

Allegato al D.R. n. 2095 del 17 dicembre 2020

## MASTER'S DEGREE PROGRAMME IN MATERIALS AND NANOTECHNOLOGY

(LAUREA MAGISTRALE IN MATERIALS AND NANOTECHNOLOGY – Italian Degree class LM-53)

### CALL FOR APPLICATIONS - ACADEMIC YEAR 2021 - 2022

#### Art. 1

#### Admission to the Master's Degree Programme in Materials and Nanotechnology (Laurea Magistrale in Materials and Nanotechnology, Italian Degree class LM-53)

1. The University of Pisa (hereafter "the University") announces for the academic year 2021/2022 a public call for admissions to the Master's Degree Programme in Materials and Nanotechnology (Laurea Magistrale in Materials and Nanotechnology, Italian Degree class LM-53) at the Departments of Civil and Industrial Engineering, Information Engineering, Physics, Chemistry and Industrial Chemistry of the University of Pisa. Detailed information on the Master Degree Programme is available at: <https://www.unipi.it/index.php/lauree/corso/11047>.
2. Due to the specific features of its teaching and research activities, the Master's Degree Programme in **Materials and Nanotechnology** aims to select at most 35 students, including 6 reserved places for the internal students of the Scuola Normale Superiore and 10 for non-EU students not residing in Italy (2 of which reserved for Chinese applicants of the exchange Marco Polo project between Italy and China). The admission procedure foresees three sessions as follows:
  - a. 2 sessions for non-EU applicants exclusively (citizens of extra-EU countries) and not residing in Italy (hereafter "non-EU<sup>4</sup> Applicants") – up to 10 places;
  - b. 1 session for EU applicants and non-EU applicants residing in Italy exclusively (hereafter "EU Applicants") – up to 19 places.
3. If fewer than 10 non-EU selected applicants and/or fewer than 6 Scuola Normale Superiore students join the Master Degree Programme, the quota of places available for EU applicants will be increased by the equivalent number of places for non-EU applicants and Scuola Normale Superiore students that remain vacant, up to a maximum of 35 places.
4. At the end of the third session of the selection procedure, any vacant place will be made available to EU and non-EU applicants residing in Italy (EU Applicants). Application will be accepted conditionally, according to the time of application submission, until all available places are covered. The Study Programme Board will evaluate requirements and

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<sup>4</sup> Law n. 189/2002 art.26: "Access to university courses is allowed however - with the same conditions as Italian students - to: students with a permit of stay for dependent employment, self-employment, family reasons, political asylum, humanitarian asylum or religious reasons; all foreigners regularly living in Italy for at least one year and with a higher qualification obtained in Italy; as well as to foreigners - wherever resident - with final diplomas from Italian schools abroad or foreign or international schools - operating in Italy or abroad - and subjected to bilateral agreements or special laws for the acknowledgment of qualifications and satisfying the general conditions required for entry to study. Citizens from Norway, Iceland, Liechtenstein, Switzerland and the Republic of San Marino are admitted under the same conditions as EU citizens. For extra-EU applicants - not residing in Italy - the relevant ministry rules applies.

qualifications, and it will recognise the applicant as eligible for admission. The number of vacant places and further information on application submission will be available at <https://www.unipi.it/index.php/immatricolazioni-e-iscrizioni/item/11815-materials-and-nanotechnology>

5. At the end of the selection procedures, the Selection Committee will provide a final ranking list of eligible applicants for each selection session. Admitted applicants, according to the places available for each session, will be appointed with a Rector's Decree.

## Art. 2

### Admission Requirements

- 1) By the deadlines as per arts. 3 and 4, applicants should meet one of the following requirements:
  - a) a Bachelor's Degree (First Cycle Degree; Italian "Laurea di I livello") in Information Engineering (Italian Degree class L-8 Ingegneria dell'Informazione), Industrial Engineering (Italian Degree class L-9 Ingegneria Industriale), Chemistry (Italian Degree class L-27 Scienze e Tecnologie Chimiche), or Physics (Italian Degree class L-30 Fisica) awarded by any Italian university, and their *curriculum studiorum* includes at least 60 CFU (Italian Credit Transfer System) in one of the following disciplines<sup>5</sup>:
    - CHIM/01; CHIM/02; CHIM/03; CHIM/04; CHIM/05; CHIM/06; CHIM/07; FIS/01; FIS/03; FIS/07; MAT/02; MAT/03; MAT/05; MAT/06; MAT/07; MAT/08; MAT/09; INF/01; ING-IND/03; INGIND/04; ING-IND/06; ING-IND/07; ING-IND/08; ING-IND/09; ING-IND/10; ING-IND/11; ING-IND/12; ING-IND/13; ING-IND/14; ING-IND/21; ING-IND/22; ING-IND/24; ING-IND/25; ING-IND/26; ING-IND/27; ING-IND/31; ING-IND/32; ING-IND/33; INGIND/34; ICAR/08; ING-INF/01; ING-INF/02; ING-INF/03; ING-INF/04; ING-INF/06; ING-INF/07.
    - Of the above-mentioned 60 CFU, a minimum of 6 CFU are required in one of the disciplines: CHIMI/01; CHIM/02; CHIM/03; CHIM/04; CHIM/06 or CHIM/07.
  - b) a Bachelor's Degree, a Master's Degree, an Italian "Laurea Magistrale", an Italian "Laurea vecchio ordinamento" in a different class, awarded by any Italian university, and their

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<sup>5</sup> CHIMI/01= Analytical Chemistry; CHIM/02=Physical Chemistry; CHIM/03=General and Inorganic Chemistry; CHIM/04=Industrial Chemistry; CHIM/05=Science and Technology of Polymeric Materials; CHIM/06=Organic Chemistry; CHIM/07=Chemical Foundations of Technology; FIS/01=Experimental Physics; FIS/03=Matter Physics 3; FIS/07=Applied Physics (to Cultural Heritage, Environment, Biology and Medicine); MAT/02=Algebra; MAT/03=Geometry; MAT/05=Mathematical Analysis; MAT/06=Probability and Mathematical Statistics; MAT/07=Mathematical Physics; MAT/08=Numerical Analysis; MAT/09=Operations Research; ING-IND/3=Flight Mechanics; ING-IND/04=Construction and Aerospace Structures; ING-IND/06=Fluid Dynamics; ING-IND/07=Aerospace Propulsion; ING-IND/08=Fluid machinery; ING-IND/09=Systems for Energy and the Environment; ING-IND/10=Industrial Technical Physics; ING-IND/11=Environmental Technical Physics; ING-IND/12=Mechanical and Thermal Measurements; ING-IND/13=Applied Mechanics; ING-IND/14=Mechanical Design and Construction of Machines; ING-IND/21=Metallurgy; ING-IND/22=Science and Technology of Materials; ING-IND/24=Chemical Engineering Principles; ING-IND/25=Chemical Plants; ING-IND/26 = Theory of the Development of Chemical Processes; ING-IND/27=Technological and Industrial Chemistry; ING-IND/31=Electrical; ING-IND/32=Converters, Machines and Electric Drives; ING-IND/33=Electrical Systems for Energy; INGIND/34= Industrial Bioengineering; ICAR/08=Mechanics of Materials; ING-INF/01=Electronics; ING-INF/02=Electromagnetic Fields; ING-INF/03 = Telecommunications; ING-INF/04 = Automatics; ING-ING/06=Electronics and Bioinformatics; ING-INF/07=Electrical and Electronic Measurements.

*curriculum studiorum* includes at least 60 CFU (Italian Credit Transfer System) in the following disciplines:

- CHIM/01; CHIM/02; CHIM/03; CHIM/04; CHIM/05; CHIM/06; CHIM/07; FIS/01; FIS/03; FIS/07; MAT/02; MAT/03; MAT/05; MAT/06; MAT/07; MAT/08; MAT/09; INF/01; ING-IND/03; ING-IND/04; ING-IND/06; ING-IND/07; ING-IND/08; ING-IND/09; ING-IND/10; ING-IND/11; ING-IND/12; ING-IND/13; ING-IND/14; ING-IND/21; ING-IND/22; ING-IND/24; ING-IND/25; ING-IND/26; ING-IND/27; ING-IND/31; ING-IND/32; ING-IND/33; ING-IND/34; ICAR/08; ING-INF/01; ING-INF/02; ING-INF/03; ING-INF/04; ING-INF/06; ING-INF/07.
  - Of the above-mentioned 60 CFU a minimum of 6 are required in one of the disciplines: CHIM/01; CHIM/02; CHIM/03; CHIM/04; CHIM/06 or CHIM/07.
- c) a Bachelor's Degree or equivalent first cycle degree awarded by a Foreign University after at least a three-year course of study. The Selection Committee will evaluate the qualification awarded abroad, equivalency or comparability for the only purpose of the selection procedure and may identify further mandatory educational activities. The academic qualifications awarded in a non-EU country has to be officially recognized as eligible for admission by the relevant Italian diplomatic representatives.

For those candidates who:

- a. hold a Degree awarded by the University of Pisa, as referred to in paragraph a, the requirements are automatically met;
  - b. hold a Degree awarded by another Italian university, as stated under paragraph a, or a Degree awarded by any Italian university, as stated under paragraph b the admission requirements are subject to the evaluation of eligibility by the Selection Board. The University has the right to exclude those candidates who do not fulfil the necessary requisites. In case of positive outcome of such verification, the Selection Board will also assess the curricular requirements of the candidate and may identify further mandatory educational activities: if the total missing credits are more than 40, there is no admission to the tests; if the total is less than or equal to 40, the candidate will be admitted to the tests. If successful, the candidate will be enrolled in specific courses (Corsi Singoli di Transizione) to recover the relevant educational gaps.
  - c. hold a Degree, as referred to in paragraph c, the Selection Committee will evaluate the eligibility of the applicant's qualification, admission requirements and curricular requisites.
- 2) For non-EU Applicants, admission is also extended to those who have not graduated yet. If successful, candidates will be admitted provided they will graduate and supply the relevant certification by 31 July 2021.
- 3) For EU Applicants, admission is also extended also to those who have not graduated yet. If successful, candidates will be admitted provided they will graduate and supply the relevant certification by 31 December 2021.

- 4) In addition to the academic degree, applicants are required to have a good knowledge of the English language, corresponding to at least an intermediate level (B2 Level, according to the Common European Framework of Reference for Languages). During the interview, the Selection Committee will verify the applicants' English language proficiency.

## Art. 3

### Non-EU Candidates Applications

- 1) Applicants are requested to apply online only at [www.studenti.unipi.it](http://www.studenti.unipi.it) [www.unipi.it/studenti/concorsipecialistica](http://www.unipi.it/studenti/concorsipecialistica) by **11 January 2021** (first session) and by **19 February 2021** (second session), following the instructions provided by "Informazioni generali" ("General Information"). **Submission of the application beyond the set deadline is not allowed.**

After the application submission the system will issue a receipt proving that registration is complete. This receipt, marked by a unique serial number, is the only document proving the accurate completion of registration: in the event of a dispute, only candidates that can supply the receipt are allowed to participate. During the online procedure applicant shall upload a valid ID document.

- 2) For the assessment of the requirements and qualifications, candidates shall register on <https://applymscenglish.unipi.it>, submit the application for the Master's Degree Programme in Materials and Nanotechnology and upload the necessary documentation **online only**.

During the online procedure in the section "Certificate of the Title and Exams" it is mandatory to provide:

- a. family name, first name, place and date of birth, nationality;
- b. a declaration that the candidate has never been convicted for a criminal offence and has no pending criminal proceedings;
- c. a copy of the academic degree, as per art. 2, with an indication of the year of first enrolment, the degree programme title, its duration, the final grade (if applicable) and the University or educational institute that awarded the degree. For candidates who have graduated in Italy, it is enough to upload a self-certification of the title, pursuant to the D.P.R. 445/2000, with indication of the exams taken and the related Disciplinary Scientific Sectors. Candidates who have not graduated yet shall declare the expected graduation date (no later than 31 July 2021 for non-EU applicants and no later than 31 December 2021 for EU applicants).
- d. the Cumulative Grade Point Average;
- e. a declaration of English language proficiency (and other foreign languages, if any) specifying the duration of language studies and certification(s) obtained;
- f. the permanent address and the domicile address (if different), to receive hard copy communications concerning the application. In the event of a change, applicants shall immediately inform the University.
- g. (for non-EU applicants) the Italian Embassy or Consulate where they intend to submit their student visa application in case of admission to the course.
- h. a valid email address, which is mandatory to receive all communications related to the application, as well as a telephone number and a skype id.

During this procedure candidates shall declare if they intend to perform the interview via skype or in person.

- 4) Applicants shall upload the following documents, all in PDF format and named as follows:
- h. **Surname\_Name\_Cv\_.pdf**: a copy of the complete *Curriculum Vitae et Studiorum* (in English) describing their educational pathway, cultural and professional experiences, prizes, publications, achievements and all other information that might help in the evaluation.
  - i. **Surname\_Name\_Certificate\_.pdf**: copy of the Degree Certificate (if applicable) and its translation if written in language other than English or Italian;
  - j. **Surname\_Name\_Transcripts\_.pdf**: the academic transcripts with the full list of courses and grades (in English or Italian). This list shall contain information regarding credits, grades and the date of the final examination (if applicable), also attaching a certified copy of the University Transcripts;
  - k. **Surname\_Name\_Thesis\_**: a short abstract (maximum 5 pages) of the Bachelor's Thesis or equivalent final elaborate, or a short abstract (maximum 5 pages) of the ongoing Thesis activity, if it has been not completed yet.
- Surname\_Name\_Courses\_** (not mandatory): a list of technical courses taken, specifying for each subject, according to the template provided in the application form: course name, hours, list of topics, hours per topic. Even if this attachment is not mandatory, it is highly recommended, as the Selection Committee will assess it along with the other titles submitted.
- Surname\_Name\_Achievements\_**: a list of competences and skills acquired during academic and professional experience, and recognized as eligible for the admission to the Master's Degree Programme (no more than 2.000 characters);
- l. **Surname\_Name\_Passport.pdf**: copy of valid passport or any other international ID;
  - m. **Surname\_Name\_English\_.pdf** (not mandatory): if available, a copy of any certification of English language proficiency;
  - n. **Surname\_Name\_Other\_.pdf** (not mandatory): a copy of any other document or information applicant considers eligible for this selection (documents written in languages other than Italian, English, or French shall include an abstract in one of the above languages).

According to D.P.R. no. 445/2000, articles 46 and 47, Italian citizens and EU citizens are allowed to submit self-certification. Non-EU citizens legally residing in Italy are allowed as well, but within the limit of information that can be certified or attested by Italian public bodies. Uncompleted and unsigned self-certifications will lead to exclusion from the selection procedure.

- 5) **Applications with missing information will not be considered as valid**. Integrations to the application after the call deadline will not be accepted in whatsoever circumstance.

- 6) The University of Pisa is entitled to check the truthfulness of the declarations and the documentation submitted by the candidates, and may require the submission of original documents. In the event of false statements the University might decide at any time, by justified Rector's Decree, the exclusion of the candidate from the selection procedure without prejudice to the resulting criminal law liability.
- 7) At any time, the University might exclude anyone who does not meet the requirements.
- 8) In case of any problem with the online application, please contact Direzione Servizi per la didattica e gli studenti (+390502213429, email: [concorsinumerochiuso@unipi.it](mailto:concorsinumerochiuso@unipi.it))

#### **Art. 4**

##### **EU Candidates Applications**

As provided for in article 3, applicants are required to submit their application from **19 March to 31 August 2021 at 11 AM (Italy Time)**.

#### **Art. 5**

##### **Selection procedure**

1. Applicant selection will involve, in all sessions, the evaluation of all submitted qualifications and an interview. The selection process aims to evaluate each applicant's background and abilities, assessing the potential and the attitude required when attending an interdisciplinary and innovative educational programme, such as the Master's Degree in *Materials and Nanotechnology*.
2. The Selection Committee (six members) will be the same for all sessions reserved for non-EU candidates and the EU candidate. The Committee is appointed by the Rector of the University of Pisa, upon proposal by Study Programme Board in Materials and Nanotechnology.
3. The final assessment will be on a 100 point scale, of which:
  - up to 70 points for the assessment of qualifications;
  - up to 30 points for the interview.
4. The assessment of qualifications will be focused on the Curriculum, qualifications, courses taken and on other documents submitted by the candidate. Admission to the interview is granted with a score of at least 49/70 points.
5. For non-EU applicants, the interview will be performed via videoconference (using Skype or similar tools at the Selection Committee's discretion) at Italian Embassies, Consulates or other locations identified by the Selection Committee in order to assure the fulfilment of the applicants' identification procedures. If the interview is not performed at Embassies or Consulates, the candidate should exhibit to the Committee, before starting the interview, the ID submitted in the online application.
6. For EU applicants, the interview will be held in Pisa at the University premises. In case of proper and justified reasons, candidates may ask the Selection Committee to perform the interview via videoconference (using Skype software or similar tools at the Selection



- Committee's discretion),. In this case, the candidate should exhibit to the Committee members, before starting the interview, the ID submitted in the online application.
7. A candidate not attending the scheduled interview will be excluded from the final ranking list. If the interview is performed via videoconference, the candidate is in charge of ensuring the availability of the required hardware (PC, webcam) and software, and a reliable internet connection.
  8. During the interview, the Selection Committee will evaluate the candidates' profiles on the basis of the submitted qualifications and will verify if candidates meet the technical pre-requirements as per Annex 1, as well as the candidate English proficiency level. Applicants should obtain at least 21/30 points in the interview in order to be included in the final ranking.
  9. An overall final minimum score of 70/100 is therefore necessary to successfully pass the examination and be admitted to the Master's Degree Programme.

## Art. 6

### Examination schedule and results

1. Selections will be held according to the following schedule:

#### a) non-EU candidates (first session)

|                                    |                        |
|------------------------------------|------------------------|
| Assessment of qualifications:      | within 15 January 2021 |
| Interviews:                        | 20 and 21 January 2021 |
| Publication of final ranking list: | within 27 January 2021 |

#### b) non-EU candidates (second session)

|                                    |                         |
|------------------------------------|-------------------------|
| Assessment of qualifications:      | within 26 February 2021 |
| Interviews:                        | 15 and 16 March 2021    |
| Publication of final ranking list: | within 19 March 2021    |

[OBJ]

#### c) EU candidates (third session)

[OBJ]

|                                    |                          |
|------------------------------------|--------------------------|
| Assessment of qualifications:      | within 3 September 2021  |
| Interviews:                        | 8 and 9 September 2021   |
| Publication of final ranking list: | within 17 September 2021 |

2. The results of the qualifications assessment will be published at <https://www.unipi.it/index.php/immatricolazioni-e-iscrizioni/item/8457-materials-and-nanotechnology>, with the list of applicants admitted to the interviews and all information concerning place, time and date of the interviews. The final ranking list will be published on the same website.

## Art. 7

### Final ranking list and Successful candidates

1. Successful candidates will be appointed by a Rector's Decree according to the selection final ranking, covering all available places for each session of the call.

2. In case of waiver, the next eligible candidate in the ranking list will be admitted.
3. Non-EU admitted candidates will be requested to send their written consent to [concorsinumerochiuso@unipi.it](mailto:concorsinumerochiuso@unipi.it) and to fill in the pre-enrollment form for the Master's Degree in Materials and Nanotechnology (Italian Degree class LM-53)" of the University of Pisa on the website University. Pre-enrolment terms and conditions are reported on the website: <http://www.studiare-in-italia.it/studentistranieri/>.
4. Candidates that have not graduated yet, as referred on art. 2, paragraphs 2 and 3, are admitted under condition. Their matriculation is conditional upon the awarding of the Bachelor's Degree and the submission of the corresponding documentation no later than the given deadlines.

## Art. 8

### Enrolment

Successful candidates are required to enrol at the University of Pisa according to the terms and conditions that will be communicated after the publication of final ranking list on the above-mentioned website. Successful candidates holding a non-Italian degree for enrolment must refer to the Ammissionelm portal and the wis office ([wis@unipi.it](mailto:wis@unipi.it)). The documentation necessary for the purposes of enrollment to be uploaded on the portal is the following: the original academic title, the official translation of the degree in Italian, the relevant consular legalization of the foreign title, along with the "Declaration of Value", issued by the Italian diplomatic representative in the awarding university home country **OR** the Certificate of Comparability issued by the [ENIC-NARIC](#) centers (in Italian) **OR** Diploma Supplement, the University transcript of Records with a list of all the exams completed abroad and its official translation into Italian language. More info at <https://www.unipi.it/index.php/enrolment/itemlist/category/1326-qualifications-obtained-abroad>

## Art. 9

### Tuition fees and grants

1. Tuition fees depend on the student's family income and home country according to the University of Pisa regulations (please see the webpage: [www.unipi.it/tuition-fees](http://www.unipi.it/tuition-fees)).
2. Students may apply for the grants provided by "Azienda della Regione Toscana per il Diritto allo Studio Universitario" (DSU- Student's Support Office). The annual call for grants will be published in July at <http://www.dsu.toscana.it>.
3. To foster the participation of foreign applicants, the University of Pisa offers 18 grants to the best eighteen international students who will enrol in Degree programmes provided in English language for the academic year 2021/2022, including the 14 second-cycle degree programmes. Grants will be allocated according to the following criteria: evaluation of Curriculum, interview, Cumulative Grade Point Average and country of origin, by giving priority to the less economically developed countries.



4. The /grant foresees:

- First academic year: € 6,000 (net) and exemption from paying tuition fees
- Second academic year: € 8,000 (net) and a 50% discount of tuition fees, if the student obtained at least 36 CFU with a grade point average of at least 25/30.

For further information please see the webpage: <https://www.unipi.it/contribution>.

For other subsidies on the basis of international agreements of the University of Pisa please see the webpage: <https://www.unipi.it/index.php/internazionalizzazione>.

**Person in charge of the procedure:**

Dott.ssa Cristiana Bertini, Unità procedure selettive e carriere studenti - Direzione Servizi per la didattica e gli studenti - Largo Bruno Pontecorvo n. 3 - 56127 Pisa - tel. +39 0502213406, Fax +39 0502213408, E-mail: [cristiana.bertini@unipi.it](mailto:cristiana.bertini@unipi.it).

**Treatment of Personal Data:**

The personal data supplied by the applicants will be mainly processed automatically by the University of Pisa and in accordance with Legislative Decree no. 196/2003 ("Code Concerning the Protection of Personal Data") , Art. 11 for the management of selection procedures. The data may also be used in anonymous form for statistical purposes. Personal data supply is essential for the admission to the selection. At any time, anyone interested can, , exercise the rights provided by the above-mentioned Legislative Decree, Art. 7 , writing to the University of Pisa, Unità Procedure selettive e carriere studenti – Direzione Servizi per la didattica e gli studenti - Largo Bruno Pontecorvo n. 3 - 56127 Pisa (Italy).

**Transparent administration:**

The University of Pisa operates in compliance with Law no. 190/2012 concerning the prevention of corruption by implementing measures identified in the Three-year anti-corruption plan published in the section "Transparent Administration" on the website:

<https://www.unipi.it/index.php/amministrazione/item/9109-piano-triennale-per-la-prevenzione-della-corruzione-e-della-trasparenza>

**REGULATORY REFERENCES:**

Equivalence and recognition of foreign titles: art. 2, L. 148/2002; art. 6 Decree 270/2004 Self-declarations: DPR no. 445/2000 and subsequent modifications and supplements.

**ANNEX 1 TO THE CALL FOR APPLICATION FOR THE ADMISSION TO THE MASTER'S DEGREE PROGRAMME IN MATERIALS AND NANOTECHNOLOGY, ACADEMIC YEAR 2021-22**

**Candidate's Profile: requested skills and background**

The courses of the Master's Degree programme in Materials and Nanotechnology assume the existence of a solid background knowledge at the technological and methodological level, that typically features the Bachelor's programmes in Engineering, Chemistry, Physics or equivalent ones. It is expected that students of the Master of Science in Materials and Nanotechnology have a good analysis and synthesis abilities, as well as problem solving skills. During the interview, questions to applicants could concern their thesis activity, as well as their whole educational process. Moreover, questions could be made in the form of problems (even unstructured ones), in order to test the candidate's reasoning ability.

In general, the basic concepts and principles of materials and nanotechnology are necessary, in particular as regards:

- Mathematics: analytic geometry (equations of lines, circles, parabolas, ellipses and hyperbolas in the plane), differential and integral calculus in one and two variables (limits, derivatives, maxima and minima, definite integrals), series, linear algebra (matrices, vectors, determinants and solving linear systems).
- Physics: kinematics of the material point, the principles of dynamics, work, energy, gravitation, elastic forces, electrical charge, field concept and potential, laws of flow and circulation of field, "resistive-capacitive-inductive" circuits;
- Chemistry: atomic structure, bonds, organic and inorganic chemical compounds, errors and uncertainty in experimental data, stoichiometry, chemical reactions, thermodynamics outline, states of matter, solutions, chemical equilibrium, the dissociation of water and pH, solubility product, chem