



Department of Biology

College of Science

University of Salahaddin-Erbil

Subject: Medical Genetics

Course Book – (Year 2)

Lecturer's name Dr. Mukhlis Hamad Aali, PhD.

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Mr. Academic Year: 2023/2024

Course Book

1. Course name	Medical Genetics
2. Lecturer in charge	Dr.Mukhlis Hmad Aali Mustafa Fahmi Rajab Abdullah Abubakir Shareef
3. Department/College	Biology / Science
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5. Time (in hours) per week	Theory: 2 Practical: 2
6. Office hours	To be Return to the schedule on the office door
7. Keywords	Genetics, Principles of Genetics, Animal Genetics, Plant Genetics, Microbial Genetics, Population Genetics, Sex and Environment, Chromosomal aberrations, Repair system, Molecular biology.

8. Course overview:

Course description, objectives, and format

Genetics is one of the basic science courses that comprise the biology curriculum of the four years of Science College. The overall goal of these courses is to provide with the knowledge and understanding of the scientific principles that are the basis of current approaches to know the genetic basis of organisms. The application of these scientific principles and knowledge to the practice of science and diseases, including the development of life-long learning and problem-solving skills, is emphasized. The genetic course consists of 30 lectures (annually) and covers topics are integrated with the concurrent agriculture, medicine, statistics, microbiology, pathology, and integrated problems.

Lectures from basic sciences, clinical disciplines and microbiology teach the fundamental principles of genetic and how these principles apply to the diagnosis and treatment of these problems in above fields.

Course learning objectives

By the end of this course, students will be able to apply their basis background in genetics to the practice of agriculture, scientific research, including the effective diagnosis, treatment and prevention of genetic disease. Detailed learning objectives are provided for each lecture.

11. Course objective:

Each lecture is accompanied by a power point presentation. Information from the presentation and assigned reading is important for mastering the learning objectives which are the primary focus of exam questions.

Example:

- History of Genetics,1-Blending theory, 2-Acquired character inheritance, 3-Pangenesis theory, 4- Performation and Epigenesis, 5-Cell theory (Classical and modern interpretation)
- The subject matter of genetics includes: Heredity; The molecular nature of the genetic material; The ways in which genes, which determine the characteristics of organisms, control life functions; The distribution and behavior of genes in populations.
- Genetics four major subdisplines: Transmission Genetics; Molecular Genetics; Population Genetics; Quantitative Genetics
- Gene Expression, Genome, chromatin, chromosome, Gene (Mendelian factor), Allele, Homozygous, Heterozygous, Genotype, Phenotype.
- Characteristics of Organisms Used for Genetic Studies, General Features
- Viruses, *Eschirichia.coli*, Human, *Drosophila melanogaster*, Maize, *Arabidopsis thaliana*.
- Methods of genetic study, 1- Planned breeding, 2- Pedigree analysis
- Why do Pedigrees?, Goals of Pedigree Analysis, Symbols used in pedigree analysis
- Autosomal recessive trait, Autosomal dominant trait
- Complete dominance, -incomplete dominance, Codominance, Overdominance, Heterosis.
- Lethal genes, a-Dominant genes with recessive lethal effect, b- Recessive gene with recessive lethal effect.
- Multiple alleles
- Multiple genes (Polygeny)
- Qualitative genetics
- Quantitative traits
- Epistasis, epistatic gene, hypostatic gene, Types of epistasis, Classical ratio, Dominant epistasis, Recessive epistasis, Duplicate genes with cumulative effect, Duplicate dominant genes, Duplicate recessive genes, Dominant and recessive interaction.

9. Student's obligation

***Exam policy:** Student Should take 2 examinations during the course. There will be no make-up exams for absences students without medical report.

***Classroom polices:**

1- Attendance: You are strongly encouraged to attend class on a regular basis, as participation is important to your understanding of the material. This is your opportunity to ask questions. **You are responsible for obtaining any information you miss due to absence.**

2- Lateness: Lateness to class is disruptive.

3- Electronic devices: All cell phones are to be turned off at the beginning of class and put away during the entire class.

4- Talking: During class, please refrain from side conversations. These can be disruptive to your fellow students and your professor.

5- No Disrespectful to both the professor and to your fellow students.

10. Forms of teaching

Course book, Power point, Soft and hard copy lectures, white board and black board.

11. Assessment scheme

Breakdown of overall assessment and examination

Pre final (50 marks)

Practical (35 marks)

Exam 15

Quiz 6

Report 8

Assignment 6

Theory (15 marks)

Exam = 10 marks

Quizzes, seminar, and attendance = 5 marks

Final

Theory (50 marks)

12. Student learning outcome:

At the end of your undergraduate teaching you will be expected to be able to:

- **Recognize pattern of inheritance.**
- **Have knowledge of several Mendelian and chromosomal conditions.**
- **Recognize the genetic and environmental contribution to multifactorial conditions.**
- **To know the genetic and environmental basis of sex determination.**
- **Learned approaches which can be used for the diagnosis of genetic disease and carrier detection.**
- **Learned different forms of DNA testing (prenatal diagnosis, predictive testing, and diagnostic testing).**
- **Be familiar with the practice of the genetic counseling.**
- **Know when and where to get genetic advice and information.**
- **Be familiar with the major ethical issues.**
- **To know the effects of cytoplasmic inheritance.**
- **To know the population genetics and the factors affects the gene frequency in the population.**
- **Types of mutations, mutagens and repair systems.**
- **To know some approaches of biotechnology and their applications.**

13. Course Reading List and References:

- 1- Tamarin, R.H. (1995). Principles of genetics (5th edi.). Wm. C. Brown publisher. U.S.A
- 2- Tamarin, R.H. (1996). Principles of genetics (6th edi.). Wm. C. Brown publisher. U.S.A
- 3- Nester, E.W.; Anderson, D.G.; Roberts, Jr. C.E.; Pearsall, N.N.; Nester, M.T. (2001). Microbiology a human perspective (3rd ed.). Mc Graw Hill, U.S.A .
- 4- Tortora, G.J. ; Funke, B. R. and Case, Christine, L. (2004). Microbiology: an introduction (6th edi.). Pearson, Benjamin Cummings. U.S.A .
- 5- Brooker, Robert J. (2005). Genetics (analysis and principles). Mc Graw Hill. U.S.A .
- 6- Pierce B.A. (2006). Genetics, A conceptual approach (2nd edi.). W.H. Freeman and Company. New York, U.S.A .

17. The Topics:

Weeks	Topics	Lectures
1	Introduction	Course outline, how to study Genetics, the role of genetics in life, distribution of marks, exams, and final exams
2	History of Genetics	History of genetics, the genetic theories, the subject matter of genetics includes, genotype and phenotype
3	Mendelian inheritance	Gregor Mendel (1822-1884), Genetic terminology, Punnett square, Mendel's experimental methods, Mendel's 1st and 2nd laws, test cross and back cross
4	Characteristics of Organisms Used For Genetic Studies	Viruses, <i>E.coli</i> , Human, <i>Drosophila</i> , maize, <i>Arabidopsis thaliana</i> , methods of genetic study, pedigree analysis
5	Type of dominance	Dominant/ recessive, incomplete dominance, Codominance, Overdominance, Lethal genes, Multiple alleles (Polygenic inheritance)
6	Epistasis	Dominant epistasis (12:3:1), Recessive epistasis (9:3:4), Duplicate genes with cumulative effect (9:6:1), Duplicate dominant genes (15:1), Duplicate recessive genes (9:7), Dominant and recessive interaction (13:3), Gene interactions (non-epistatic interaction)
7	Sex-determination System	Genetic mechanisms of sex determination, chromosomal basis of sex determination, Genic balance
8	Exam.	
9	Sex Determination And Environment	Haplodiploidy, Single gene effect, Sex determination and environment
10	Inheritance related to sex (X-linked recessive and dominant traits)	Variation of sex-linkage, Pseudoautosomal Inheritance, Sex linked in <i>Drosophila</i> , Criteria for an X-linked recessive trait and examples, Criteria for an X-linked dominant trait and examples.

11	Y-linked traits, Sex influenced traits, sex limited traits	Y-linked inheritance and their examples, Sex influenced traits, sex limited traits and their examples
12	Linkage and recombination	Work of Bateson and Punnett, Coupling and repulsion, Linkage, crossing over, Factors affecting crossing over, Methods of calculation of crossing over, Complete linkage, Mapping Genes
13	Chromosome aberrations, variation in chromosome Number	History of cytogenetics, classification of chromosomes, aneuploidies of the sex chromosomes, aneuploidies of the somatic chromosomes, aneuploidy vs polyploidy
14	Variation in chromosome structure	Deficiencies/Deletions; Duplications The genetic material remains the same, but is rearranged; Inversions; Translocations and their examples
15	Population Genetics	Defenition, Hardy-Weinberg principle and population equilibrium, Applying the Hardy-Weinberg Principle
16	Exam.	
17	Changes in Gene Pools	Genetic drift, mutations, natural selection, non-random mating
18	Microbial genetics, Types of mutation	Definition, What Are Mutations?, causes and types, Are mutations helpful or harmful?, single base-pair mutations, point mutation, substitutions, inversion, additions, Deletions, tautomeric shifts
19	Mutagenic agents and the mechanisms of mutation	Physical agents, ionizing and non-ionizing radiation, chemical agents, nitrous acid, hydroxylamine, base analogue mutagen, alkylating agents, acridines
20	Detection and isolation of mutants	(a) Plating the bacteria on antibiotic media, Visible Mutations, Auxotrophic Mutations, Conditional Mutations, Resistance Mutations, Using minimal media with sugars. (b) Using minimal media with sugars. Replica plating technique, Ames test
21	Repair of DNA	Photoreactivation repair, Base excision Repair, Nucleotide Excision Repair, Recobination repair, MisMatch Repair, SOS response, Double strand break repair
22	Regulation of gene expression, inducible operon	Definition, the operon system, genetic map of lactose operon, negative and positive control, Catabolite repression
23	Repressible Operon	Definition, genetic map of tryptophan operon, Organization of the trp operon and regulation via the trp repressor protein, attenuation, Comparative properties of inducible and repressible operons

Practical Course programme:

Week 1:

Course book and Course guide

Week 2:

Introduction to genetics, important terms in genetics and chromosome nomenclature

Week 3:

Cell cycle and mitosis

(Quiz 1)

Week 4:

Study of Meiosis in eukaryotes

(Report 1) (Onion Root Tip)

Week 5:

DNA Extraction process

(Quiz 2)

Week 6:

Cytogenetics Techniques in Diagnosing Disorders

**Report 2 (Video banana method)
(Poster Activity)**

Week 7:

Karyotype (Metaphase chromosome preparation)

Week 8:

Using of *Drosophila melanogaster* in genetic research

(Quiz 3 Lab 6 & 7)

Week 9:

Mutation induction in *Drosophila melanogaster*

Week 10:

Seminar presentation

(Quiz 4 both labs 8 & 9)

(Genetic disorders)

Week 11:

Examination

Week 12:

Fingerprints & Palmar Dermatoglyphics

Week 13

A Nuclear Bioassay: Micronucleus test

Week 14

Human simple non metric traits

Quiz 5

18. Examinations:

1. Compositional: In this type of exam the questions usually starts with Explain how, What are the reasons for...?, Why...?, How....?

With their typical answers

Examples should be provided

Question/ Why do Pedigrees? Punnett squares and chi-square tests work well for organisms that have large numbers of offspring and controlled mating, but humans are quite different:

1. Small families. Even large human families have 20 or fewer children.
2. Uncontrolled matings, often with heterozygotes.
3. Failure to truthfully identify parentage.

2. True or false type of exams:

In this type of exam a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided

Q1/Write True and False in front of the following sentences, then correct the false. (15 Marks)

1-Although incorrect, the concept of pangensis was highly influential and persisted until the late 1900s.

2- The genetic and molecular organization of the mouse and human genes are quite similar.

Answers/1-F/1900 ---T/1800, 2-T.

3. Multiple choices:

In this type of exam there will be a number of phrases next or below a statement, students will match the correct phrase. Examples should be provided.

Question/ For each term in the left column, choose the best matching phrase in the right column.

A				Answer
B	Karyotype	1	Crosses in which the male and female traits are reversed, thereby controlling whether a particular trait is transmitted by the egg or the pollen	A-4
C	Reciprocal crosses	2	The cross of an individual of ambiguous genotype with a homozygous recessive individual	B-1
D	Population genetics	3	Which deals with heredity in groups of individuals for traits that are determined by one or only a few genes	C-3
D	Test cross	4	The array of chromosomes in a given cell	D-2

20. Extra notes:

21. Peer review پندارچونھوھى ھاوھل

This course book has to be reviewed and signed by a peer. The peer approves the contents of your course

book by writing few sentences in this section.

(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).

ئھم كۆرسبووكە دەبىت لھالىھن ھاوھلىكى ئھكادىمىھوھ سھىر بكرىت و ناوھرۆكى بابھتھكانى كۆرسھكە پھسھند بكات و جھند ووشھىھك بنووسىت لھسھر شىاوى ناوھرۆكى كۆرسھكە و واژووى لھسھر بكات. ھاوھل ئھو كھسھىھ كھ زانىارى ھبىت لھسھر كۆرسھكە و دەبىت پلھى زانستى لھ مامۇستا كھمتر نھبىت.