

# MSc COURSE IN MATERIALS SCIENCE & NANOTECHNOLOGY – 2024-25

## TABLE OF COURSES – SCHEMES OF TRACKS

### LIST OF ALL COURSES

#### MANDATORY COURSES – FUNDAMENTAL AREA

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	I	SOLID STATE PHYSICS	6	PHYS-04/A
	I	THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHEM-02/A
	I-II	MATERIALS SPECTROSCOPY AND MICROSCOPY	9	PHYS-03/A
Integrative and related courses	I-II	STRATEGIES FOR MATERIALS SYNTHESIS	9	CHEM-3-4-5/A
	I	MATHEMATICAL METHODS FOR MATERIALS SCIENCE	6	MATH-03/A

#### ELECTIVE COURSES GROUPED IN 6 AREAS

##### MATERIALS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	I	CHEMISTRY OF INORGANIC MATERIALS	6	CHEM-03/A
	II	CHEMISTRY OF MOLECULAR MATERIALS	6	CHEM-05/A
	II	PHYSICAL CHEMISTRY OF SOLIDS	6	CHEM-02/A
	II	PHYSICS OF SEMICONDUCTORS	6	PHYS-03/A
	II	METALS SCIENCE AND SUSTAINABILITY	6	PHYS-03/A
	II	ADVANCED SOLID STATE PHYSICS	6	PHYS-04/A
Core courses-Mater.Eng.	I	COMPUTATIONAL MATERIALS SCIENCE	6	PHYS-04/A
	III	ADVANCED FUNCTIONAL POLYMERS	6	ICHI-02/B

##### THEORY & MODELS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	II	ADVANCED SOLID STATE PHYSICS	6	PHYS-04/A
	I	COMPUTATIONAL MATERIALS SCIENCE	6	PHYS-04/A
Further elective courses	II (LM STC)	THEORY OF INORGANIC MATERIALS SPECTROSCOPY	6	CHEM-03/A
	I (LM AEPS)	MACHINE LEARNING	6	INFO-01/A

##### QUANTUM SYSTEMS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	II	FABRICATION & CHARACTERIZATION OF NANO AND QUANTUM MATER.	6	PHYS-03/A
	II	QUANTUM PHOTONICS	6	PHYS-03/A
	I	NANOTECHNOLOGY & INNOVATION	6	PHYS-03/A
	II	ADVANCED SOLID STATE PHYSICS	6	PHYS-04/A
Core courses-Mater.Eng.	III	QUANTUM ELECTRONICS	6	IMAT-01/A
Further elective courses	II (LM PHYS)	QUANTUM MATERIALS	6	PHYS-03/A

##### ENERGY area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	I	FUNDAMENTALS OF ELECTROCHEMISTRY FOR ENERGY STORAGE	6	CHEM-02/A
	II	MODELS AND MATERIALS FOR ELECTROCHEMICAL ENERGY GENERATION AND CONVERSION	6	CHEM-02/A
	I (LM STC)	CATALYSIS FOR ENERGY AND THE ENVIRONMENT	6	CHEM-03/A
	II (LM PHYS)	ENERGETICS	6	PHYS-03/A
Core courses-Mater.Eng.	III	PHOTOVOLTAICS & OTHER RENEWABLE ENERGY TECHNOLOGIES	6	ING-IND-22

##### NANOSYSTEMS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	I	NANOTECHNOLOGY & INNOVATION	6	PHYS-03/A
	II	NANOCHEMISTRY, NANOPOROUS MATERIALS & NANOMEDICINE	6	CHEM-04/A
	I	PHYSICS OF SOFT MATTER NANOSTRUCTURES	6	PHYS-03/A
	II	FABRICATION & CHARACTERIZATION OF NANO AND QUANTUM MATER.	6	PHYS-03/A
Core courses-Mater.Eng.	III	ENGINEERED NANOMATERIALS	6	IMAT-01/A
Further elective courses	I (LM STC)	CHEMISTRY & NANOTECHNOLOGY FOR BIOMEDICINE	6	CHEM-05/A

##### APPLICATIONS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	II	CHEMISTRY & TECHNOLOGY OF POLYMERS & INDUSTRIAL APPL.	6	CHEM-04/A
	II	APPLS. OF MATERIALS FOR IONIZING RADIATION DETECTION	6	PHYS-06/A
	II (LM STC)	LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES	6	CHEM-05/A
	II	MOLECULAR ELECTRONICS AND PHOTONICS	6	PHYS-03/A
	II	QUANTUM PHOTONICS	6	PHYS-03/A
Core courses – Materials Engineering	III	PHYSICS AND TECHNOLOGY OF ELECTRONIC DEVICES	6	IMAT-01/A
	III	QUANTUM ELECTRONICS	6	IMAT-01/A

# LIST AND SCHEMES OF TRACKS

(NOTE: E-existent, R-rimodulated, N-new, LM-from other master courses)

**Track A - FUNCTIONAL MATERIALS**

**Track B – MATERIALS FOR NANOTECHNOLOGY**

**Track C - MATERIALS FOR ENERGY**

**Track D - MATERIALS FOR DIGITAL & QUANTUM TECHNOLOGY**

## TRACK A – FUNCTIONAL MATERIALS

### 5 Mandatory courses (36 credits) – *FUNDAMENTALS* area

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	21		SOLID STATE PHYSICS	6	PHYS-04/A	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHEM-02/A	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	PHYS-03/A	I-II
Integrative and related courses	15		STRATEGIES FOR MATERIALS SYNTHESIS	9	CHIM/3/4/6	I-II
			MATH. METHODS FOR MATER. SCIENCE	6	MAT/05	I

### 2 Elective compulsory courses (12 credits) out of the *MATERIALS* area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	12		CHEMISTRY OF INORGANIC MATERIALS	6	CHEM-03/A	I
			CHEMISTRY OF MOLECULAR MATERIALS	6	CHEM-05/A	II
		Mandatory for SUMA	PHYSICAL CHEMISTRY OF SOLIDS	6	CHEM-02/A	II
			PHYSICS OF SEMICONDUCTORS	6	PHYS-03/A	II
		Mandatory for SUMA	METALS SCIENCE AND SUSTAINABILITY	6	PHYS-03/A	II
			ADVANCED SOLID STATE PHYSICS	6	PHYS-04/A	II
	COMPUTATIONAL MATERIALS SCIENCE	6	PHYS-04/A	I		

### 1 Elective compulsory course (6 credits) out of the *APPLICATIONS* area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	6	Mandatory for SUMA	CHEMISTRY & TECHNOLOGY OF POLYMERS & INDUSTRIAL APPLICATIONS	6	CHEM-04/A	II
			APPLICATIONS OF MATERIALS FOR IONIZING RADIATION DETECTION	6	PHYS-06/A	II
		LM STC	LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES	6	CHEM-05/A	II
			MOLECULAR ELECTRONICS AND PHOTONICS	6	PHYS-03/A	II
			QUANTUM PHOTONICS	6	PHYS-03/A	II

### 1 Elective compulsory course (6 credits) out of *Materials Engineering* core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Materials Engineering	6		ADVANCED FUNCTIONAL POLYMERS	6	ICHI-02/B	III
			ENGINEERED NANOMATERIALS	6	IMAT-01/A	III
			QUANTUM ELECTRONICS	6	IMAT-01/A	III

*\*For SUMA Dual degree track, please see the scheme of Learning Agreement.*

**1 Further Conditional Elective Course (6 credits)** out of all CORE courses in *Physics & Chemistry of Matter* in any AREAS (*Materials, Theory&Models, Quantum Systems, Energy, Nanosystems, Applications*). In the SUMA track, the course *Physics of Soft Matter Nanostructures* must be included in the plan of study.

**3 Free Elective courses (18 credits)** OUT OF ALL COURSES IN ANY AREAS (*Materials, Theory&Models, Quantum Systems, Energy, Nanosystems, Applications*) OR IN OTHER MSc COURSES OR IN MOBILITY PROGRAMS

+ **Communication skills (3 credits)**

+ **Internship (3 credits including Scientific Literacy course)**

+ **MSc THESIS (30 credits)**

## TRACK B – MATERIALS FOR NANOTECHNOLOGY

### 5 Mandatory courses (36 credits) – FUNDAMENTALS area

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	21		SOLID STATE PHYSICS	6	PHYS-04/A	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHEM-02/A	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	PHYS-03/A	I-II
Integrative and related courses	15		STRATEGIES FOR MATERIALS SYNTHESIS	9	CHIM/3/4/6	I-II
			MATH. METHODS FOR MATER. SCIENCE	6	MAT/05	I

### 1 Elective compulsory course (6 credits) out of the MATERIALS area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	6		CHEMISTRY OF INORGANIC MATERIALS	6	CHEM-03/A	I
			CHEMISTRY OF MOLECULAR MATERIALS	6	CHEM-05/A	II
			PHYSICAL CHEMISTRY OF SOLIDS	6	CHEM-02/A	II
			PHYSICS OF SEMICONDUCTORS	6	PHYS-03/A	II
			METALS SCIENCE AND SUSTAINABILITY	6	PHYS-03/A	II
			ADVANCED SOLID STATE PHYSICS	6	PHYS-04/A	II
			COMPUTATIONAL MATERIALS SCIENCE	6	PHYS-04/A	I

### 3 Elective compulsory courses (18 credits) out of the NANOSYSTEMS area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	12		NANOTECHNOLOGY & INNOVATION	6	PHYS-03/A	I
			NANOCHEMISTRY, NANOPOROUS MATERIALS AND NANOMEDICINE	6	CHEM-04/A	II
			PHYSICS OF SOFT MATTER NANOSTRUCTURES	6	PHYS-03/A	I
			FABRICATION & CHARACTERIZATION OF NANO AND QUANTUM MATERIALS	6	PHYS-03/A	II
Core courses – Materials Engineering	6		ENGINEERED NANOMATERIALS	6	IMAT-01/A	III
			QUANTUM ELECTRONICS	6	IMAT-01/A	III

### 1 Elective compulsory course (6 credits) out of the APPLICATIONS area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	6		CHEMISTRY & TECHNOLOGY OF POLYMERS & INDUSTRIAL APPLICATIONS	6	CHEM-04/A	II
			APPLICATIONS OF MATERIALS FOR IONIZING RADIATION DETECTION	6	PHYS-06/A	II
		LM STC	LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES	6	CHEM-05/A	II
			MOLECULAR ELECTRONICS AND PHOTONICS	6	PHYS-03/A	II
			QUANTUM PHOTONICS	6	PHYS-03/A	II

**3 Free Elective courses (18 credits) OUT OF ALL COURSES IN ANY AREAS (Materials, Theory&Models, Quantum Systems, Energy, Nanosystems, Applications) OR IN OTHER MSc COURSES OR IN MOBILITY PROGRAMS**

- + **Communication skills (3 credits)**
- + **Internship (3 credits including Scientific Literacy course)**
- + **MSc THESIS (30 credits)**

## TRACK C – MATERIALS FOR ENERGY

### 5 Mandatory courses (36 credits) – FUNDAMENTALS area

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	21		SOLID STATE PHYSICS	6	PHYS-04/A	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHEM-02/A	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	PHYS-03/A	I-II
Integrative and related courses	15		STRATEGIES FOR MATERIALS SYNTHESIS	9	CHIM/3/4/6	I-II
			MATH. METHODS FOR MATER. SCIENCE	6	MAT/05	I

### 1 Elective compulsory course (6 credits) out of the MATERIALS area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	6		CHEMISTRY OF INORGANIC MATERIALS	6	CHEM-03/A	I
			CHEMISTRY OF MOLECULAR MATERIALS	6	CHEM-05/A	II
			PHYSICAL CHEMISTRY OF SOLIDS	6	CHEM-02/A	II
			PHYSICS OF SEMICONDUCTORS	6	PHYS-03/A	II
			METALS SCIENCE AND SUSTAINABILITY	6	PHYS-03/A	II

### 4 Compulsory courses (24 credits) out of the ENERGYs area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	18		FUNDAMENTALS OF ELECTROCHEMISTRY FOR ENERGY STORAGE	6	CHEM-02/A	I
		LM STC	CATALYSIS FOR ENERGY AND THE ENVIRONMENT	6	CHEM-03/A	I
			MODELS AND MATERIALS FOR ELECTROCHEMICAL ENERGY GENERATION AND CONVERSION	6	CHEM-02/A	II
		LM PHYS	ENERGETICS	6	PHYS-03/A	II
Core courses – Materials Engineering	6		PHOTOVOLTAICS & OTHER RENEWABLE ENERGY TECHNOLOGIES	6	IMAT-01/A	III

**3 Free Elective courses (18 credits) OUT OF ALL COURSES IN ANY AREAS (Materials, Theory&Models, Quantum Systems, Energy, Nanosystems, Applications) OR IN OTHER MSc COURSES OR IN MOBILITY PROGRAMS**

**SUGGESTED ELECTIVE COURSES: FURTHER COURSES OF ENERGY GROUP.**

- + **Communication skills (3 credits)**
- + **Internship (3 credits including Scientific Literacy course)**
- + **MSc THESIS (30 credits)**

## TRACK D – MATERIALS FOR DIGITAL AND QUANTUM TECHNOLOGY

### 5 Mandatory courses (36 credits) – *FUNDAMENTALS* area

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics & Chemistry of Matter	21		SOLID STATE PHYSICS	6	PHYS-04/A	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHEM-02/A	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	PHYS-03/A	I-II
Integrative and related courses	15		STRATEGIES FOR MATERIALS SYNTHESIS	9	CHIM/3/4/6	I-II
			MATH. METHODS FOR MATER. SCIENCE	6	MAT/05	I

### 2 Compulsory courses (12 credits) out of the *MATERIALS*-area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics&Chemistry of Matter	12		PHYSICS OF SEMICONDUCTORS	6	PHYS-03/A	II
			PHYSICAL CHEMISTRY OF SOLIDS	6	CHEM-02/A	II
			COMPUTATIONAL MATERIALS SCIENCE	6	PHYS-04/A	I
			METALS SCIENCE AND SUSTAINABILITY	6	PHYS-03/A	II

### 2 Elective compulsory course (12 credits) out of the *QUANTUM SYSTEMS*-area courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics&Chemistry of Matter	12		FABRICATION & CHARACTERIZATION OF NANO AND QUANTUM MATERIALS	6	PHYS-03/A	II
			QUANTUM PHOTONICS	6	PHYS-03/A	II
			NANOTECHNOLOGY & INNOVATION	6	PHYS-03/A	I
			ADVANCED SOLID STATE PHYSICS	6	PHYS-04/A	II

### 1 Elective compulsory course (6 credits) out of these *materials engineering* core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Materials Engineering	6		PHYSICS AND TECHNOLOGY OF ELECTRONIC DEVICES**	6	IMAT-01/A	III
			QUANTUM ELECTRONICS*	6	IMAT-01/A	III

**3 Free Elective courses (18 credits) OUT OF ALL COURSES IN ANY AREAS (*Materials, Theory&Models, Quantum Systems, Energy, Nanosystems, Applications*) OR IN OTHER MSc COURSES OR IN MOBILITY PROGRAMS**

**SUGGESTED ELECTIVE COURSES:** FURTHER COURSES OF *QUANTUM* GROUP, OR COURSES OUT OF THIS LIST: COMPUTATIONAL MATERIALS SCIENCE, MOLECULAR ELECTRONICS AND PHOTONICS, NANOTECHNOLOGY AND INNOVATION, PHYSICS OF SOFT MATTER NANOSTRUCTURES.

- + **Communication skills (3 credits)**
- + **Internship (3 credits including Scientific Literacy course)**
- + **MSc THESIS (30 credits)**

\* QT sub-Track

\*\* ICT sub-Track