Lecture	Topic	Pages 2013	Additional
	Part 1: Linear systems, protein signal transduction		
1	Course introduction. Linear time-independent systems. MAPK signaling.	1-8	HOG video
2	Laplace transform. Linear operators. Eigenfunctions of the time derivative.	9-12	
3	Complex variables and contour integrals. Understanding the math behind spectral transforms.	13-17	
4	MAPK signaling cascades, linear regime.	18-21	
5	Pharmacokinetics and pharmacodynamics. Quantifying systems response: AUC, mean time, duration. Generating functions.	22-25	
6	Feedback.	26-30	Caffeine paper
	Part 2: Non-linear deterministic systems, transcriptional regulation		
7	System memory. Transcription. Information theory and regulation.	32-33, 46-50	Stem cell papers. PDB crystal structures.
8	Cooperativity, ultra-sensitivity, Hill functions. Activation and repression. Combinatorial regulation.	33-36	
9	Transcription, translation, decay. Timescale separation. Logic function approximation.	37-39	
10	Transcriptional circuits. Response times. Punctuated linearity. Auto-regulation. Feedback control.	40-45	
11	Multi-TF gene regulatory motifs. Logic gates. Oscillators.	51-58	
	Part 3: Stochastic systems		
12	Delta-Notch signaling.	59-63	Fly wing development.
13	Revisiting transcription and translation with stochastic models.	64-66	Single cell noise.
14	Noise, correlations at equilibrium, and non-equilibrium response. The fluctuation-dissipation theorem for transcriptional relaxation.	67-70	
15	Simulating stochastic systems. The Gillespie algorithm.	71-76	
16	Stability analysis. Transition state theory for cell fate determination.	77-84	
	Part 4: Spatial systems		
17	Dorsal-ventral patterning. Morphogen gradients.	86-88	Embryonic development.
18	The diffusion equation. The general solution for the diffusion kernel.	91-96	
19	Diffusion patterning with transients. Diffusion patterning with steady state.	97-101	
	Part 5: Networks		
20	Disease spread. Epidemics. Network diameter and the giant component. The percolation phase transition.	109-112	Human disease transmission networks.
21	The degree distribution. Small-world networks. Scale-free networks. Immunization.	113-115	
22	Graph motifs. Clustering. Modularity.	120-121	
23	Diffusion on a network. The graph Laplacian. Graph diffusion kernels. Spectral clustering.	102-108, 122-125	
24	Metabolic networks. Metabolic optimization. Flux-balance analysis.	126-129	