GUJARAT TECHNOLOGICAL UNIVERSITY
NANO TECHNOLOGY
SUBJECT NAME: SPINTRONICS
SUBJECT CODE: 2173902
B.E. VII SEMESTER

Type of course: Physics of Material Science, microelectronics and VLSI, Nanotechnology and Electronics Devices

Prerequisite: Physics of Nanomaterials, microelectronics and VLSI, Coating Technology and Nano thin film devices

Rationale: To make the students understand the newly developed devices and its operation.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P	C	Theory Marks			Practical Marks			
				ESE (E)	PA (M)		PA (V)		PA (I)	
					PA	ALA	ESE	OEP		
3	0	0	3	70	20	10	0	0	0	100

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

Content:

Sr. No.	Content	Total Hrs.	% Weightage
1	**INTRODUCTION:** The Early History of Spin, Quantum Mechanics of Spin, Spin – Orbit interaction, Spin – Orbit interaction of Solids	15	23%
2	**BASIC ELECTRON TRANSPORT:** Basic Electron Transport**,** Basic Electron Transport in thin film**,** Conduction in Discontinuous film**,** Magnetoresistance, Spin-Dependent Scattering, Giant Magneto Resistance, Spin Dependent Tunneling, Tunnel Magnetoresistance.	19	30%
3	**MAGNETIC DOMAIN WALLS AND ITS DYNAMICS** Ratchet effect in domain wall motion, Domain Wall Motion, Domain Wall Scattering.	12	19%
4	**SPIN TRANSISTOR** Silicon based spin electron device, Spin LED: Fundamental and		16%

	Application, Spin photo electronics Devices	**10**	
5	**SPIN EFFECTS IN QUANTUM DOTS** Charge and spin in single quantum dots, Constant interaction model, Spin and exchange effect, Controlling spin states in single quantum dots	**8**	**12%**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks				
Remembrance **R Level**	**Understanding U Level**	**Application A Level**	**Analyze** **N Level**	**Evaluate E Level**
17	**32**	**21**	**0**	**0**

Legends: R: Remembrance; U = Understanding; A = Application and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table

Reference Books:

1. **INTRODUCTION TO SPINTRONICS**
   CRC Press S. Bandyopadhyay, M. Cahay

2. **ADVANCED MAGNETIC NANOSTRUCTURES**
   SpringerPublished by D. J. Sellmyer, R. Skomski.

3. **CONCEPTS IN SPIN ELECTRONICS**
   Oxford University Press by S. Maekawa.

4. **SPIN ELECTRONICS**
   D.D. Awschalom, R.A. Buhrman, J.M. Daughton, S.V. Molnar, and M.L. Roukes, Spin Electronics, Kluwer Academic Publishers, 2004.

5. **SPINTRONIC MATERIALS AND TECHNOLOGY**
   Y.B. Xu and S.M.Thompson, , Taylor & Francis, 2006.

Course Outcome:

After learning the course the students should be able to:

1. To notify the learner about the various type of spintronics-based devices.

2. To understand about spin based transport in the device.

3. To understand about magnetic domain wall motion.

List of Open Source Software/learning website:

http://nptel.ac.in/courses/115103039/

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.