**PH 523: Spintronics (3-0-0: 3)**

**History of Spin**

Spin, the Bohr planetary model and space quantization, the birth of spin, the Stern-Gerlach Experiment. **[3L]**

**Quantum Mechanics of Spin**

Pauli spin matrices, the Pauli equation and spinors, more on the Pauli equation, extending the Pauli equation, the Dirac equation. **[2L]**

**Spin Orbit Interaction**

Spin orbit interaction in solid, Rashba interaction, Dresselhaus interaction. **[3L]**

**Exchange Interaction**

Direct exchange, indirect exchange, superexchange interaction, double exchange, RKKY exchange interaction. **[2L]**

**Spin Relaxation**

Elliott-Yafet mechanism, D’yakonov Perel’ mechanism, Bir-Aronov-Pikus mechanism, hyperfine interaction with nuclear spin. **[4L]**

**Spin Dependent Electron Transport**

Basic transport in continuous thin film, Datta -Das transistor, elastic scattering, inelastic scattering, basic transport in discontinuous film, thermoionic emission, tunneling, Andreev reflection theory at ferromagnetic/semiconductor interface. **[8L]**

**Spin Transfer Torque and its Magnetic Dynamics**

Spin injection phenomena, dynamics of domain wall, magnetoresistance, giant magnetoresistance (GMR), tunnel magnetoresistance (TMR). **[7L]**

**Application to Spintronics**

Spin photoelectronic devices, magnetic tunneling devices, spin qubits, Quantum spin hall effect, band inversion, strained semiconductor, HgTe-CdTe quantum well. **[7L]**

**Text Books and References**

1. S. Bandyopadhyay and M. Cahay, “Introduction to Spintronics”, CRC Press.
2. Y. Xu, D. D. Awschalom and J. Nitta, “Handbook of Spintronics”, Springer.
3. T. Dieti, D. D. Awschalom, M. Kaminska and H. Ohno, “Spintronics”, Academic Press.
4. T. Shinjo, “Nanomagnetism and Spintronics”, Elsevier.
5. C. Felser and G. H. Fecher, “Spintronics”, Springer.
6. M. Johnson, “Magnetoelectronics”, Academic Press.