Week	Section	Dates	L#	Content	Lecturer	Jones
1	A	16/02	1	Introduction to the course. Discussion of schedule issues. Definition of soft matter, overview of the main classes. Self-assembly versus self-organization, dynamic versus static self-assembly. Central role of entropy.	JL	1-4
		18/02	2	Energy scales compared to covalent bonding energies. Van der Waals interactions: three types of attractive interactions and steric repulsion. The Hamaker constant and its application. The Casimir force.	JL	5-7; 53-57
2	A	23/02	3	Hydrogen bonds. Hydrophobic effect, aromatic interactions. Ionic interactions and ion dissolution. The electric double layer, the ζ potential and the hydrodynamic radius.	JL	8; 136-137
		23/02	*E1*	*Exercise on van der Waals interactions etc.*	*GS*	
		25/02	4	Poisson-Boltzmann theory and the concepts Debye screening length and ionic strength. DLVO theory (only introduction). Surface tension: definition and consequences.	JL	58-60, 31
3	A	***02/03 8-9:20***	5	The response of matter to shear stress: viscous, elastic and viscoelastic behavior. Life at low Reynolds number.	JL	10-16;68-71, 85-86
	B	***02/03 9:30-10:50***	6	Definition of colloids and overview of main classes. Stability of colloidal liquids: Brownian motion vs. gravity and viscosity.	JL	49-52, 60
	A	***02/03 11 - 12:30***	*E2*	*Exercise on hydrogen bonds, hydrophobic effect, ions in solution, surface tension, …*	*GS*	
4	B	09/03	7	Sedimentation and centrifugation. Amphiphiles and surfactants: design and function. Supramolecular self-assembly of surfactants; the packing parameter and its relation to micelle vs. bilayer assembly.	JL	61-62
		09/03	*E3*	*Exercise on viscoelasticity, low Reynolds number swimmer, colloid stability and Brownian motion*	*GS*	
		11/03	8	Introduction to lyotropic liquid crystals. Vesicles. Emulsions and foams. Mixtures and phase diagrams.	JL	136-145
5	B	16/03	9	Ostwald ripening. Preparation of particle colloids. Destabilization: aggregation versus flocculation. Depletion attraction. Langmuir films.	JL	97-102
		18/03	*L1*	*Lab on colloid preparation and the properties of colloids.*	*GS*	
		18/03	10	Colloid crystallization. Glass formation, jamming and gelation. Percolation.	GS	16-23; 62-68; 95-102

Week	Section	Dates	L#	Content	Lecturer	Jones
6	B	23/03	11	Further examples of gelation and percolation. Drying of colloidal suspensions: evaporation-induced self-assembly, the coffee ring and Marangoni effects.	GS	
		23/03	*E4*	*Extra lecture: wrap-up of mixtures and phase diagrams. Exercise on gels.*	*JL*	
	C	25/03	12	Liquid crystals: definition of key concepts and overview of classes, phases and their building blocks, typical molecule structures. Historical development.	GS	104-106
7	C	30/03	13	Thermotropic nematics and smectic and phases. Symmetry considerations. Optical anisotropy (birefringence).	GS	41; 107-111; 126-128
		30/03	*ME*	*Mid-term exam*	*JL*	
		01/04	14	Optical anisotropy of liquid crystals, biaxiality, optically positive and negative liquid crystal phases. Refractive index versus dielectric constant. Phase plates.	GS	
				Easter Holidays		
9	E	13/04	15	Characterization 1: polarizing optical microscopy. Fundamentals of the microscope. The Michel-Levy diagram and determination of birefringence, the practical use of phase plates.	JL	
		13/04	*L2*	*Lab on polarizing microscopy.*	*JL*	
	C	15/04	16	Liquid crystal polymers and elastomers. Applications in fibers, actuators etc.	JL	
10	C	20/04	17	Connection between refractive index and molecular polarizability. Pockels and Kerr effects etc.	GS	
		20/04	*E5*	*Exercise on liquid crystal optics and birefringence effects*	*JL*	
		22/04	18	Colloid stabilization mechanisms; steric vs. electrostatic colloid stabilization. Langmuir-Blodgett films. Self-assembled monolayers. Biomembranes.	JL	
11	C	27/04	19	Nematic order parameter and its relation to birefringence, helix formation in chiral liquid crystals, discotics, liquid crystal elasticity: splay, bend and twist deformations.	GS	
		27/04	*E6*	*Exercise on Kerr and Pockels effects, rubber elasticity, liquid crystal elastomers*	*GS*	
		29/04	20	Elasticity for cholesteric phases. Surface anchoring and alignment control.	GS	
		04/05	21	Anisotropic viscous properties of liquid crystals. The Miesowicz and the rotational viscosities of nematics and SmC phases. Dielectric and magnetic anisotropy of liquid crystals and their response to electric and magnetic fields	GS	

Week	Section	Dates	L#	Content	Lecturer	Jones
12	C	04/05	22	Liquid crystal displays: how do they work?	GS	
		06/05	*E7*	*Exercise on colloid stabilization, patterning of hydrophilicity/-phobicity, interactions within biomembranes, liquid crystal birefringence and liquid crystal elastic deformations*	*JL*	
13	C	11/05	23	The peculiar optical properties of chiral nematics: Mauguin-type polarization guiding, optical activity and selective reflection. The peculiar dielectric properties of chiral smectics: spontaneous polarization and ferroelectricity.	GS	
		11/05	*E8*	*Exercise on liquid crystal field response and displays*	*GS*	
	D	13/05	24	Topological defects in nematics. Self-assembly of block co-polymers in water and without solvent.	JL	76-77; 151-157
14	F	18/05	25	Biological soft matter 1: nucleic acids and their self-assembled structures, natural and artificial.	JL	159-164
		18/05	*E9*	*Exercise on topological defects, chirality effects in liquid crystals, and block co-polymers, …*	*JL*	
	F	20/05	26	Biological soft matter 2: protein self-assembly.	JL	118-121; 165-173
15	E	27/05 10:00	27	Characterization 2: electron microscopy, light and x-ray scattering, rheology, probe microscopy.	GS	
		27/05 11:45	*E10*	*Exercise on biological soft matter, …*	*GS*	
	G	27/05 15:45	28	Granular soft matter	GS	

A	Definition of soft matter, self-assembly and the key interaction mechanisms: van der Waals attraction, steric repulsion, hydrogen bonding and the hydrophobic effect.
B	Colloids and their stabilization; gels and glasses
C	Liquid crystals, lyotropic and thermotropic, low molar mass and polymeric.
D	Self-assembly in polymeric soft matter.
E	Key characterization techniques in soft matter physics
F	Biological soft matter
G	Granular soft matter