Physics of Magnetic Recording and Recording Media - Web course

COURSE OUTLINE

The motivation of the course is to provide an understanding of fundamentals of magnetic recording process, recording head and media, and recent advances in these areas.

This course is designed for the students studying in any B.Tech. engineering branches, Master of Science and M.Tech. with a background in Solid State Physics and/or magnetic materials. The course covers the basics of existing and futuristic materials and technologies.

This is the first course in physics of magnetic recording and media, which introduces the fundamental concepts on magnetic recording, form of recording media, and magnetoelectronics.

Also, the overview of magnetism in solids, various types of anisotropies, soft and hard magnetic materials would be discussed. This course covers a deeper insight in electronic structure of normal metals and ferromagnetic metals, spin dependent transport, model approach for magnetic recording, recording losses, and various aspects of magnetic recording head and media.

Also, it brings out the advanced theories and practical knowledge of Giant Magnetoresistance, Tunneling Magnetoresistance, Spin-valve devices, and advances in recording technology and materials.

Each topic will be developed in logical progression with up-to-date information on this field of research. The topics covered in this course includes magnetoelectronics, magnetic recording and play back theories, aspects of magnetic recording heads, and advances in developing future materials and media for ultrahigh areal density exceeding 1 Tera-bits/inch^2.

The advanced course material on physics of magnetic recording and recording media will be very much useful to undergraduate students, post-graduate students, teachers and practitioners. A number of selected problems will be worked out to illustrate different concepts clearly.

Contents:

History and overview of magnetic recording; Magnetism in solid state; Form of magnetic media; Types of magnetic anisotropy energies; Soft and hard magnetic materials; Stoner-Wohlfarth theory; Electronic structure of normal, ferromagnetic metals and halfmetals; Recording model approach;

Media magnetization; Erasure and overwrite; Recording zone; Recording and play back losses; Magnetic circuits; Selection of core materials; Magnetoresistance; Giant Magnetoresistance Heads; Tunneling

Magnetoresistance heads; Spin Valves; Field from Magnetic Heads; Perpendicular head fields; Shielding; Flux linkage and leakage; Particulate media; Thin magnetic films; Patterning media;

Flexible media substrates, Rigid disk substrates; Properties: Magnetic hysteresis loop, Coercivity, and Switching Field Distribution, Effects of Time and Temperature; Storage stability; Advances in recording; Futuristic devices based on magnetoelectronics.

COURSE DETAIL

A Web course shall contain 40 or more 1 hour lecture equivalents.

NPTEL

http://nptel.iitm.ac.in

Physics

Pre-requisites:

Solid State Physics and/or magnetic materials.

Additional Reading:

Literature on Magnetic recording.

Coordinators:

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Sl. No.	Module/ Lecture Topics	No. of Hours
1.	**Introduction:** History and overview of magnetic recording; Magnetism in solid state; Form of magnetic media;	02
	Types of magnetic anisotropy energies; Magnetic anisotropy and Magnetostriction;	02
	Soft and hard magnetic materials; Stoner-Wohlfarth theory.	01
2.	**Magnetoelectronics:** Electronic structure of normal metals; ferromagnetic metals and Half-metals;	03
	Spin-dependent transport; Spin polarization.	02
3.	**Recording and Play Back Theories:** Recording model approach; Media magnetization;	01
	Setting recording level; Erasure and overwrite;	03
	Recording zone; Recording losses; Flux level;	03
	Play back loss; Spacing loss; Coating thickness loss; Response to a transition.	03
4.	**Aspects of Magnetic Recording Head** Magnetic circuits; Eddy current loss;	01
	Selection of core materials;	01
	Magnetoresistance; Giant Magnetoresistance (GMR) Heads; Tunneling Magnetoresistance (TMR) heads;	04
	Spin Valves;	02
	Field from Magnetic Heads; High-gradient heads;	01
	Perpendicular head fields; Response of probe	01

	heads; Shielding; Flux linkage; Flux leakage.	
5.	**Advances in Recording Technology and Materials** Particulate media; Thin magnetic films;	02
	Patterning media; Flexible media substrates, Rigid disk substrates;	02
	Properties: Magnetic hysteresis loop, Coercivity, Remnant Flux, Slope at Coercivity, Switching Field Distribution, Effects of Time, Temperature; Storage stability; Measurement of spin polarization.	03
	Recording of a single transition, Narrow-track recording, Shortgap recording	02
	Perpendicular recording, Ultrahigh density recording, Future projection on recording; futuristic devices based on magnetoelectronics.	03

References:

1. F. Jorgensen, The Complete Handbook of Magnetic Recording, TAB Books; 1995.
2. M.L. Plumer, Ek. J. van, D. Weller, The Physics of Ultrahigh-Density Magnetic
   Recording, Springer, 2001.
3. M. Ziese, M.J. Thornton (Eds)., Spin Electronics, Springer 2001.
4. C. D. Mee and M. H. Clark, Magnetic Recording, Wiley-IEEE, 1999.
5. M. Johnson, Magnetoelectronics, Academic Press 2004.