<table>
<tr><td>Course Title</td><td colspan="5">Medical Genetics</td></tr>
<tr><td>Course Code</td><td colspan="5">MED-306</td></tr>
<tr><td>Course Type</td><td colspan="5">Required</td></tr>
<tr><td>Level</td><td colspan="5">Undergraduate</td></tr>
<tr><td>Year / Semester</td><td colspan="5">Year 3/ Semester 6 (Spring)</td></tr>
<tr><td>Teacher’s Name</td><td colspan="5">Course Lead:
Dr Adonis Ioannides
Other contributors:
Dr George Tanteles
Dr Maria Loizidou
Dr Carolina Sismani
Dr Anthi Drousiotou</td></tr>
<tr><td>ECTS</td><td>6</td><td>Lectures / week</td><td>4</td><td>Laboratories / week</td><td>0</td></tr>
<tr><td>Course Purpose and Objectives</td><td colspan="5">Medical genetics is a rapidly advancing field of medicine. Genetic mechanisms play a fundamental role in the pathogenesis and treatment of diseases and in the maintenance of health. This course is designed to provide an overview of human genetic concepts and clinical disorders that have a genetic component. The course seeks to teach the students to apply their knowledge of the principles of human genetics to a variety of clinical problems. It covers a number of clinical areas including cytogenetics, molecular genetics, biochemical genetics, population genetics and clinical genetics.</td></tr>
<tr><td>Learning Outcomes</td><td colspan="5">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. Revise the structure and function of genes, the normal human karyotype, meiosis and mitosis.
2. Describe the role of the clinical geneticist in a modern healthcare system.
3. Outline the diagnostic tools available to the clinical geneticist.
4. Describe in detail the construction of a genogram.
5. Identify the key diagnostic information and the main pointers to inheritance patterns that can be extracted from the genogram.

Week 2
Lobs covered during lectures:</td></tr>
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6. Define the terms mutation and polymorphism.
7. Describe the different mutation types.
8. Explain the implications of the different mutation types on the function of the gene product.
9. Describe genotype/ phenotype correlation and provide examples.
10. Define the terms penetrance, expressivity and genetic heterogeneity and provide examples.
11. Outline epigenetic mechanisms.
12. Define genomic imprinting and describe key imprinting disorders including Angelman, Prader-Willi and Beckwith-Wiedemann syndromes.
13. Define X-inactivation and discuss briefly its clinical relevance.

Week 3

Lobs covered during lectures:

14. Explain how mutations in genes encoding structural proteins cause disease and illustrate with examples.
15. Explain how mutations in genes encoding transmembrane channels cause disease and illustrate this with relevant examples.
16. Explain how mutations in genes encoding receptors and signaling pathway components cause disease and illustrate with relevant examples.
17. Explain how expansion of triple repeats cause disease and illustrate this with relevant examples.
18. Define the term genetic anticipation and illustrate with examples.

Week 4

Lobs covered during lectures:

19. Describe autosomal recessive and autosomal dominant inheritance and provide clinical examples.
20. Outline the role of consanguinity in autosomal recessive disorders.
21. Explain the role of germline mosaicism, *de novo* mutations and reduced penetrance in autosomal dominant disorders.
22. Explain X-linked recessive and dominant inheritance.
23. Explain the role of skewed X-inactivation in X-linked conditions and illustrate with examples.
24. Outline Y-linked and pseudo-autosomal inheritance.
25. Interpret genograms appropriately to establish the likely mode of inheritance.

Lobs covered during tutorials:

26. Outline the main techniques used in molecular genetic diagnosis including sequencing, MLPA and Next Generation Sequencing.

Week 5

Lobs covered during lectures:

27. Describe mitochondrial inheritance and provide relevant examples.
28. Outline multifactorial inheritance and the role of genetic factors in the aetiology of common medical conditions such as diabetes mellitus and ischaemic heart disease.
29. Correlate types of mutations with different patterns of inheritance.

Week 6

Lobs covered during lectures:

30. Define the term pleiotropy and give examples of this phenomenon.
31. Outline the correlation of the role of genes in developmental processes with the abnormalities caused by mutations in these genes and give relevant examples.
32. List the clinical features that are routinely assessed during the clinical examination of a dysmorphic child.
33. Use standard terminology to describe dysmorphic features.
34. Define the terms deformation, disruption, sequence and association when describing congenital malformations.
35. Describe the features of the more common associations such as VACTERL.

Online Formative Midterm Exam

Week 7

Lobs covered during lectures:

36. Define oncogenes and describe how they contribute to the development of neoplasia.
37. Explain how the different types of tumour suppressor genes prevent the development of neoplasia.
38. Outline the types of DNA repair genes which, when mutated, lead to cancer predisposition.
39. Describe the clinical features of the main cancer predisposition syndromes (such as Lynch syndrome and *BRCA*-associated breast and ovarian cancer) and explain their genetic basis.
40. Evaluate a family history for the possibility of inherited predisposition to cancer using the genogram.

Week 8

Lobs covered during lectures:

41. Describe the fundamental principles of conventional cytogenetics: appearance, structure and classification of human chromosomes.

42. Describe meiosis and mitosis and outline the differences between the two processes.
43. Describe the numerical and structural chromosomal abnormalities, their inheritance, segregation and pathogenicity.
44. Outline the clinical features of the common chromosomal disorders including autosomal trisomies, sex chromosome aneuploidies and structural abnormalities.
45. Outline the various cytogenetic and molecular cytogenetic methodologies and applications in clinical practice.

Lobs covered during tutorials:

46. Explain how clinical cases are resolved using conventional cytogenetic and molecular cytogenetic methods.

Week 9

Lobs covered during lectures:

47. Define the principles of Biochemical Genetics and describe the transition from inherited protein/enzyme deficiency to metabolic block and disease pathology.
48. Define how enzyme deficiencies affect the function of organelles such as lysosomes, peroxisomes and mitochondria.
49. Describe the clinical, biochemical and genetic features of the commonly encountered Inborn Errors of Metabolism (IEM).
50. Define clinical and genetic heterogeneity as observed in IEM.
51. Outline the main therapeutic approaches for IEM.
52. Describe the benefits, problems and dilemmas associated with Newborn Screening.
53. Describe the basic principles of the laboratory investigation of IEM.
54. Define the strategies and approaches used for the laboratory investigation of IEM.
55. Describe the methodology and instrumentation used for the laboratory diagnosis of IEM.
56. Outline appropriate tests for the diagnosis of the major groups of IEM.

Week 10

Lobs covered during lectures:

57. Explain the Hardy-Weinberg law/ equilibrium and outline those factors that may disturb this equilibrium.
58. Describe the use of the Hardy-Weinberg law to estimate the carrier frequency of autosomal recessive disorders.
59. Explain the term mutation-selection equilibrium and describe the use of the Hardy-Weinberg law to estimate the new mutation rate in autosomal dominant disorders.

	60. Explain the founder effect in relation to mutations and outline other factors affecting the incidence of specific genetic conditions in certain populations providing relevant examples. 61. Define genetic linkage and outline its use in genetic testing. 62. Outline the use of genetic linkage in gene mapping. **Week 11** ***Lobs covered during lectures:*** 63. Determine occurrence and recurrence risks associated with genetic disorders. 64. Outline the principles of genetic counselling. 65. Discuss ethical aspects of genetic counselling. 66. Describe the benefits and risks of genetic testing and the principles of pre-test counselling. 67. Outline the use of preimplantation genetic diagnosis. 68. Describe the different types of prenatal diagnosis and their use at the appropriate stage of pregnancy. **Week 12** ***Lobs covered during lectures:*** 69. Define gene therapy and outline the different types of methodological approaches. 70. Define current applications and limitations of gene therapy. 71. Describe whether and how genetic disorders can be cured by stem cell and tissue engineering approaches. 72. Outline how stem cell technology and precision gene therapy can be united to treat genetic diseases. 73. Illustrate how targeted treatments can be tailored to the specific mutations causing genetic disease.		
Prerequisites	MED-103 Biology I MED-109 Biology II MED-204 Biochemistry I MED-209 Biochemistry II	Required	None
Course Content	**<u>Topics covered in lectures:</u>** • Introduction to the Medical Genetics course. • Elements of Clinical Genetics practice. • Genograms. • Mutations and genotype/ phenotype correlation. • Penetrance/ expressivity/ genetic heterogeneity.		

	• Introduction to epigenetics. • Genetic disorders (structural proteins). • Genetic disorders (receptors, pathways, channels). • Triple repeat disorders. • Autosomal recessive inheritance. • Autosomal dominant inheritance. • Sex-linked inheritance. • Molecular genetic techniques. • Mitochondrial inheritance. • Multifactorial inheritance. • Mutation types and inheritance patterns. • Oncogenes and tumour suppressor genes. • Developmental genes and consequences of disturbed function. • Common malformation 'syndromes'. • Introduction to clinical dysmorphology. • Tumour predisposition syndromes I. • Tumour predisposition syndromes II. • Introduction to human chromosomes. • Numerical and structural chromosomal abnormalities. • Cytogenetic and molecular cytogenetic methodologies. • Biochemical Genetics I. • Biochemical Genetics II. • Laboratory Investigation of IEM. • Hardy-Weinberg law and its applications. • Other aspects of population genetics. • Genetic linkage. • Genetic risks. • Genetic counselling and genetic testing. • Preimplantation genetic and prenatal diagnosis. • Principles of gene therapy. • Stem cells in genetic disease. • Targeted therapies in Genetic disease. **Topics covered in tutorials:** • Case Studies

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- Interactive discussion: Genetic diseases and hypothetical therapeutic approaches from the future doctor (including stem cells, genetic engineering etc).

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<tr><td>Teaching Methodology</td><td>The course is delivered by lectures and tutorials.</td></tr>
<tr><td>Bibliography</td><td>

Required Textbooks/Reading:

Authors	**Title**	**Edition**	**Publisher**	**Year**	**ISBN**
Nussbaum, R. L. et al.	Thompson & Thompson Genetics in Medicine	8th edition	Elsevier	2015	9781437706963

Recommended Textbooks/Reading:

Authors	**Title**	**Edition**	**Publisher**	**Year**	**ISBN**
Peter S. Harper	Practical genetic counselling	7th edition	London: Hodder Arnold	C2010	9780340990698
Peter D. Turnpenny, Sian Ellard	Emery's elements of medical genetics	14th edition	Philadelphia, PA.: Elsevier / Churchill Livingstone	2012	9780702040436

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<tr><td>Assessment</td><td>On-line Formative Midterm Exam and Summative Final Exam. The Summative Final Exam will contribute towards 100% of the course grade. Assessment is by Single Best Answer MCQs (SBAs) and there may also be some Short Answer Questions (SAQs).</td></tr>
<tr><td>Language</td><td>English</td></tr>
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