

Fall 2015, ECE 5390/MSE 5472, Quantum Transport in Electron Devices and Novel Materials

Parts	Class #	Dates	Day	Makeup for Day	Lecture Topics	Reading Notes	Further	Assgn Posted	Due
	1	26-Aug	Wed		Introduction, Semiconductor electron devices, Drude transport, Electron transport in vacuum tubes				
	2	28-Aug	Fri	31-Aug	Quantum mechanics recap: Matrix mechanics, Schrodinger equation, quantization	1	QM books	1	27-Aug
		31-Aug	Mon		No class (DJ@ICNS)				
		2-Sep	Wed		No class (DJ@ICNS)				
		7-Sep	Mon		Labor day				
	3	9-Sep	Wed		Stationary states, Time-dependent Schrodinger eqn, Current flow in quantum mechanics	1,2	QM books		9-Sep
	4	11-Sep	Fri	2-Sep	Fermions & Bosons, Quantum statistics & Equilibrium, Contacts as Reservoirs	1,2	LN chp 16	2	13-Sep
	5	14-Sep	Mon		DOS, Effective mass, Group velocity, Ballistic current flow, Conductance quantization	2	LN 1-9		
	6	16-Sep	Wed		Electron modes, Ballistic resistor to Ohm's law, the Ballistic MOSFET: Gain and Speed	2	LN 1-9		
		18-Sep	Fri		Cornell president inauguration				
	7	21-Sep	Mon		Linearity/Switching of Ballistic FETs, History of tunneling transport in atomic, semiconductor, and superconductors	2	Natori paper		
	8	23-Sep	Wed		Tunneling: Exact,WKB - Feynman path integral link, and Interband Zener tunneling	3			23-Sep
	9	25-Sep	Fri	5-Oct	Tunneling transport and the tunneling FET, Introduction to NEGF: level broadening	3, 4	LN 19,20		
	10	28-Sep	Mon		Closed vs open systems: Matrix version of quantum mechanics, Appearance of NEGF Matrices	4	LN 19,20	3	27-Sep
	11	30-Sep	Wed		NEGF formalism for current	4	LN 19,20		
	12	2-Oct	Fri	19-Oct	Summary of NEGF, scattering in NEGF	4	LN 19,20		
		5-Oct	Mon		No class (DJ@ND)				
	13	7-Oct	Wed		NEGF examples, Time-dependent perturbation theory	5	LN 19,20		
	14	9-Oct	Fri	2-Nov	Fermi's Golden Rule	5	QM Books		9-Oct
		12-Oct	Mon		Cornell Fall Break				
	15	14-Oct	Wed		Application of Golden Rule to calculate scattering rates due to defects, Boltzmann Transport Equation	5	FCT	4	14-Oct
	16	16-Oct	Fri	4-Nov	The Boltzmann Transport Equation, Equilibrium, and Scattering Processes	5	FCT		
		19-Oct	Mon		No class (DJ@Sandia)				
	17	21-Oct	Wed		Low-field transport coefficients, Mobility, introduction to phonons	5	FCT		
	18	23-Oct	Fri	9-Nov	Phonon dispersion and electron-phonon interactions	5	FCT		
	19	26-Oct	Mon		Phonon modes and electron phonon scattering rates	5	FCT		26-Oct
	20	28-Oct	Wed		Introduction to Feynman Path Integrals, The Aharonov Bohm effect in transport	TBP			
	21	30-Oct	Fri	11-Nov	Path Integrals, and explanation of Weak Localization phenomena in transport	TBP			
		2-Nov	Mon		No class (DJ@IWGO)				
		4-Nov	Wed		No class (DJ@IWGO)				
		9-Nov	Mon		No class (DJ@ISGN)				
		11-Nov	Wed		No class (DJ@ISGN)				
	22	16-Nov	Mon		Special Relativity, Dirac Equation, and origin of Electron Spin				
	23	18-Nov	Wed		Berry phase effects on transport properties, Chern numbers, Topological Insulators				
	24	20-Nov	Fri	30-Nov	Many-particle formalism for correlated transport, Fock-space, Creation/Annihilation operators, Occupation number formalism				
	25	23-Nov	Mon		Transport in the many-particle picture, the 2/3 conductance anomaly, Mott insulators, Metal-Insulator transitions				
		25-Nov	Wed		Cornell Thanksgiving Break				
		30-Nov	Mon		No class (DJ@MRS)				
	26	2-Dec	Wed		Superconductivity, Transport of Cooper Pairs, BCS Theory				
	27	4-Dec	Fri		Survey of the course contents, Transport physics: past, present and future				