SHARDA UNIVERSITY
Beyond Boundaries

NAAC A+ ACCREDITED

SHARDA SCHOOL OF ENGINEERING & SCIENCE

COURSE

# ENGINEERING SIMULATION USING COMSOL MULTIPHYSICS

(NV36011)

**VALUE ADDED**
**COURSE BROCHURE-30 HRS**
**2026-27**

## 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 multidiscipline campus in the NCR, spread over 63 acres and equipped with world class 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. Sharda School of Basic Sciences and Research (SSBSR) boasts of providing an interdisciplinary approach, exposure to different disciplines in science including Chemistry, Biochemistry, Physics, Mathematics, Life Sciences, and Environmental Sciences.

## ABOUT SCHOOL

The Sharda School of Engineering & Sciences (SSES) provides a vibrant academic ecosystem that integrates engineering and scientific education with real-world relevance, research excellence and interdisciplinary learning. It serves as a platform where students are empowered to explore, innovate and build impactful careers across a wide spectrum of disciplines. SSES combines the strengths of engineering and basic sciences to create a dynamic environment that fosters innovation and technical excellence along with a sense of social responsibility. With high-ranked programmes in engineering and robust offerings in pure and applied sciences, the school provides a comprehensive and future-ready education. The school has a legacy of excellence in the fields of Physics, Chemistry, Biochemistry, Mathematics, Data Science and Environmental Sciences. The academic programmes at SSES span undergraduate, postgraduate and doctoral levels and are aligned with the latest technology and scientific advancements in alliance with the NEP 2020. The school is deeply involved in academic research, industry collaboration, and consultancy projects—providing students with an exposure to both theoretical knowledge and practical applications.

## ABOUT DEPARTMENT

Department of Electrical Electronics and Communication Engineering is one of the premier departments od School of Engineering and Sciences, Sharda University. The department offers B.Tech, M.Tech and Ph.D programmes. The department has people of eminence from academia as well as industry, who have exposure to future cutting – edge research programs in the field of Power system, Power electronics, control engineering, smart grid communication Engineering, Internet of Things, LTE, Embedded systems, Microwave Engineering, Wireless Sensor Networks and VLSI, Robotics.

## ABOUT COURSE

VACs are relevant academic method in order to fill the gaps in students knowledge and add competitive edge to their job prospects. A well defined of offspring VACs in the courses makes them extremely useful for improving employability quotient of students by building a range of competencies. It helps students to build a creative foundation for their passion in an area (literary, visual and performing arts, etc) in additional to their professional courses creating dimensions which can help in converting their passion into profession. VAC can also serve as top-up courses to make students industry-ready by exposing them to the current technology and practices than those covered in their formal degree courses.

# COURSE CONTENT

| Week | Topics Covered | Subtopics / Activities |
|---|---|---|
| 1. | Introduction to Multiphysics Simulation | What is Multiphysics modelling,<br>Finite Element Method basics,<br>Overview of COMSOL Environment |
| 2. | Geometry, Meshing and Solvers | Meshing techniques,<br>Boundary conditions, Stationary vs time-dependent solvers |
| 3. | Electrical Modelling | Electrostatics module, AC/ DC Module |
| 4. | Electronics Modelling | Hands-on: P N junction modelling,<br>Electric field distribution analysis |
| 5. | MEMS and Microdevice Simulation | Hands-on: Cantilever beam deflection,<br>Resonant frequency analysis |
| 6. | Mini Project | Students simulate one of the following:<br>1.MEMS cantilever sensor<br>2.Capacitive pressure sensor<br>3.Microheater design<br>4.Pressure Sensor<br>Battery Modelling |

## Resource Person

**Dr. Arpana Niranjan** is currently working as an Assistant Professor in the Department of Electrical, Electronics and Communication Engineering at Sharda University. She holds a Ph.D. in MEMS Biosensors for Virus Detection and has over 9 years of teaching experience in Electronics and Communication Engineering. Her research interests include MEMS biosensors, polymer-based sensing technologies, virus detection, and computational modeling using COMSOL and MATLAB. She has published several research papers in reputed journals and international conferences, including works on SARS-CoV-2 and Chikungunya virus detection. She is proficient in simulation and modeling tools such as COMSOL Multiphysics, MATLAB, Intellisuite, and AVR Programming. Dr. Niranjan is passionate about research-led teaching, innovation, and mentoring students toward industry-oriented learning and technological advancement.

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|---|---|
| **School: SSES**<br>**Programme: B.Tech**<br>**Branch: EECE** | **Batch : 2026-2027**<br>**Current Academic Year: 2026-2027**<br>**Semester : V/ VII** |

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|---|---|---|
| **1.** Course Code | NV36011 | |
| **2.** Course Title | Engineering Simulation using COMSOL Multiphysics | |
| **3.** Credits | Audit Course | |
| **4.** Contact Hours (L-T-P) | 30 Hours | |
| Course Type | Value added course | |
| **5.** Course Objective | 1. To introduce the fundamentals of multiphysics modelling and simulation.<br>2. To develop an understanding of the Finite Element Method (FEM) for engineering analysis.<br>3. To familiarize students with the COMSOL Multiphysics environment and tools.<br>4. To enable modeling of electrical, thermal, and MEMS-based systems.<br>5. To provide hands-on experience in solving real-world engineering problems using simulation.<br>6. To enhance analytical and design skills through mini-project work. | |
| **6.** Course Outcomes | CO1: Explain the fundamentals of Multiphysics modelling, Finite Element Method (FEM), and the COMSOL environment, including geometry creation, material selection, and post-processing tools. (K3)<br>CO2: Apply geometry creation, meshing techniques, boundary conditions, and solver selection to simulate basic engineering problems such as electrostatic systems. (K4)<br>CO3: Analyse electrical and thermal systems using COMSOL modules such as Electrostatics, AC/DC, and Heat Transfer, and interpret field distributions in semiconductor devices. (K5)<br>CO4: Analyse solid mechanics and Multiphysics coupling to model MEMS devices such as microcantilevers, including deflection and resonant behaviour. (K4))<br>CO5: Design and simulate engineering systems such as MEMS sensors, microheaters, or pressure sensors using appropriate Multiphysics models and interpret simulation results. (K6)<br>CO6: Integrate Multiphysics concepts and computational tools to model, simulate, and evaluate real-world engineering problems across electrical, thermal, and mechanical domains. (K6) | |
| **7.** Course Description | This course introduces students to Multiphysics modelling with a focus on engineering applications in electronics and MEMS. It covers fundamental concepts of the Finite Element Method (FEM) and provides hands-on experience with COMSOL Multiphysics software. Students will learn to simulate electrical, thermal, and mechanical systems. The course emphasizes practical problem-solving through guided simulations. A mini-project enables students to apply Multiphysics concepts to real-world ECE problems. | |
| **9.** Outline syllabus | | CO Mapping |
| **Unit 1** | **Introduction to Multiphysics Simulation** | |
| A | What is Multiphysics modelling, Finite Element Method basics, Overview of COMSOL Environment | CO1 |
| B | Model Builder and physics interfaces, Geometry and material library, Post-processing in COMSOL Multiphysics | CO2 |
| C | Hands On: Computing the Resistance of a Wire | CO3 |
| **Unit 2** | **Geometry, Meshing and Solvers** | |
| A | Creating 2D and 3D geometries, importing CAD models | CO3 |
| B | Meshing techniques, Boundary conditions, Stationary vs time-dependent solvers | CO3, CO4 |
| C | Hands-on: Simulation of a parallel plate capacitor | CO4 |
| **Unit 3** | **Electrical and Electronics Modelling** | |
| A | Electrostatics module, AC/ DC Module | CO4 |
| B | Heat Transfer Module | CO4/CO5 |
| C | Hands-on: P N junction modelling, Electric field distribution analysis | CO6 |
| **Unit 4** | **MEMS and Microdevice Simulation** | |
| A | Solid mechanics basics, Microcantilever modelling | CO2/CO4 |
| B | Piezoelectric effects, Multiphysics coupling | CO5 |
| C | Hands-on: Cantilever beam deflection, Resonant frequency analysis | CO5 |
| **Unit 5** | **Mini Project** | |
| A | Students simulate one of the following: | CO5 |
| B | 5.MEMS cantilever sensor | CO6 |
| C | 6.Capacitive pressure sensor<br>7.Microheater design<br>8.Pressure Sensor<br>Battery Modelling | CO6/CO1 |
| **Mode of examination** | Assignments / Quizzes | |