Reading List for Lectures by Brian Charlesworth

General: the textbook referred to is *Elements of Evolutionary Genetics*, by Brian Charlesworth and Deborah Charlesworth (2010; Roberts & Co., Greenwood Village, Co, USA). The material in starred boxes can be omitted, unless students are especially interested in the mathematical details and are happy with calculus and/or matrix algebra.

For a relatively short overview of the whole subject, see the 2001 article *Population Genetics* by B. Charlesworth (*Encylopedia of Life Sciences*).

Some handouts with mathematical details will be provided along with the lectures, as well as suggestions for further reading, together with more detailed references.

Lecture 1 *DNA sequence variability and the coalescent process*
This lecture describes how variability is measured at the level of DNA sequences, and introduces its interpretation in terms of genetic drift and mutation by means of the coalescent process, including the concept of effective population size.

Suggested readings:
Textbook
pp.2-14 (introduction and section 1.1.1: general background on genetic variability)
pp.33-35 (section 1.3.1: conservation of variability by Mendelian inheritance).
pp.42-45 (section 1.3.iii: generation of new variability by mutation)
pp.196-201 (introduction to genetic drift)
pp.207-216 (section 5.1.iii: the coalescent process)
pp.216-217, 221-228 (sections 5.2.i-5.2.ii.a, 5.2.iii: effective population size)
Papers
A good review paper on the coalescent process and its applications is Rosenberg, N. & M. Nordborg (2002) *Nature Reviews Genetics* 3:380.
A review of effective population size and its relation to the coalescent process is Charlesworth, B. (2009) *Nature Reviews Genetics* 10:195.

Lecture 2 *The effects of selection on variation and evolution*
This lecture describes the principles of single locus selection theory, including balancing and directional selection, with some real-life examples. It also introduces the concept of the probability of survival of a mutation, and the study of the interactions between selection and other evolutionary forces, especially genetic drift.
Textbook
pp.48-56 (introduction and sections 5.2.1 – 2.1.ii.b: basic principles of selection theory)
pp.56-61 (sections 2.1.ii.c-d: heterozygote advantage)
pp.65-72 (section 2.2.i: frequency-dependent selection)
pp.86-90 (introduction and sections 3.1.i-ii: basic theory of directional selection)
pp.93-97 (sections 3.i.iii.d-3 and 3.1.iv: some biological applications)

pp.106-114 (sections 3.2.i-iii: survival probability of a beneficial mutation in a large population [the derivation in Box 3.4 can be omitted]).
pp.144-156 (introduction and sections 4.1.i to 4.1.ii.c: migration and selection)
pp.159-160 (section 4.2.i: introduction to mutation and selection)
pp.228-233, 239-240 (sections 5.3.i, 5.3.ii.i.b and 5.3.iii.d-e: drift and selection)

Lecture 3 *Linkage and selection*
This lecture describes how to measure non-random associations between variants at different sites in the genome. It introduces the theory of selection involving interactions between the fitness effects of variants at different loci. It also describes the ways in which evolution and variation at a given site in the genome can be influenced by selection at genetically linked sites. The implications of this for the evolutionary significance of sexual reproduction and genetic recombination are briefly considered.
Textbook
pp.368-373, 376-7 (introduction and sections 8.1.i-8.ii.b: measurement of associations between loci [linkage disequilibrium: LD])
pp.378-382 (sections 8.2.i-8.2.ii.a: changes in LD in infinite populations with neutrality)
pp.383-384, 388[last paragraph] (section 8.2.ii.a: LD between neutral sites caused by genetic drift and population admixture)
pp.418, 421-425 (sections 8.4.i-ii.c: selection at two loci that interact)
pp.390-393 (section 8.3.i: introduction to effects of selection on variability at linked sites)
pp.393-396 (section 8.3.2.ii.a: effects of balancing selection [ignore Box 8.5 on a first reading])
pp.399-403 (section 8.iii.a: effects of background selection)
pp.407-409, 413-418 (sections 8.3.v.a-8.3.v.d: effects of selective sweeps)
pp.539-443 (section 10.2.i-ii: introduction to evolutionary significance of sex and recombination)
pp.550-552 (section 10.2.v.a-c: introduction to Hill-Robertson interference).
Papers
An excellent review of the concept of linkage disequilibrium and its applications is
Slatkin, M. (2008) *Nature Reviews Genetics* 9: 477.
A review of the evolutionary consequences of selection and recombination is
Charlesworth, B. *et al.* (2010) *Cold Spring Harb, Symp. Quant. Biol.* 74:177.