# Course Specification

(Postgraduate Programs)



| |
|---|
| **Course Title:** Genetic Engineering and Genomics |
| **Course Code:** BIO-6312 |
| **Program:** Master of Science in Applied Biology (Cell and Molecular Biology) |
| **Department:** Biology |
| **College:** Science |
| **Institution:** Imam Mohammad Ibn Saud Islamic University |
| **Version:** 1 |
| **Last Revision Date:** |

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## A. General information about the course:

### 1. Course Identification:

| 1. Credit hours: ( Lecture 2+ Lab 2) | | | | |
|---|---|---|---|---|
| 2. Course type | | | | |
| A. | ☐University | ☐College | ☐Department | ☒ Track |
| B. | ☒ Required | | ☐Elective | |
| 3. Level/year at which this course is offered: ( Level 3 / second year) | | | | |

**4. Course general Description:**

This course introduces the students to the molecular methods and applications of recombinant DNA technology as well as the structural and functional genomics. This graduate course focuses on tools of genetic engineering (vectors and enzymes), genetic engineering blotting techniques, application of recombinant technology to diagnostics and therapeutics. Genome definition and function, genome variations and diversifications, and structural organization of eukaryotic genomes, organelle genomes, sequencing and mapping, and comparative genomics are among the topics covered in this course. The course also places an emphasis on transcriptomes, population genetics and genomics, basic bioinformatics, population-level variation (SNPs, MNPs, and indels), evolutionary genomics, and functional genomics.

**5. Pre-requirements for this course** (if any)**:**

None

**6. Co-requirements for this course** (if any)**:**

None

**7. Course Main Objective(s):**

The major aim of this graduate course is to provide a comprehensive knowledge, via lectures, tutorials, and lab activities, to the students regarding the modern concepts of genetic engineering and genomics. The course also aims to develop professional laboratory skills and practices that enable the students to perform research activities in the multidisciplinary fields of genetic engineering. The students, by the aid of the acquired knowledge, become competent to recognize and explain databases about genes and genomes.

## 2. Teaching Mode: (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | √ | 100% |
| 2 | E-learning | | - |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |



## 3. Contact Hours: (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 30 |
| 2. | **Laboratory/Studio** | 30 |
| 3. | **Field** | |
| 4. | **Tutorial** | |
| 5. | **Others (specify) .....** | |
| | **Total** | 60 |



# C. Course Learning Outcomes, Teaching Strategies, and Assessment Methods:

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |
| 1.1 | **Explain the concepts of genetic engineering including those related to techniques, applications and limitations** | K1 | Three credits weekly lectures | -Quizzes<br>-Presentations<br>-Assignments<br>-Classroom discussions<br>-Written exams |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 1.2 | **Outline the structural organization of eukaryotic nuclear and organelle genomes** | K2 | Three credits weekly lectures | -Quizzes<br>-Presentations<br>-Assignments<br>-Classroom discussions<br>-Written exams |
| 1.3 | **Describe the modern sequencing techniques and the whole genome sequencing strategies** | K3 | Three credits weekly lectures | -Quizzes<br>-Presentations<br>-Assignments<br>-Classroom discussions<br>-Written exams |
| 1.4 | **List the lab tools that are necessary to identify and analyze genes and genomes** | K4 | Three credits weekly lectures | -Quizzes<br>-Presentations<br>-Assignments<br>-Classroom discussions<br>-Written exams |
| 2.0 | **Skills** | | | |
| 2.1 | **Practice the different techniques applied in the lab settings of genetic engineering** | S1 | -Lab demonstration<br>-Independent lab activities | -Lab reports<br>-Lab exams |
| 2.2 | **Apply genome-wide and high-throughput DNA and RNA analyses in order to detect genomic variations and changes in gene expression** | S2 | -Lab demonstration<br>-Independent lab activities | -Lab reports<br>-Lab exams |
| 2.3 | **Interpret and analyze the genomic data by employing the appropriate analytical methods** | S3 | -Lab demonstration<br>-Independent lab activities | -Lab reports<br>-Lab exams |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 2.4 | **Propose and conduct a research work using the different methods of genetic engineering, and genome sequencing and assembly.** | S4 | -Lab demonstration<br>-Independent lab activities | -Lab reports<br>-Lab exams |
| 3.0 | **Values, autonomy, and responsibility** | | | |
| 3.1 | **Perform a research work independently, and cooperate effectively in team activities.** | V1 | Group discussions | -Performance<br>-Participation<br>-Lab reports |
| 3.2 | **Participate in discussions of the scientific issues, and present scientific data to a varied audience** | V2 | Group discussions | -Performance<br>-Participation<br>-Lab reports |
| 3.3 | **Adhere to the ethics related to the research activities in the field of genetic engineering and genomics** | V3 | Group discussions | -Performance<br>-Participation<br>-Lab reports |



## C. Course Content:

| No | List of Topics | Contact Hours |
|---|---|---|
| 1. | **Tools and Techniques of Genetic Engineering:**<br>-Tools: restrictions enzymes, vectors, CRISPR-Cas<br>-Techniques: PCR, RAPD, RFLP, AFLP, Cloning, blotting, Isolation of Chromosomes, In Situ Hybridization, Next-Generation Sequencing Technologies, Sequencing an Entire Genome, Creating Random Mutations, Site-Directed Mutagenesis, Knockout, Silencing Genes with RNAi, | **4** |
| 2. | **Introduction To Genomics:**<br>What is a genome? How does my genome work? | **2** |
| 3. | **Basic Aspects of Gene Expression & Regulation**<br>Eukaryotic gene expression | **4** |
| | | |

| | | |
|---|---|---|
| 4. | **Structural Genomics**<br>Genetic Maps<br>Physical Maps<br>Sequence Variation: The Denaturation and Renaturation of DNA, copy-Number Variations<br>Single-Nucleotide Polymorphisms<br>Expressed-Sequence Tags<br>Bioinformatics<br>Metagenomics<br>Synthetic Biology | **8** |
| | **Functional Genomics**<br>Predicting Function from Sequence<br>Gene Expression and Microarrays<br>Gene Expression and Reporter Sequences<br>Genome wide Mutagenesis | **4** |
| ***5.*** | **Genome Models**<br>Saccharomyces cerevisiae, Drosophila melanogaster Caenorhabditis elegans Danio rerio Mus musculus Rattus norvegicus | **4** |
| ***6.*** | **Comparative Genomics**<br>Syntheny, homologous and orthologous genes<br>Eukaryotic Genomes<br>Comparative Drosophila Genomics<br>The Human Genome<br>Comparison of Human and Chimpanzee Genomes Is Helping to Reveal Genes That Make Humans Unique? | **4** |
| 7. | **Sequenced Genomes Databases**<br>The Genome Sequence DataBase (GSDB), Database of Genomic Structural Variation (dbVar), Database of Genotypes and Phenotypes(dbGaP) | **8** |
| 9. | **Proteomics Analyzes**<br>Determination of Cellular Proteins<br>Affinity Capture<br>Protein Microarrays<br>Structural Proteomics | **8** |
| | **The Saudi Genome Project:**<br>-Database 0f Genetic Information | **2** |
| **Total** | | **60** |

## D. Students Assessment Activities:

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| 1. | **Midterm exam-1** | 5th week | 15% |
| 2. | **Midterm exam-2** | 10th week | 15% |
| 3. | **Assignments, presentations, attendance, participation** | Throughout the course duration | 10% |
| 4. | **Final lab exam** | 15th week | 20% |
| ... | **Final exam** | 16th week | 40% |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.)

## E. Learning Resources and Facilities:

### 1. References and Learning Resources:

| | |
|---|---|
| **Essential References** | -Desmond S. T. Nicholl (2023). An Introduction to Genetic Engineering, 4th edition, Cambridge University Press, ISBN-13-978-1009180597.<br>-Arthur M. Lesk (2017). Introduction to Genomics, 3rd edition, Oxford University Press ISBN-13- 978-0198754831.<br>-Benjamin A Pierce (2020) Genetics: a conceptual approach. 7th edition W.H. Freeman. ISBN-13-978-1319216801. |
| **Supportive References** | https://harvard.simplesyllabus.com<br>https://m.mu.edu.sa |
| **Electronic Materials** | |
| **Other Learning Materials** | |

### 2. Educational and Research Facilities and Equipment Required:

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | Classroom, laboratories |
| **Technology equipment**<br>(Projector, smart board, software) | Projector, smart board |
| **Other equipment**<br>(Depending on the nature of the specialty) | |



## F. Assessment of Course Quality:

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| **Effectiveness of teaching** | Students | Indirect |
| **Effectiveness of students assessment** | Faculty | Direct |
| **Quality of learning resources** | Faculty | Direct |
| **The extent to which CLOs have been achieved** | Faculty | Direct |
| **Other** | | |

Assessor (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)



## G. Specification Approval Data:

| | |
|---|---|
| - | **BIOLOGY DEPARTMENT COUNCIL** |
| **REFERENCE NO.** | **23** |
| **DATE** | **23/8/1445** |