# JAWAHARLAL NEHRU UNIVERSITY

## University of Excellence

## (*Established by an act of Parliament in 1966*)


# Curriculum and Syllabi
# Of
# M.Tech. Nano Electronics
# (w.e.f. 2025)

## Special Centre for Nano Science

| | | |
|---|---|---|
| **Approved by** | **Special Committee** | **Academic Council** |
| **Approval Status** | | |
| **Approval Date** | **12-03-2025** | **03.04.2025** |

# M. Tech. in Nano Electronics (NE) 2025-2026 onwards

## Course Structure & Syllabus

A student shall have to earn **88 credits**at the end of two years in order to be eligible for the award of M. Tech. Degree.

### Semester I: Total Credits = 24

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Core - 1 | NS 684 | VLSI Design | 4 |
| 2 | Core - 2 | NS 685 | Process Technology for VLSI | 4 |
| 3 | Core - 3 | NS657N | Thin Film Technology | 4 |
| 4 | Core - 4 | NS656N | Nano electronics | 4 |
| 5 | Core - 5 | NS 689 | Quantum Mechanics &Nanostructures | 4 |
| 6 | Core - 6 | NS655N | Lab – 1 | 4 |

### Semester II: Total Credits = 24

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Elective | NS659N | Elective- I | 4 |
| 2 | Elective | NS658N | Elective - II | 4 |
| 3 | Elective | NS674N | Elective – III | 4 |
| 4 | Elective | NS677N | Elective - IV | 4 |
| 5 | Elective | NS680N | Elective - V | 4 |
| 6 | Core - 7 | NS671N | Lab – 2 | 4 |

### Semester III: Total Credits = 20

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Core - 8 | NS690 | Research Methodology | 4 |
| 2 | Project | NS691 | Minor Project | 16 |

### Semester IV: Total Credits = 20

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Project | M.Tech. Dissertation | Dissertation | 20 |

## List of Electives Courses for M.Tech. Semester II

**Program Electives** (***Select any five of the following)***

| Course No. | Course Code | Course Name |
|---|---|---|
| NE7 | NS659N | Nano Biosensors and Microfluidics |
| NE8 | NS658N | Advance Semiconductor Devices |
| NE9 | NS674N | VLSI Design & Testing |
| NE10 | NS 687 | CMOS RF Integrated Circuits |
| NE11 | NS676N | MEMS/NEMS |
| NE12 | NS677N | Analog IC Design |
| NE13 | NS680N | RFIC/MMIC |
| NE14 | NS679N | CAD for VLSI Design |
| NE15 | NS662N | Nanolithography & Nano scale devices |
| NE16 | NS631 | Nanotechnology in Manufacturing |
| NE17 | NS 688 | Frontiers in Nano Science & Technology |

**Note:**

Minor project: Minor project can be taken up with the faculties of the Centre.

Major Project: For Major Project & Dissertation the students will be encouraged to join any industry or research laboratory.

*Elective courses will be offered by the SCNS as per the availability of the teachers.

## Laboratory: M.Tech. Nano electronics

**Core – 6: Lab – 1**

List of experiments

| | |
|---|---|
| 1 | X-Ray Diffraction |
| 2 | Nanowires and nanotubes deposition by Electro-deposition |
| 3 | MOS characteristics using H-Spice model in ADS tool |
| 4 | Fabrication of thin films by sputtering |
| 5 | Fabrication of thin films by sol-gel method |
| 6 | Thin film deposition by sputtering / thermal evaporation |
| 7 | Design and Characterization of TFET using Silvaco |
| 8 | Design an CMOS Inverter and find output Characteristics |
| 9 | Design and Implementation of CMOS Transmission Gates |
| 10 | Design of CMOS Logic Circuits |
| 11 | Measuring the current-voltage (I-V) characteristics of Nano-devices like single-molecule junctions |
| 12 | Analyzing the electronic properties of Nano-materials using techniques like Raman spectroscopy |

***Note: Minimum eight (08) experiments have to be performed.***

**Core – 7: Lab – 2**

List of experiments

| | |
|---|---|
| 1 | Fabrication of biosensing electrodes |
| 2 | Transmission Electron Microscopy |
| 3 | Microwave measurements by Spectrum Analyzer & Vector Network Analyzer |
| 4 | Lithography for fabrication of microwave & mm-wave Filter & Phase shifter |
| 5 | Design and Simulate basic Common Source, Common Gate and Common Drain Amplifiers. Analyze the input impedance, output impedance, gain and bandwidth |
| 6 | Design an Adder (Min 8 Bit) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 7 | Design a Multiplier (4 Bit Min) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 8 | Design a Common source (CS) and Common Gate (CG) amplifier using CMOS 90nm H-Spice model at 10MHz with supply of 1.8V. Find out the DC and AC Characteristics |
| 9 | Design a CS Low Noise Amplifier with current mirror technique using CMOS 90nm H-Spice model for blue-tooth applications and find out S-parameters, noise figure and 1-dB compression point. |
| 10 | Take a CGH40010F MACOM GaN HEMT device with operating voltage of 28V and gate voltage of -2.7V at S-band applications and find out the DC Characteristics and S-parameters and verified data with commercial datasheets |
| 11 | Design Finite State Machine (Moore/Mealy) using HDL. Simulate it using Xilinx/Altera Software and implement by Xilinx/Altera FPGA |
| 12 | Scanning Electron Microscopy (SEM) |

***Note: Minimum eight (08) experiments have to be performed.***

**Eligibility for Admission:**

**M.Tech. in Nano Electronics:**B.E./ B.Tech. in Electronics & Communications/ Electrical Engineering or Master's degree in Electronics with 55% marks of a recognized University/ Institution or equivalent grade 'B' in UGC 7-point scale or an equivalent grade in a point scale where grading system is followed.

**M.Tech. Degree Credit Requirements**: No student admitted to the program shall be eligible for the award of M.Tech. degree unless he/she secures 88 credits in all. Students securing minimum required CGPA as per ordinance will be eligible for M. Tech. degree.

# Program Core

**Semester-I**

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Core - 1 | NS684 | VLSI Design | 4 |
| 2 | Core - 2 | NS685 | Process Technology for VLSI | 4 |
| 3 | Core - 3 | NS657N | Thin Film Technology | 4 |
| 4 | Core - 4 | NS656N | Nano electronics | 4 |
| 5 | Core - 5 | NS689 | Quantum Mechanics and Nanostructures | 4 |
| 6 | Core - 6 | NS655N | Lab – 1 | 4 |

# JAWAHARLAL NEHRU UNIVERSITY

## University of Excellence

## (*Established by an act of Parliament in 1966*)

# Curriculum and Syllabi

# Of

# M.Tech. Nano Science

# (w.e.f. 2025)

## Special Centre for Nano Science

| | | |
|---|---|---|
| **Approved by** | **Special Committee** | **Academic Council** |
| **Approval Status** | √ | |
| **Approval Date** | **12-03-2025** | **03.04.2025** |

# M. Tech. in Nano Science (NS) 2025-2026 onwards

## Course Structure & Syllabus

A student shall have to earn **88 credits**at the end of two years in order to be eligible for the award of M. Tech. Degree.

### Semester I: Total Credits = 24

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Core - 1 | NS 689 | Quantum Mechanics and Nanostructures | 4 |
| 2 | Core - 2 | NS652N | Nano Chemistry | 4 |
| 3 | Core - 3 | NS653N | Nano Bioscience | 4 |
| 4 | Core - 4 | NS657N | Thin Film Technology | 4 |
| 5 | Core - 5 | NS663N | Design & Synthesis of Nanostructures | 4 |
| 6 | Core - 6 | NS655N | Lab – 1 | 4 |

### Semester II: Total Credits = 24

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Elective | NS 631 | Elective- I | 4 |
| 2 | Elective | NS 659N | Elective - II | 4 |
| 3 | Elective | NS 660N | Elective – III | 4 |
| 4 | Elective | NS 661N | Elective - IV | 4 |
| 5 | Elective | NS662N | Elective - V | 4 |
| 6 | Core - 7 | NS671N | Lab – 2 | 4 |

### Semester III: Total Credits = 20

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Core - 8 | NS 690 | Research Methodology | 4 |
| 2 | Project | NS 691 | Minor Project | 16 |

### Semester IV: Total Credits = 20

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Project | M.Tech. Dissertation | Dissertation | 20 |

## List of Electives Courses for M.Tech. Semester II

**Program Electives:**

| Course No. | Course Code | Course Name |
|---|---|---|
| NS7 | NS631 | Nanotechnology in Manufacturing |
| NS8 | NS659N | Nano Biosensors and Microfluidics |
| NS9 | NS660N | Nanobiotechnology and Nanomedicine |
| NS10 | NS661N | Nanoscale Characterization |
| NS11 | NS662N | Nanolithography & Nanoscale devices |
| NS12 | NS664N | Chemical Engineering of Nanostructures |
| NS13 | NS673N | Renewable Energy Technology |
| NS14 | NS 688 | Frontiers in Nanoscience |

**Note:**

Minor Project (Semester III) and Major Project (Semester IV): Projects will be taken up with the faculties of the SCNS.

Elective courses will be offered by the SCNS as per the availability of the teachers.

## Laboratory: M.Tech. Nanoscience

**Core – 6 : Lab – 1**

List of experiments

| | |
|---|---|
| 1 | Handling of microbial culture/cell lines |
| 2 | Microbial growth curve |
| 3 | Nano-bio interactions I: Cyto-toxicity (effect of nanomaterials on growth curve of microbial cells) |
| 4 | Nano-bio interactions II: Cyto-toxicity (zone inhibition assay) |
| 5 | X-Ray Diffraction |
| 6 | Nanowires and nanotubes deposition by Electrodeposition |
| 7 | UV-Visible spectroscopy |
| 8 | Nanostructure synthesis by Reduction Method |
| 9 | Nanostructure synthesis by Solid State Method/Ceramic Method |
| 10 | Nanostructure synthesis by Hydrothermal method |
| 11 | Fabrication of thin films by sputtering |
| 12 | Fabrication of thin films by sol-gel method |

***Note: Minimum eight (08) experiments have to be performed.***

**Core – 7 : Lab – 2**

List of experiments

| | |
|---|---|
| 1 | Fabrication of biosensing electrodes |
| 2 | Transmission Electron Microscopy |
| 3 | Atomic Force Microscopy |
| 4 | Dielectric measurement by Impedance Analyzer |
| 5 | Polarization versus Electric field; hysteresis loop measurement |
| 6 | Nanomaterial-biomolecule interactions |
| 7 | Bio-conjugates |
| 8 | Handling ofcell lines; Cell viability (Cyto-toxicity, MTT assay) |
| 9 | Dynamic light scattering |
| 10 | Light Microscopy |
| 11 | Raman spectroscopy |
| 12 | Scanning Electron Microscopy |

***Note: Minimum eight (08) experiments have to be performed.***

**Eligibility for Admission:**

**M.Tech. in Nano Science:** Master's degree in Science or B.E./ B.Tech. in any branch of engineering and technology with 55% marks of a recognized University/ Institution or equivalent grade 'B' in UGC 7-point scale or an equivalent grade in a point scale where grading system is followed.

**M.Tech. Degree Credit Requirements**: No student admitted to the program shall be eligible for the award of M.Tech. degree unless he/she secures 88 credits in all. Students securing minimum required CGPA as per ordinance will be eligible for M. Tech. degree.

# Program Core

**Semester-I**

| Sr. No. | Course Type | Course Code | Course Name | Credits |
|---|---|---|---|---|
| 1 | Core - 1 | NS 689 | Quantum Mechanics and Nanostructures | 4 |
| 2 | Core - 2 | NS652N | Nano Chemistry | 4 |
| 3 | Core - 3 | NS653N | Nano Bioscience | 4 |
| 4 | Core - 4 | NS657N | Thin Film Technology | 4 |
| 5 | Core - 5 | NS663N | Design & Synthesis of Nanostructures | 4 |
| 6 | Core - 6 | NS655N | Lab – 1 | 4 |