Spintronics: Physics and Technology - Web course

COURSE OUTLINE

The course in physics and technology of spintronics introduces the fundamental concepts on spin electronics, Classes of magnetic materials, quantum mechanics of spins, spin-orbit interaction, and exchange interactions.

In addition, the spin relaxation mechanisms, spin relaxation in quantum dots, spin galvanic effect, spin-dependent transport in single-electron devices and magnetic nanostructures would be discussed.

This course covers a deeper insight in theories and practical knowledge of Spin dependent transport, Andreev Reflections at ferromagnet and superconductor interfaces, measurement of spin polarization, spin-transfer torques and domain wall magnetoresistance in nanostructures, Spin injection in hybrid nanostructures.

Also, this book brings out the basics and advanced practical knowledge in Spintronic Materials, Technology and Spin Devices for futuristic applications.

The topics covered in this course include introduction to spin and spin electronics, spin relaxation behavior, Spin dependent transport, Spin-transfer torque, Spin injections and spin devices, and Advances in spintronic materials, technology.

As the motivation of the course is to provide an understanding of fundamentals of spin electronics, spin relaxation, spin transport in metal and semiconductors, and advances in spin electronic technology and futuristic materials with high spin polarization.

This will be very much useful to the students studying in any B.Tech. engineering branches, Master of Science and M.Tech. with the background knowledge on Solid State Physics and for teachers and practitioners.

Contents:

History and overview of spin electronics; Classes of magnetic materials; The early history of spin; Quantum Mechanics of spin; The Bloch sphere; Spin-orbit interaction;

Exchange interaction; Spin relaxation mechanisms; spin relaxation in a quantum dots; The spin Galvanic effect; Basic electron transport; Spin-dependent transport; Spin dependent tunneling; Andreev Reflection at ferromagnet and Superconductor interfaces; Spintransfer torques;

Spin-transfer drive magnetic dynamics; Current-driven switching of magnetization and domain wall motion; Domain wall scattering and Current-Induced switching in ferromagnetic wires;

Spin injection, spin accumulation, and spin current, Spin hall effect, Silicon based spin electronic devices,

Spin LEDs: Fundamental and applications, Spin photoelectronic devices based on Heusler alloy, Electron spin filtering, Materials for spin electronics, Nanostructures for spin electronics, Deposition techniques, micro and nanofabrication techniques.

Spin-Valve and spin-tunneling devices: Read Heads, MRAMS, Field Sensors, Spintronic Biosensors, Spin transistors, Quantum Computing with spins.

COURSE DETAIL

Pre-requisites:
Solid State Physics and/or magnetic materials.

Additional Reading:
Literature on Magnetic recording.

Coordinators:
Dr. A. Perumal
Department of Physics, IIT Guwahati

http://nptel.iitm.ac.in
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<td>The early history of spin, Quantum Mechanics of spin, The Bloch sphere,</td>
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<td><strong>2. Spin relaxation:</strong></td>
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<td><strong>3. Spin dependent transport:</strong></td>
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<td><strong>4. Andreev Reflection at ferromagnet and Superconductor Interfaces:</strong></td>
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<td>Ferromagnet/Superconductors/Ferromagnet double junctions, crossed Andreev reflections.</td>
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<td><strong>5. Spin transfer torques:</strong></td>
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<td>Intuitive picture of spin-transfer torques, spin-transfer drive magnetic dynamics,</td>
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14. Current-driven switching of magnetization and domain wall motion. 02
15. Domain wall scattering and Current-Induced switching in ferromagnetic wires. 02

6. Spin injection:
16. Spin injection, spin accumulation, and spin current. 02
17. Spin hall effect, Silicon based spin electronic devices: Toward a spin transistor, 02
18. Spin LEDs: Fundamental and applications, 02
19. Spin photoelectronic devices based on Heusler alloy, 02
20. Electron spin filtering, Monolithic and Hybrid Spintronics, 02

7. Advances in Spintronic Materials, Technology and Devices
21. Materials for spin electronics, Nanostructures for spin electronics 02
22. Deposition techniques, micro and nanofabrication techniques. 03
23. Spin-Valve and spin-tunneling devices: 02
24. Read Heads, MRAMS, Field Sensors, Spintronic Biosensors, 02
25. Quantum Computing with spins. 01

Total 42

References:
