SHARDA UNIVERSITY
Beyond Boundaries

SHARDA SCHOOL OF ENGINEERING & SCIENCES

VALUE ADDED COURSE BROCHURE 2026-27

COURSE:

Synthesis and Characterization of Nanomaterials for energy Application.

NV31010

ABOUT THE UNIVERSITY

Sharda University is a leading Educational institution based out of Greater Noida, Delhi NCR. A venture of the renowned Sharda Group of Institutions (SGI), The University has established itself as a high quality education provider with prime focus on holistic learning and imbibing competitive abilities in students.

The University is approved by UGC and prides itself in being the only multi-discipline campus in the NCR, spread over 63 acres and equipped with worldclass facilities. Sharda University promises to become one of the India's leading universities with an acknowledged reputation for excellence in research and teaching. With its outstanding faculty, world class teaching standards, and innovative academic programs, Sharda intends to set a new benchmark in the Indian education system.

ABOUT THE SCHOOL

The Sharda School of Engineering and Sciences (SSES) offers a comprehensive and interdisciplinary educational experience that seamlessly blends engineering, science, and research. The programmes under SSES are designed to empower students with a strong academic foundation, practical skills, and the ability to address real-world challenges through innovation and critical thinking. The school aspirations are align with the vision of Viksit Bharat@2047

VISION OF SCHOOL

Achieve academic excellence in the realm of basic and engineering science to address the global challenges and to become global leaders.

MISSION OF SCHOOL

- To impart basic, advanced and transformative knowledge and skills in science and technology.
- To strengthen capacity and capabilities in cutting-edge technology and research.

- To nurture multidisciplinary research and entrepreneurship temperament for developing innovative solutions to global, societal and environmental challenges.
- To foster multi-dimensional partnerships and collaborations for skill development and global employability.

ABOUT THE DEPARTMENT

The Department of Physics & Environmental Sciences is dedicated to the development of global, multicultural, and multifaceted scientists, teachers, administrators, and engineers capable of working across borders and boundaries. Department of Physics & Environmental Sciences , a department equipped with world-class labs, classrooms and eminent professors, offers three year and four year B.Sc. (Hons./Hons. with research) programme in Physics, with minor in Computational Physics /Renewable Energy, three year and four year B.Sc. (Hons./Hons. with research) programme in Environmental Science, two years M.Sc. programme in Physics, two years M.Sc. programme in Environmental Science, two years M.Sc. programme in Water resource and environmental management, an active Ph.D. programme in both Physics and Environmental Science. The department has 27 faculty members who, apart from world class teaching, undertake cutting edge research on various active fields in physics eg: Nano Science, Solar cell technology, Actuators, Super capacitors, Ultrasonics, Cosmic rays, Photonics, Liquid crystals, and Multiferroics. It also has Physics laboratories of global standard to support teaching and research. Apart from regular engineering Physics labs, Nuclear physics lab, Optics lab, Electronics lab, and centre for Solar Cells and Renewable Energy (CSRE) are also essential part of the teaching learning/research. World level Centre for Solar cells and Renewable Energy (CSRE) is a common platform for

providing hands on training on synthesis, characterization and application of nanomaterials. CSRE is equipped with most important characterization tools like impedance spectroscopy, Keithley source major unit, FTIR, UV/Vis absorption spectroscopy. Using materials (stated above) and specialized equipments we are able to develop electrochemical devices like Solar Cells- Dye sensitized solar cell (DSSC), Perovskite solar cell (PSC), Quantum dot sensitized solar cell (QDSSC), Super Capacitors, Electrochemical Double Layer Capacitor (EDLC), Sensors, Fuel Cells.

ABOUT THE COURSE

The Synthesis and Characterization of Nanomaterials for Energy Applications course provide students with fundamental knowledge of nanomaterial synthesis, characterization, and their applications in sustainable energy systems. It covers top-down and bottom-up fabrication techniques, advanced characterization methods, and the role of nanomaterials in solar cells, supercapacitors, batteries, hydrogen production, and flexible energy devices. The course combines theoretical concepts with practical exposure to prepare students for research and innovation in renewable energy and advanced materials. It equips learners with the skills required to address emerging challenges in clean energy technologies.

COURSE SCHEDULE

Week	Contents	Duration
1	Introduction to Nanotechnology	2
2	Types of Nanomaterials	2
3	Size-dependent Properties, Applications of the Nanomaterials	2
4	Introduction to top-down approach	2
5	Synthesis of the nanomaterials by the ball milling method	2

6	Synthesis of the nanomaterials by the LASER induced graphene and the Arc discharge method	2
7	Introduction to Bottom-up approach	2
8	Synthesis of the nanomaterials by the Sol-gel method	2
9	Synthesis of the nanomaterials by Ball milling and the hydrothermal method	2
10	Study of the structural properties by using the XRD	2
11	Study of the optical properties by using the UV-Visible Spectroscopy	2
12	Morphological studied via SEM, Contact angle measurement	2
13	Introduction to Clean Energy Technology	2
14	Use of synthesized nanomaterials for the solar cell, Supercapacitor and Nanogenerator applications	4

RESOURCE PERSON

Dr. Sunil Chauhan is an Associate Professor in the Department of Physics & Environmental Sciences, Sharda School of Engineering & Science, Sharda University, Greater Noida. He has over 9 years of teaching experience and more than 15 years of research experience in materials science, crystallography, functional nanomaterials, and advanced characterization techniques. He has published 70+ research papers, 1 edited book, holds 5 granted and 5 filed patents, and has successfully completed four funded research projects, including a project supported **by the Science and Engineering Research Board (SERB). His research has earned** 1850+ citations, with a Google Scholar h-index of 23 and an i10-index of 41, while he continues to mentor Ph.D., M.Sc., and B.Sc. research scholars.

COURSE CONTENT

School: SSES Program: UG Branch:	Batch:2025-2028 Current Academic Year: 2026-2027 Semester: III
1. Course Code	**NV31010**
2. Course Title	**Synthesis and Characterization of Nanomaterials for Energy Applications**
3. Credits	0
4. Contact Hours (L-T-P)	30 Hours (0-0-2)
5. Course Type	Non-Credit Value-added course
6. Course Objective	To introduce the fundamentals and properties of advanced nanomaterials. To impart practical knowledge of top-down and bottom-up nanomaterial synthesis techniques. To develop skills in structural, optical, and morphological characterization of nanomaterials. To evaluate advanced nanomaterials for sustainable and emerging clean energy applications.
7. Course Outcomes	Students will be able to: CO1: Explain the fundamental concepts of nanotechnology, classification of nanomaterials, and their size-dependent properties for clean energy applications. CO2: Apply top-down synthesis techniques, including high-energy ball milling, Laser-Induced Graphene (LIG), and arc discharge methods, for the preparation of advanced nanomaterials. CO3: Apply bottom-up synthesis techniques such as sol-gel, hydrothermal, and electrospinning synthesis methods for the fabrication of nanomaterials. CO4: Analyze the structural, optical, and morphological properties of synthesized nanomaterials using XRD, UV–Visible spectroscopy, SEM, and contact angle measurements. CO5: Evaluate the suitability and performance of nanomaterials for clean energy

	technologies such as solar cells, supercapacitors and Nanogenerator applications. CO6: Design and evaluate suitable nanomaterial-based solutions for sustainable clean energy technologies by integrating material synthesis, characterization, and device applications.		
8. Course Description	This course provides students with theoretical knowledge and practical exposure to the synthesis, characterization, and application of advanced nanomaterials for clean energy technologies. It emphasizes nanomaterial fabrication techniques, advanced characterization methods, and their applications in solar cells, supercapacitors and other next-generation renewable energy systems. The course prepares students to understand the role of nanotechnology in developing sustainable and efficient energy solutions.		
9. Outline syllabus		CO Mapping	Schedule
Unit 1	**Fundamentals of Nanomaterials**		
A	Introduction to Nanotechnology	CO1	1st and 2nd Week
B	Types of Nanomaterials	CO1	
C	Size-dependent Properties, Applications of the Nanomaterials	CO1, CO6	
Unit 2	**Synthesis of nanomaterials by Top-down Approach**		3rd and 4th Week
A	Introduction to top-down approach	CO2, CO6	
B	Synthesis of the nanomaterials by the ball milling method	CO2, CO6	
C	Synthesis of the nanomaterials by the LASER induced graphene and the Arc discharge method	CO2, CO6	
Unit 3	**Synthesis of nanomaterials by bottom-up approach**		5th and 6th

A	Introduction to Bottom-up approach	CO3, CO6	Week
B	Synthesis of the nanomaterials by the Sol-gel method	CO3, CO6	
C	Synthesis of the nanomaterials by Ball milling and the hydrothermal method	CO3, CO6	
Unit 4	**Characterization of nanomaterials**		7th and 8th Week
A	Study of the structural properties by using the XRD	CO4, CO6	
B	Study of the optical properties by using the UV-Visible Spectroscopy	CO4, CO6	
C	Morphological studied via SEM, Contact angle measurement	CO4, CO6	
Unit 5	**Application of nanomaterials for Clean Energy Technology**		9th and 10th Week
A	Introduction to Clean Energy Technology	CO5, CO6	
B and C	Use of synthesized nanomaterials for the solar cell, Supercapacitor and Nanogenerator applications	CO5, CO6	
Mode of examination	**Assignment, quiz and presentation**		11th Week
Weightage Distribution	CA		
Text book/s*	1. Nanostructures and Nanomaterials: Synthesis, Properties and Applications (World Scientific Series in Nanoscience and Nanotechnology). 2. Electrical Properties of Polymers by Tony Blythe and David Bloor, Cambridge University Press, Second Edition, 2005		