האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

# *The Hebrew University of Jerusalem*

## *Syllabus*

# *WORK SHOP POPULATION GENETICS - 71991*

*Last update 23-07-2020*

*HU Credits:* *2*

*Degree/Cycle:* *2nd degree (Master)*

*Responsible Department:* *Genetics & Breeding*

*Academic year:* *0*

*Semester:* *1st Semester*

*Teaching Languages:* *English*

*Campus:* *Rehovot*

*Course/Module Coordinator:* *Dr. Tamar Friedlander*

*Coordinator Email:* *tamar.friedlander@mail.huji.ac.il*

*Coordinator Office Hours:* *Please coordinate with me.*

*Teaching Staff:*

*Dr. Tamar Friedlander,*
*Mr. Harel Bacher*

*Course/Module description:*
*in this course the students will learn about the basic evolutionary processes in a population and will get familiarized with their mathematical description.*

*Course/Module aims:*

*Learning outcomes - On successful completion of this module, students should be able to:*
*The students will gain acquaintance with basic evolutionary processes and their mathematical description in a single locus: random mating, drift, mutation and natural selection.*
*The students will learn different examples to the occurrence of these processes in the lab and in natural populations and will apply the models they learned to different cases.*

*Attendance requirements(%):*

*Teaching arrangement and method of instruction: Lecture, tuition (partly in computer class) and home assignments.*

*Course/Module Content:*
*Introduction:*
*• What are the evolutionary processes?*
*• Which questions are we asking and what kind of data do we have?*
*History of evolutionary theory since Darwin.*
*review of probability: random variables, expectation, variance, Gaussian distribution.*
*Random mating in infinite population, Hardy-Weinberg equilibrium; when do we expect deviations from H-W? structured population.*
*Small population effect: drift.*
*What is the probability that a mutant fixes (neutrally)?*
*Effective size of population can differ from actual size: different numbers of males and females, variability in number of offspring, fluctuating population size: population bottlenecks decrease population variability (harmonic mean).*

*Fitness landscapes: different models, epistasis, experimental landscapes (examples).*
*Genotype-phenotype maps – examples (RNA secondary structure, etc.)*
*Definition of fitness, Fisher's theorem; 3 kinds of selection: directional, balancing (heterozygote advantage) & disruptive; discuss stability of each.*
*example of sickle-cell anemia.*
*Dynamics of fixation under selection.*
*Selection: mutation-selection balance.*
*How can polymorphism be maintained? Neutral evolution or changing environments or heterozygote advantage.*
*Fixation probability of a mutant: how it depends on its fitness advantage and the mutant frequency. Most mutations are lost due to stochastic effects even if they are beneficial. Can a deleterious mutation fix?*
*Experimental evolution – guest lecture*
*Linkage disequilibrium: definition, how it decays in time; model of 2 loci: one is selected and one is neutral – hitchhiking, selective sweeps.*
*Selfing vs. outcrossing, inbreeding depression. Self-incompatibility mechanisms in plants.*
*Differences in genetic architecture between selfers and outcrossers.*

*If time allows:*
*Open problems in evolutionary theory: the evolution of innovation.*
*How are new genes created? gene duplication, Ohno's model, evolution from random sequences, orphan genes.*
*Polyploidy, aneuploidy: mechanisms (allo-, auto-), how it affects adaptation.*

*Required Reading:*
*No obligatory reading.*

*Additional Reading Material:*
*The course is based on the book:*
*Population genetics / Gillespie, 2nd ed.*

*Course/Module evaluation:*
*End of year written/oral examination 0 %*
*Presentation 0 %*
*Participation in Tutorials 0 %*
*Project work 50 %*
*Assignments 50 %*
*Reports 0 %*
*Research project 0 %*
*Quizzes 0 %*

*Other 0 %*

*Additional information:*