

Course Code MED-109	Course Title Biology II	ECTS Credits 6
School Medical School	Semester Spring (Semester 2)	Prerequisites MED-103 Biology I
Type of Course Required	Field Medicine	Language of Instruction English
Level of Course Undergraduate	Year of Study 1st	Lecturer(s) Dr Christiana Charalambous
Mode of Delivery Face-to-face	Work Placement N/A	Co-requisites None

Objectives of the Course:

This course complements Biology I and aims to teach students the complexity of life at the cellular, protein and gene level. The course also aims to provide students with the opportunity to develop further laboratory skills through practice. The main objectives of the course are:

- To explain how genetic information is decoded and inherited in multicellular and unicellular organisms
- To discuss the principles of Mendelian genetics and the chromosomal basis of inheritance and employ Punnett squares to demonstrate genotypic and phenotypic inheritance.
- To explain the main principles of DNA replication, transcription and translation and to discuss the regulation of gene expression.
- To introduce students to the different types of prokaryotic and eukaryotic microorganisms and viruses and their role in disease pathogenesis.
- To introduce students to Darwin's theory of natural selection and evolution.

Learning Outcomes:

The following list provides the learning objectives that will be covered in the lectures and tutorials of each week:

Week 1

LOBs covered during lectures:

1. Define and describe the concepts of karyotype and pedigree.
2. Outline the basis of Mendelian genetics.
3. Explain the Mendel laws of segregation and independent assortment.
4. Explain autosomal dominant vs autosomal recessive inheritance.
5. Explain the inheritance of X-linked genetic diseases.
6. Outline the role of genetic testing in identification of human genetic disorders.

LOBs covered during laboratory practical:

7. Distinguish between antigen and antibody.
8. Explain the differences between the different human blood types.
9. Explain the procedure of the haemagglutination inhibition test.
10. Explain blood type choice during transfusions.

11. Explain the pattern of inheritance of the blood type alleles.

Week 2

LOBs covered during lectures:

12. Explain the chromosomal basis of inheritance.
13. Explain the role of gene linkage in inheritance.

LOBs covered during tutorial:

14. Calculate the probability of independent events occurring simultaneously and the probability of either one or the other of two mutually exclusive events occurring.
15. Use binomial expansion to calculate the probability of certain combinations of events happening.

Week 3

LOBs covered during lectures:

16. Describe human disorders that occur due to chromosomal alterations.
17. Describe the structure and functions of DNA.
18. Describe the structure of chromosomes, including the structure and organisation of chromatin.
19. Describe the process of DNA replication including the processes of telomere replication and DNA repair.

LOB covered during laboratory practical:

20. Define plasmids.
21. Successfully isolate plasmid DNA from *E. Coli* and calculate its concentration using spectrophotometry.
22. Describe the role and chemical effect of the reagents used in DNA isolation.

LOBs covered during field trip to CING

6. Outline the role of genetic testing in identification of human genetic disorders (that occur due to chromosomal alterations).

Week 4

LOBs covered during lectures:

23. Describe the structure and functions of RNA.
24. Describe the steps and molecules involved in transcription and RNA processing.
25. Describe the steps and molecules involved in translation.

LOBs covered during tutorial:

26. Describe the connection between genes, proteins and the genetic code.

Week 5

LOBs covered during lectures:

27. Describe the mechanisms involved in the regulation of gene expression in prokaryotes.
28. Describe the mechanisms involved in the regulation of gene expression in eukaryotes.
29. Describe the role of non-coding RNAs in the regulation of gene expression.

LOBs covered during tutorial:

30. Solve genetic problems involving human pedigree analysis.

Week 6

LOBs covered during lectures:

31. Describe the role of abnormal gene expression in carcinogenesis.

LOBs covered during tutorial:

32. Calculate simple genotype/phenotype frequencies and recombination frequencies.

Week 7

33. Describe the structure and morphology of prokaryotes.

MIDTERM EXAM

Week 8

LOBs covered during lectures:

34. Identify the role of pathogenic bacteria in human disease.

LOBs covered during laboratory practical:

35. Describe and recognize the different blood cell types in a blood smear preparation and explain the role of each cell type.

Week 9

LOBs covered during lectures:

36. Describe the different types and categories of protists and their role in human disease.

37. Describe the different types of fungi and their potential role in human disease.

LOBs covered during tutorial:

38. Conduct total cell counts using a haemocytometer.

Week 10

LOBs covered during lectures:

39. Describe the structure of viruses and phages and their replicative cycles.

40. Describe the role of viruses in human disease pathogenesis (including the mechanisms by which they destroy the host cells) and identify the major viruses that cause human disease.

LOBs covered during laboratory practical:

41. Prepare Petri dishes with agar media.

42. Prove the presence of microorganisms in the environment through culturing.

43. Evaluate and describe specific characteristics of colonies formed by different microorganisms.

Week 11

LOBs covered during lectures:

44. Describe the structure of prions and viroids and their role in disease pathogenesis.

45. Explain Darwin's theory of Evolution, Natural selection and adaptation and provide examples of evolution and adaptation in prokaryotes, eukaryotes and humans.

LOBs covered during laboratory practical:

46. Distinguish between sterilization, disinfection, sanitisation and antisepsis.
47. Describe the factors which affect the efficiency of an antimicrobial agent.
48. Evaluate the effectiveness of various antimicrobial agents.
49. Describe the different categories of antibiotics based on their mode of action, including antibiotic examples from each category.

Week 12

LOBs covered during lectures:

Final exam revision

LOBs covered during tutorial:

Lab report feedback and review.

Course Contents:

Topics covered in lectures:

- Human Genetics: Mendelian Inheritance, Karyotypes and Pedigrees.
- The chromosomal basis of inheritance: chromosomes structure and function, linkage and chromosomes.
- The Molecular Basis of Inheritance: Watson and Crick Model of DNA, DNA Replication.
- Gene expression: the connection between genes and proteins, the genetic code, transcription and translation.
- Regulation of gene expression: Regulation of chromatin structure, regulation of transcription, post-transcriptional regulation, post-translational regulation, noncoding RNAs, operons.
- Prokaryotes: Bacteria and Archaea.
- Eukaryotic microorganisms: Protists and Fungi.
- Viruses.
- The Darwinian Theory of Evolution, Natural Selection and Adaptation.

Topics covered in lab practicals:

- Human blood groups.
- DNA Isolation.
- DNA and protein synthesis
- Blood cell types (blood smear preparation).
- Blood cell counting.
- Microbial culture and growth.
- Antibiotic resistance selection and microorganism control

Topics covered in tutorials:

- Genetics tutorial I: Probabilities in Genetics.
- Field trip: Visit to the CING (Department of Cytogenetics and Genomics).
- DNA and protein synthesis.
- Genetics tutorial II: Pedigree analysis and genetics exercise solving
- Genetics tutorial III: Mendelian Genetics and Genetic Problems.

Learning Activities and Teaching Methods:

Lectures, Tutorials, Laboratory Practical Sessions.

Assessment Methods:

Laboratory reports (10%), Midterm Exam (30%), and Final Exam (60%). Assessment is by Single Best Answers (SBAs) and Short Answer Questions (SAQs).

Required Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
L. A. Urry, M.L. Cain, S.A. Wasserman, P.V. Minorsky, J.B. Reece	Campbell Biology	11 th Edition	Pearson	2017

Recommended Textbooks/Reading:

Authors	Title	Publisher	Year	ISBN
J. D. Watson, A. Berry	DNA: The Secret of Life	Knopf	2003	0375415467
Michael A. Palladino	Understanding the Human Genome Project	Benjamin/ Cummings	2003, 3 rd Edition	0-8053-6774-8