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Lecture plan

SC: Schaeffer and Cain, P: Perko

Week	Lecture	References	Topics	Notes
2	I: Linear Systems on R^2 I	SC2.2 – 2.3	phase space/flows, exponentiation of matrices	lec1.pdf
2	II: Linear Systems on R^2 II	SC2.4 – 2.5	autonomous systems of two linear equations, phase portraits, examples galore — nodes, centres, foci, saddles	lec2.pdf
3	IIB: Linear Systems on R^2 III	SC2.4 – 2.5	drawing phase portraits	lec3A.pdf, lec3_phaseportraits.pdf
3	III: Linear Systems on R^d	SC2.3, P1.9	Jordan normal form, stability theory: decomposition of phase space $R^d = E^s + E^c + E^u$	lec4.pdf
4	IV: Local Well-posedness I	SC3.2 - 3.3	Lipschitz condition, Picard's local existence and uniqueness theorem and proof	lec5.pdf
4	V: Local Well-posedness II	SC4.2, 4.5	Gronwall's Lemma with proof, continuous dependence on initial data, finite time blow-up	lec6.pdf
5	VII: Hyperbolic Critical Points	SC6.1, 1.4, 1.6	linearization of 2X2 systems, examples: van der Pol, Duffing, Lotka-Volterra, activator-inhibitor	lec7.pdf
5	VIII: Embedded Submanifolds of R^d	SCB.3	differential structure of embedded submanifolds of R^d	lec8.pdf
6	IX: Stable Manifold and Hartman-Grobman Theorems	SC6.6, 6.9, 6.10, P2.7, 2.8	topological equivalence and conjugacy, Stable Manifold Theorem, Hartman-Grobman Theorem, applications	lec9.pdf
6	X: The Method of Lyapunov	SC6.2, 6.5, P2.9	Lyapunov functions and stability, proof, examples and applications	lec10.pdf
7	XI: Gradient and Hamiltonian Systems	SC6.5, SC6.8, P2.14	conservation of energy, nondegenerate critical points, examples and applications	lec11.pdf
7	XII: Critical Points of Planar Systems I	P2.10	topological saddles, spirals, and centres	lec12.pdf
8	XIII: Critical Points of Planar Systems II	P2.11	non-hyperbolic critical points, examples	lec13.pdf
8	XIV: Centre Manifold Theory	SC6.9, P2.12	statement of the Local Centre Manifold Theorem	lec14.pdf
9	XV: Limit Sets	P3.2, 3.3	trajectories, limit sets, attractors, periodic orbits, limit cycles, examples including the Lorenz system	lec15.pdf
9	XVI: Poincare Map and Stability	SC7.3, 7.10.1, P3.4, 3.5	the Poincare map, stable manifold theorem for periodic orbits, some Floquet theory	lec16.pdf
10	XVII: Poincare-Bendixson Theorem	SC7.2	Poincare-Bendixson Theorem and proof	lec17.pdf
10	XVIII: Perturbation Theory I	SC7.5	Poincare-Lindstedt method	lec18.pdf
11	XIX: Perturbation Theory II	SC7.6, P3.8	multi-scale expansion and singular perturbations, application to van der Pol system, Lienard's theorem	lec19.pdf
11	XX: Index Theory I	P3.12	Bendixson's index formula and proof, corollaries, applications	lec20.pdf
12	XXI: Index Theory II	P3.12	Euler-Poincare characteristic, index at infinity	lec21.pdf
12	XXII: One-Dimensional Local Bifurcations I	SC8.1 – 8.4	degeneracy/transversality/symmetries leading to one-dimensional bifurcations — saddle-node, transcritical, and pitchfork; examples	lec22.pdf
13	XXIII: One-Dimensional Local Bifurcations II	SC8.7 – 8.8	continuation of XXII, Hopf bifurcation; examples	lec23.pdf
13	XXIV: One-Dimensional Global Bifurcations I	SC9.1 – 9.2	bifurcations of limit cycles, examples	lec24.pdf
14	XXV: One-Dimensional Global Bifurcations II	SC9.6 - 9.7	continuation of XXIV, Neimark-Sacker bifurcation, period-doubling bifurcation, examples (another look at the Lorenz system)	lec25.pdf
14	XXVI: Higher-dimensional Bifurcations	P4.3/SC8.6	cusp bifurcations/ steady state bifurcations	lec26.pdf
16	XXVII: Revision Session I		Korteweg-de Vries equation project	
17	XXVIII: Revision Session II			