

MSc COURSE IN MATERIALS SCIENCE & NANOTECHNOLOGY – 2023-24

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	FIS/03
	I	THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHIM/02
	I-II	MATERIALS SPECTROSCOPY AND MICROSCOPY	9	FIS/01
Integrative and related courses	I-II	STRATEGIES FOR MATERIALS SYNTHESIS	9	CHIM/3/4/6
	I	MATHEMATICAL METHODS FOR MATERIALS SCIENCE	6	MAT/05

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	CHIM/03
	II	CHEMISTRY OF MOLECULAR MATERIALS	6	CHIM/06
	II	PHYSICAL CHEMISTRY OF SOLIDS	6	CHIM/02
	II	PHYSICS OF SEMICONDUCTORS	6	FIS/03
	I	METALS SCIENCE AND SUSTAINABILITY	6	FIS/03
Core courses – Materials Engineering	III	ADVANCED FUNCTIONAL POLYMERS	6	ING-IND/27

THEORY & MODELS area courses

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

QUANTUM SYSTEMS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	II	QUANTUM MATERIALS SYNTHESIS	6	FIS/03
	II	QUANTUM PHOTONICS	6	FIS/03
Core courses – Materials Engineering	III	QUANTUM ELECTRONICS	6	ING-IND/22
Further elective courses	II (LM PHYS)	QUANTUM MATERIALS	6	FIS/03

ENERGY area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	I	FUNDAMENTALS OF ELECTROCHEMISTRY FOR ENERGY STORAGE	6	CHIM/02
	II	MODELS AND MATERIALS FOR ELECTROCHEMICAL ENERGY GENERATION AND CONVERSION	6	CHIM/02
	I (LM STC)	CATALYSIS FOR ENERGY AND THE ENVIRONMENT	6	CHIM/03
	II (LM PHYS)	ENERGETICS	6	FIS/03
Core courses – Materials Engineering	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	FIS/01
	II	NANOCHEMISTRY AND NANOPOROUS MATERIALS	6	CHIM/04
	I	PHYSICS OF SOFT MATTER NANOSTRUCTURES	6	FIS/01
Core courses – Materials Engineering	III	ENGINEERED NANOMATERIALS	6	ING-IND/22
Further elective courses	I (LM STC)	CHEMISTRY & NANOTECHNOLOGY FOR BIOMEDICINE	6	CHIM/06

APPLICATIONS area courses

Course category	Semester	Course	credits	sector
Core courses – Physics & Chemistry of Matter	II	CHEMISTRY & TECHNOLOGY OF POLYMERS & INDUSTRIAL APPL.	6	CHIM/04
	II	APPLS. OF MATERIALS FOR IONIZING RADIATION DETECTION	6	FIS/07
	II (LM STC)	LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES	6	CHIM/06
	II	MOLECULAR ELECTRONICS AND PHOTONICS	6	FIS/01
Core courses – Materials Engineering	III	PHYSICS AND TECHNOLOGY OF ELECTRONIC DEVICES	6	ING-IND/22

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	FIS/03	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHIM/02	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	FIS/01	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	CHIM/03	I
			CHEMISTRY OF MOLECULAR MATERIALS	6	CHIM/06	II
		Mandatory for SUMA	PHYSICAL CHEMISTRY OF SOLIDS	6	CHIM/02	II
			PHYSICS OF SEMICONDUCTORS	6	FIS/03	II
		Mandatory for SUMA	METALS SCIENCE AND SUSTAINABILITY	6	FIS/03	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	CHIM/04	II
			APPLICATIONS OF MATERIALS FOR IONIZING RADIATION DETECTION	6	FIS/07	II
		LM STC	LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES	6	CHIM/06	II
			MOLECULAR ELECTRONICS AND PHOTONICS	6	FIS/01	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	ING-IND/27	III
			ENGINEERED NANOMATERIALS	6	ING-IND/22	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) + 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	FIS/03	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHIM/02	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	FIS/01	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	CHIM/03	I
			CHEMISTRY OF MOLECULAR MATERIALS	6	CHIM/06	II
			PHYSICAL CHEMISTRY OF SOLIDS	6	CHIM/02	II
			PHYSICS OF SEMICONDUCTORS	6	FIS/03	II
			METALS SCIENCE AND SUSTAINABILITY	6	FIS/03	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	FIS/01	I
			NANOCHEMISTRY AND NANOPOROUS MATERIALS	6	CHIM/04	II
			PHYSICS OF SOFT MATTER NANOSTRUCTURES	6	FIS/01	I
Core courses – Materials Engineering	6		ENGINEERED NANOMATERIALS	6	ING-IND/22	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	CHIM/04	II
			APPLICATIONS OF MATERIALS FOR IONIZING RADIATION DETECTION	6	FIS/07	II
		LM STC	LOW ENVIRONMENTAL IMPACT MATERIALS AND PROCESSES	6	CHIM/06	II
			MOLECULAR ELECTRONICS AND PHOTONICS	6	FIS/01	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) + 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	FIS/03	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHIM/02	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	FIS/01	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	CHIM/03	I
			CHEMISTRY OF MOLECULAR MATERIALS	6	CHIM/06	II
			PHYSICAL CHEMISTRY OF SOLIDS	6	CHIM/02	II
			PHYSICS OF SEMICONDUCTORS	6	FIS/03	II
			METALS SCIENCE AND SUSTAINABILITY	6	FIS/03	I

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	CHIM/02	I
		LM STC	CATALYSIS FOR ENERGY AND THE ENVIRONMENT	6	CHIM/03	I
			MODELS AND MATERIALS FOR ELECTROCHEMICAL ENERGY GENERATION AND CONVERSION	6	CHIM/02	II
		LM PHYS	ENERGETICS	6	FIS/03	II
Core courses – Materials Engineering	6		PHOTOVOLTAICS & OTHER RENEWABLE ENERGY TECHNOLOGIES	6	ING-IND/22	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) + 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	FIS/03	I
			THERMODYNAMICS AND KINETICS OF MATERIALS	6	CHIM/02	I
			MATERIALS SPECTROSCOPY AND MICROSCOPY	9	FIS/01	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	FIS/03	II
			PHYSICAL CHEMISTRY OF SOLIDS	6	CHIM/02	II

1 Elective compulsory course (6 credits) out of the *THEORY & MODELS*-area core courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics&Chemistry of Matter	6		ADVANCED SOLID STATE PHYSICS	6	FIS/03	II
			COMPUTATIONAL MATERIALS SCIENCE	6	FIS/03	I

1 Elective compulsory course (6 credits) out of the *QUANTUM SYSTEMS*-area courses

Course category	credits	Notes	Course	credits	Scientific sector	Semester
Core courses – Physics&Chemistry of Matter	6		QUANTUM MATERIALS SYNTHESIS	6	FIS/03	II
			QUANTUM PHOTONICS	6	FIS/03	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	ING-IND/22	I
			QUANTUM ELECTRONICS*	6	ING-IND/22	I

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) + MSc THESIS (30 credits)

* QT sub-Track

** ICT sub-Track