   | <b>Recombinant DNA technology</b>                            | Basics of Molecular Cloning<br>Clone types<br>DNA cloning definition<br>Types. components process-<br>application<br>Cloning vectors types and<br>Application2 | 1         | 2         | a4                      |
| ١٣   | <b>Microbial pathogenesis and host-pathogen interactions</b> | Infection Process<br>Virulence Factors<br>Evading the Host Immune<br>Response<br>Evading the Host Immune<br>Response   | 1         | 2         | b1, b2                  |
| ١٤   | <b>Antibiotic types</b>                                      | Types – structure<br>Main classes<br>–mode of action<br>Members of each classes<br>Antibiotic sensitivity testing<br>methods                                   | 1         | 2         | b2                      |
| ١٥   | <b>Molecular mechanisms of antibiotic resistance</b>         | Types . mechanism and genes of<br>resistance<br>For beach class  | 1         | 2         | b1, b2                  |
| ١٦   | <b>Final Theoretical Exam</b>                                |  | 1         | 2         | a1-a4,b1-<br>b3, ,d1,d2 |
| <b>Number of Weeks /and Units Per Semester</b> |  |  | <b>16</b> | <b>32</b> |                         |

|   |                                |                                |                                |                                   |
|---|--------------------------------|--------------------------------|--------------------------------|-----------------------------------|
| Prepared by:                              | Reviewed by:                   | Head of the Department:        | Vice Dean for Quality affairs  | Dean of College:                  |
| - Assistant Prof. Dr<br>Ghamdan Al-Tahish | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Ass.Pr. Dr.<br>Ebtessam Al-Zabedi |

#### V. Teaching Strategies of the Course:

|    |                       |
|----|-----------------------|
| 1- | Lectures              |
| 2- | Self leaning          |
| 3- | <b>Group research</b> |

#### VI. Assessment Methods of the Course:

| No | Assignment                               |                     |
|----|--|---------------------|
| 1  | Written Exams (Short Essays) and Quizzes | a1-a4,b1-b3, ,d1,d2 |
| 2  | Written Exams(MCQ)                       | a1-a4,b1-b3, ,d1,d2 |
| 3  | Structured Oral Exams                    | a1-a4,b1-b3, ,d1,d2 |

#### VII. Assignments:

| No.          | Assignments  | Week Due                | Mark | Proportion of Final Assessment | Aligned CILOs (symbols) |
|--------------|--------------|-------------------------|------|--------------------------------|-------------------------|
| 1            | Midterm Exam | 7                       | 25   | 25%                            | a1-a4,b1-b3, ,d1,d2     |
| 2            | Activity     | Throughout the semester | 5    | 5%                             | a1-a4,b1-b3, ,d1,d2     |
| 3            | Final Exam   | 16                      | 70   | 70%                            | a1-a4,b1-b3, ,d1,d2     |
| <b>Total</b> |              |                         |      |                                |                         |

|  |                             |                             |                               |                               |
|--|-----------------------------|-----------------------------|-------------------------------|-------------------------------|
| Prepared by:                           | Reviewed by:                | Head of the Department:     | Vice Dean for Quality affairs | Dean of College:              |
| - Assistant Prof. Dr Ghamdan Al-Tahish | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni   | Ass.Pr. Dr. Ebtesam Al-Zabedi |



|   |  |
|---|--|
| <b>Learning Resources:</b>  |  |
| <ul style="list-style-type: none"> <li>Written in the following order: ( Author - Year of publication – Title – Edition – Place of publication – Publisher).</li> </ul> |  |
| <b>1- Required Textbook(s) ( maximum two ).</b>   |  |
| Molecular Microbiology: Principles and Perspectives" by Joan Slonczewski and John Foster  |  |
| Molecular Genetics of Bacteria" by Larry Snyder, Joseph E. Peters, Tina M. Henkin, and Wendy Champness  |  |
| <b>2- Essential References.</b>   |  |
| Essential Molecular Biology, 4th edition, by Thomas D. Brock, Michael Madigan, John Martin, and Jack Parker   |  |
| Molecular Microbiology, 5th edition, by Christopher Davies  |  |
| <b>3- Electronic Materials and Web Sites etc.</b>   |  |
| The American Society for Microbiology (ASM) website:<br><a href="https://www.asm.org/">https://www.asm.org/</a>   |  |
| The National Center for Biotechnology Information (NCBI) website:<br><a href="https://www.ncbi.nlm.nih.gov/">https://www.ncbi.nlm.nih.gov/</a>                          |  |
| The European Molecular Biology Laboratory (EMBL) website:<br><a href="https://www.embl.de/">https://www.embl.de/</a>  |  |

|                             |   |
|-----------------------------|---|
| <b>XI. Course Policies:</b> |   |
| 1                           | <b>Class Attendance:</b><br>Class Attendance is mandatory. A student is considered absent and shall be banned from taking the final exam if his/her absence exceeds 25% of total classes.     |
| 2                           | <b>Tardiness:</b><br>-If the student dose not attend for more than 6 times, the student will be obligated to withdrew from the course   |
|                             | <b>Exam Attendance/Punctuality:</b><br>No student shall be allowed to the exam hall after 30 minutes of the start time, and shall not leave the hall before half of the exam time has passed. |
| 3                           | <b>Assignments &amp; Projects:</b><br>Assignments and projects must be submitted on time. Students who delay their assignments or projects shall lose the mark allocated for the same.        |
|                             | <b>Cheating:</b><br>Cheating is an act of fraud that results in the cancelation of the student's exam or assignment. If it takes place in a   |

|  |                             |                             |                               |                               |
|--|-----------------------------|-----------------------------|-------------------------------|-------------------------------|
| Prepared by:                           | Reviewed by:                | Head of the Department:     | Vice Dean for Quality affairs | Dean of College:              |
| - Assistant Prof. Dr Ghamdan Al-Tahish | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni | Dr Gamil Taher Abdul Mughni   | Ass.Pr. Dr. Ebtesam Al-Zabedi |



|   |  |
|---|--|
|   | final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply.  |
| 4 | <b>Forgery and Impersonation:</b><br>Forgery/Impersonation is an act of fraud that results in the cancelation of the student's exam, assignment or project. If it takes place in a final exam, the penalties stipulated for in the Uniform Students' Bylaw (2007) shall apply. |
| 5 | <b>Other policies:</b><br>The University official regulations in force will be strictly observed and students shall comply with all rules and regulations of the examination set by the Department, Faculty and University Administration                                      |

|   |                                |                                |                                |                                   |
|---|--------------------------------|--------------------------------|--------------------------------|-----------------------------------|
| Prepared by:                              | Reviewed by:                   | Head of the Department:        | Vice Dean for Quality affairs  | Dean of College:                  |
| - Assistant Prof. Dr<br>Ghamdan Al-Tahish | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Dr Gamil Taher<br>Abdul Mughni | Ass.Pr. Dr.<br>Ebtessam Al-Zabedi |