SARDAR PATEL UNIVERSITY

NAAC 'A' Grade (10-01-2023 To 09-01-2028)

Vallabh Vidyanagar

Gujarat

Academic Program Structure

&

Curriculum

(Aligned with NEP-2020)

M. Sc. (Semiconductor Science and Technology)

NHEQF Level: 6.5

Entry NHEQF Level	:	5.5
Duration	:	Two Years (Four Semesters)
Total Courses	:	21
Total Learning Hours	:	2640
Total Credits	:	88
Total Marks	:	2200

Graduate Attributes (GAs)

Upon successful completion of the M.Sc. programme, graduates are expected to attain the following Graduate Attributes:

GA1. Integrated Knowledge of Semiconductor Science and Technology

Apply the knowledge gained from prior training in physics, electronics and materials science for a coherent and comprehensive understanding of semiconductor materials, device physics, and modern fabrication and characterization techniques.

GA2. Analytical Problem-Solving in Semiconductor devices

Evaluate complex problems related to semiconductor materials, devices as well as technological processes and apply appropriate theoretical, computational and experimental knowledge to develop effective solutions.

GA3. Critical Thinking and Scientific Reasoning

Question and critically examine existing concepts and technological claims in semiconductor science and technology. Demonstrate the ability to analyse complex problems, evaluate experimental and theoretical evidence, construct logically consistent arguments using systematic scientific approaches.

GA4. Innovation in Defect Engineering and Device Optimization

Learn to explore innovative solutions for material defects and device failures. Analyze physical phenomena and experimental data related to semiconductor materials and devices to identify performance limitations and propose innovative solutions. Apply statistical and data analysis methods to interpret results and optimize semiconductor processes and device efficiency.

GA5. Technical Communication and Scientific Presentation Skills

Improve communication skills to effectively present technical ideas, analyses and research outcomes and function as a competent scientific communicator. Communicate scientific concepts, experimental results and technological developments effectively through technical reports, presentations and graphical representations.

GA6. Experimental, Computational and Teamwork Skills

Learn to work with various experimental techniques and sophisticated instruments used in semiconductor research, characterization, and device fabrication. Utilize modern simulation and computational tools for semiconductor device modelling, circuit design and performance optimization. Work effectively as a member or leader in diverse, multidisciplinary teams to solve complex scientific and engineering problems.

GA7. Design and Optimization of Semiconductor Technologies

Design and develop techniques for optimization of semiconductor materials, devices and fabrication processes to address academic, industrial, research and societal challenges in modern electronics and emerging technologies.

GA8. Leadership and Knowledge Dissemination in Emerging Technologies

Learn and disseminate emerging topics in semiconductor science and technology through academic, co-curricular, and extra-curricular activities, and take leadership in fostering academic, industrial and multidisciplinary research collaborations.

GA9. Professional Skills and ICT Competency

Develop professional and interpersonal soft skills required for teamwork, problem solving and effective management of semiconductor-related academic and research activities using modern ICT tools.

GA10. Professional Integrity, Ethics and Accountability in Research

Demonstrate professional integrity, ethical conduct and accountability while engaging in semiconductor research and technological applications across academic, industrial, and societal contexts.

GA11. Sustainability and Energy-Efficient Semiconductor Technologies

Understand the environmental, sustainability and energy implications of semiconductor technologies for the development of energy efficient semiconductor devices based on renewable energy for net-zero targets.

GA12. Industry-Oriented Internship and Practical Exposure

Develop industry and research-oriented competencies through a semester-long internship in semiconductor industries and national as well as in-house (SPU) laboratories, facilitating practical problem-solving, professional skill development and exposure to real-world semiconductor technologies.

GA13. Societal and Industrial Impact of Semiconductor Technologies

Recognize the transformative role of semiconductor technologies in modern society, digital infrastructure as well as industrial development and apply professional knowledge responsibly for technological progress as well as societal well-being. Evaluate the broader industrial, economic and societal impact of semiconductor innovations and contribute to addressing global technological challenges through informed and ethical decision-making.

GA14. Innovation, Entrepreneurship and Technology Driven Learning

Translate semiconductor research into practical applications contributing to technological innovation, industry progress and entrepreneurship.

GA15. Lifelong Learning and Adaptability in Semiconductor Technologies

Possess the motivation and ability in lifelong learning, intellectual inquisitiveness and interdisciplinary approach to adapt rapidly evolving technologies in semiconductor manufacturing.

Programme Educational Objectives (PEOs):

Within 3–5 years of completing the programme, graduates are expected to:

PEO1. Establish careers in semiconductor industries, research laboratories, academic institutions, and national technology organizations by applying strong theoretical, computational, and experimental expertise in semiconductor materials, devices, and fabrication technologies.

PEO2. Pursue doctoral as well as post-doctoral research in thrust areas such as semiconductor physics, Electronics, nanoelectronics, optoelectronics, crystal growth, thin films, advanced materials, wide bandgap semiconductors and allied fields in national and international labs.

PEO3. Contribute to semiconductor manufacturing sectors such as VLSI, assembly, testing, marking packaging in ATMP/OSAT plants. Engage in technological entrepreneurship and innovation within the semiconductor ecosystem, contributing to technology transfer and startup development in areas such semiconductor device fabrication, 2D materials, wafer fabrication, sensors/detectors and allied fields.

PEO4. Contribute to industrial innovation by undertaking research and development to identify and solve challenges faced by the semiconductor industry. Lead research projects involving advanced instrumentation, device fabrication and semiconductor characterization techniques.

PEO5. Contribute to national mission of technological self-reliance by supporting national semiconductor initiatives such as India Semiconductor Mission and production linked incentive (PLI) schemes. Continuously upgrade expertise in emerging fields such as AI hardware, sensors and detectors, nanoscale devices, 2D materials, neuromorphic electronics and advanced semiconductor packaging as well as testing.

PEO6. Practice ethical research and strictly adhere to cleanroom protocols, safety standards, and contamination control procedures in semiconductor laboratories and fabrication environments, ensuring responsible innovation and reliable device development. Publish scientific research in peer-reviewed journals and present findings at national and international conferences/seminar/symposium/workshop.

PEO7. Develop and apply device simulation techniques with the help of Electronic Design Automation (EDA) tools such as Technology Computer Aided Design (TCAD), Verilog and other tools to optimize semiconductor device performance.

Program Learning Outcomes (PLOs):

Upon successful completion of the M.Sc. (Semiconductor Science and Technology) programme, learner will be able to

PLO1. Apply scientific reasoning and modern semiconductor theories to analyze and solve complex problems related to semiconductor materials, devices and electronic systems through experimental and analytical approaches.

PLO2. Employ advanced mathematical and physical models along with computational and device simulation platforms to analyze carrier transport, semiconductor device design and characteristics, system behaviour with high precision to solve research and industrial problems.

PLO3. Analyze, formulate and conduct independent research by identifying relevant problems, planning experimental as well as simulation-based studies, performing device fabrication as well as characterization and deriving meaningful conclusions in specialized areas of semiconductor science and technology.

PLO4. Design and perform experiments using sophisticated instruments and semiconductor characterization tools, carry out calibration, uncertainty analysis, error minimization and follow safety as well as cleanroom protocols in laboratory and fabrication environments.

PLO5. Evaluate semiconductor device performance using statistical methods, error analysis and data visualization techniques with specific emphasis on wide bandgap semiconductors and their applications in power electronics as well as electric vehicles.

PLO6. Employ advanced techniques and perform synthesis, crystal growth, thin film deposition and material characterization used in semiconductor fabrication and nanotechnology applications.

PLO7. Apply the understanding of the evolution of semiconductor science and technology from basic devices such as diodes and transistors to advanced integrated circuits and VLSI systems, and relate this progression to modern electronic and nanoelectronic applications.

PLO8. Utilize principles of vacuum science and thin film technology to design, control and optimize deposition processes for achieving high-quality thin film deposition and enhanced performance in semiconductor device fabrication.

PLO9. Demonstrate understanding of semiconductor-based sensors and detectors and their integration with artificial intelligence for smart, multidisciplinary, adaptive, and data-driven electronic systems.

PLO10. Design and develop a comprehensive understanding of high-frequency semiconductor devices and their packaging technologies for applications in RF systems, space technologies, and defence electronics.

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NEP-2020 aligned Curriculum with effect from Academic Year 2026-27

M. Sc. (Semiconductor Science and Technology)

Semester-I

Course Type	Course Code	Course Title	Teaching-Learning Scheme		Credits	Assessment Scheme & Marks				
			L-P-T	Total Notional Hours		Internal Assessment			External Assessment	Total Marks
						FA	SA	Total		
DSC	PS01NCSST01	Fundamentals of Semiconductor Science and Technology	4-0-0	120	4	25	25	50	50	100
DSC	PS01NCSST02	Evolution of Semiconductor Electronics	4-0-0	120	4	25	25	50	50	100
DSC	PS01NCSST03	Physics of Condensed Matter	4-0-0	120	4	25	25	50	50	100
DSC	PS01NCSST04	Practical-1	0-8-0	120	4	25	25	50	50	100
DSC	PS01NCSST05	Practical-2	0-8-0	120	4	25	25	50	50	100
DSC	PS01NCSST06	Project Work	0-2-0	60	2	15	10	25	25	50
				660	**22**	**140**	**135**	**275**	**275**	**550**

DSC: Discipline Specific Core **DSE**: Discipline Specific Elective **L**: Lecture **P**: Practical **T**: Tutorial

FA: Formative Assessment **SA**: Summative Assessment

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Semester-II

Course Type	Course Code	Course Title	Teaching-Learning Scheme		Credits	Assessment Scheme & Marks				
			L-P-T	Total Notional Hours		Internal Assessment			External Assessment	Total Marks
						FA	SA	Total		
DSC	PS02NCSST01	Technologically Important Materials: Growth, Processing and Wafer Analysis	4-0-0	120	4	25	25	50	50	100
DSC	PS02NCSST02	Vacuum and Thin Film Technology	4-0-0	120	4	25	25	50	50	100
DSC	PS02NCSST03	Advanced Semiconductor Devices	4-0-0	120	4	25	25	50	50	100
DSC	PS02NCSST04	Practical-1	0-8-0	120	4	25	25	50	50	100
DSC	PS02NCSST05	Practical-2	0-8-0	120	4	25	25	50	50	100
DSC	PS02NCSST06	Project Work	0-2-0	60	2	10	15	25	25	50
				660	**22**	**135**	**140**	**275**	**275**	**550**

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