

**MASTER'S DEGREE PROGRAM IN BIONICS ENGINEERING
(LAUREA MAGISTRALE IN BIONICS ENGINEERING, LM-21)**

CALL FOR APPLICATIONS – ACADEMIC YEAR. 2023 - 2024

Art. 1

**Admission to the Master's Degree Program in Bionics Engineering
(Laurea Magistrale in Bionics Engineering, LM-21)**

1. Scuola Superiore Sant'Anna (hereafter "the School"), along with the University of Pisa, announces for the Academic Year 2023-2024 a public competition for admission to the Master's Degree Programme in Bionics Engineering (Laurea Magistrale in Bionics Engineering, LM-21), offered jointly by the Department of Information Engineering of the University of Pisa and the BioRobotics Institute of the School. Detailed information on the Master's Degree Programme is available at www.bionicsengineering.com.
2. The competition aims to select at most 30 candidates, as follows:
 - a. Up to 15 positions for non-EU applicants exclusively (citizens of countries not belonging to the European Union) and not residing in Italy (hereafter "*non-EU Applicants*")¹;
 - b. Up to 15 positions for EU applicants and non-EU applicants residing in Italy exclusively (hereafter "*EU Applicants*").
3. If fewer than 15 non-EU selected applicants join the Master's Degree Programme, the number of positions available for the EU Applicants will be increased by the equivalent number of positions for non-EU applicants that remain vacant. At the end of the selection procedures, the Selection Committee will provide a final ranking list of eligible applicants. Admitted applicants, according to the positions available, will be appointed with a School's Rector Decree.
4. The Master's Degree in Bionics Engineering is eligible among the Master programs that can be selected by Honour students ("Allievi Ordinari") of the School, at the Second Level of study. The Scuola Superiore Sant'Anna may award, based on criteria that will be disclosed in a future dedicated Call of the School, Honour students positions dedicated to students admitted to the Master's Degree in Bionics Engineering. Honours courses are university training courses for deserving and capable students. They implement and complete the courses offered by the University of Pisa with excellent training and early introduction to research, offering free accommodation and food in the colleges, in addition to financial contributions for studying, abroad experiences, internships in companies and public institutions, the use of modern

¹ 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.

scientific laboratories, a library, sports facilities and spaces for cultural and recreational activities. Updated information will be available on : <https://www.santannapisa.it/en/master-degree-bionics/call-for-admission-2023-2024>.

Art. 2 Admission Requirements

1. By the deadlines as per art. 3 and 4 applicants must fulfill one of the following conditions:
 - a. they hold a Bachelor of Science (First Cycle Degree) or a Master of Science (Second Cycle Degree) in Bioengineering or Biomedical Engineering;
 - b. they hold a Bachelor of Science (First Cycle Degree) or a Master of Science (Second Cycle Degree), released by any Italian university, in other disciplines and their *curriculum studiorum* includes the following ECTS:
 - At least 42 ECTS in one or more of the following scientific fields: MAT/02, MAT/03, MAT/05, MAT/06, MAT/07, MAT/08, MAT/09, FIS/01, FIS/02, FIS/03, FIS/07, CHIM/03, CHIM/07²;
 - At least 12 ECTS in one or more of the following scientific fields: ING-INF/06, ING-IND/34³;
 - At least 12 ECTS in one or more of the following scientific fields: ING-INF/01, ING-INF/05, ING-INF/04, ING-IND/13, ING-IND/14, ING-IND/15⁴;
 - At least 24 ECTS in the scientific fields featuring the Degree Classes L-8 (Information engineering) and L-9 (Industrial engineering).
 - c. they hold a Bachelor of Science or equivalent First Cycle Degree awarded by a foreign University after the completion of at least three-year course of study, in one of the subjects listed in the previous points or equivalent ones. The Examination Board will decide upon degree equivalence only for this selection purposes, and will deliberate on the debts to be assigned to the admitted students. In any case, the admission of candidates holding a degree

² MAT/02 = Algebra; MAT/03 = Geometry; MAT/05 = Mathematical analysis; MAT/06 = Probability and statistics; MAT/07 = Mathematical physics; MAT/08 = Numerical analysis; MAT/09 = Operational research; FIS/01 = Experimental Physics; FIS/02 = Theoretical physics, mathematical models and methods; FIS/03 = Physics of matter; FIS/07 = Applied physics; CHIM/03 = General and inorganic chemistry; CHIM/07 = Chemical foundations of technologies

³ ING-INF/06 = Electronic and computer science bioengineering; ING-IND/34 = Industrial bioengineering

⁴ ING-IND/3 = Flight mechanics; ING-INF/01 = Electronics; ING-INF/05 = Information processing systems; ING-INF/04 = Systems and control engineering; ING-IND/13 = Applied mechanics; ING-IND/14 = Mechanical design and machine construction; ING-IND/15 = Design methods for industrial engineering

issued in a non-EU country will be conditional to the check and the legitimacy recognition of the degree, by the relevant Italian diplomatic authorities.

2. For non-EU Applicants, admission is also extended to applicants that have not graduated yet. In this case, a successful application will be conditional upon the subsequent gaining of a degree and the submission of adequate documentation no later than July 28, 2023.
3. For EU Applicants, admission is also extended to applicants that have not graduated yet. In this case, a successful application will be conditional upon the subsequent awarding of a degree and the submission of adequate documentation no later than December 15, 2023.
4. In addition to the academic degree, applicants must also demonstrate 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). The Examination Board will verify the candidates' level of knowledge of the English language during the interviews.

Art. 3

Applications by non-EU Candidates

1. Applications are to be submitted online at: <https://www.santannapisa.it/en/master-degree-bionics/call-for-admission-2023-2024> by **March 3, 2023 at 11 am (CEST)**. In case of any problem with the online application, please contact the Honours Students and Master's Degrees Office (+39.050883372, +39.050883203, e-mail: lm.call@santannapisa.it).
2. The submission procedure consists of the following phases:
 - a) web registration to online services ESSE3, filling in the requested data;
 - b) acquisition (by receiving an e-mail) of username (login) and access code (password) that will allow you to enter the system again to complete the application, as well as to changes to personal data;
 - c) access to online Services ESSE3 with the credentials received. Save login and change password on the first login;
 - d) access the Reserved Area at the link <https://sssup.esse3.cineca.it/Home.do> from the drop-down menu at the top right. Continue in the section "Student services" and then "Applications". Enter the procedure "Select type of Course" and select the competition for which you want to apply to proceed with the online application as indicated in the different screens;
 - e) At the end of the procedure, the candidate must receive a second e-mail, confirming the registration for the selection procedure, bearing the identification code that will be associated with the candidate throughout the selection. If this e-mail is not received, it means that the application has not been successful.
3. In the application form, candidates must provide (through a self-declaration):
 - a) family name, first name, place and date of birth, nationality, gender, marital status;
 - b) a declaration that the candidate has never been convicted for a criminal offence;
 - c) a declaration that the candidate holds an academic degree, as per Article 2. Applicants must specify the degree title, the University or educational institute that awarded the



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degree, the degree course duration, the mark achieved (if applicable), the academic year in which the candidate started his/her undergraduate studies and the graduation date. Candidates who have not graduated yet shall declare the expected graduation date (that cannot be beyond July 28, 2023);

- d) the Cumulative Grade Point Average of the Bachelor Degree;
 - e) a declaration of knowledge of English language (and other foreign languages, if any) specifying the duration of language studies and the certification(s) obtained;
 - f) the permanent address, phone number and mailing address (if different), where applicants wish to receive paper communications concerning their application. Applicants shall immediately contact the School if these addresses will change as for the e-mail address, that is compulsory for the application purposes.
4. Non-EU applicants shall also specify in which Italian Embassy or Consulate they intend to submit their pre-enrolment application in case of admission to the Course.
5. Applicants shall include in the application the following documents (all in pdf format and named as follows):
- a) **Surname_Name_CV.pdf**: a copy of their complete *Curriculum Vitae et Studiorum* (in English) describing their education pathway, their cultural and professional experiences, prizes, publications, achievements and all other information that might help in the evaluation of the candidate;
 - b) **Surname_Name_Certificate.pdf**: a copy of the Degree Certificate (if applicable) and its translation if written in language other than English or Italian;
 - c) **Surname_Name_Transcripts.pdf**: the academic transcripts with the full list of courses and grades (in English or Italian) of the Bachelor Degree. This list shall contain information regarding credits, units (or equivalent) received, the grades received for each class taken, and the date in which the final examination was taken (if applicable). A certified copy of the mentioned information should be provided by the University and attached by the applicant;
 - d) **Surname_Name_Thesis**: a short summary (5 pages max) of the Bachelor Thesis, or a short summary (5 pages max) of the ongoing Thesis activity, if this has been not completed, yet. In case the Bachelor does not include a real Thesis, in this document the candidate must report a summary of projects or other relevant didactic activities carried out and useful to complete his/her Bachelor pathway. This document must be produced in English. It will be evaluated in terms of both content and care in the preparation of a professional document;
 - e) **Surname_Name_Passport.pdf**: a copy of a valid passport or any other international ID;
 - f) **Surname_Name_English.pdf** (not mandatory): if available, a copy of an English Language knowledge certification (at least intermediate B2 level);
 - g) **Surname_Name_Other.pdf** (not mandatory): a copy of any other document or information that the applicant deems suitable/useful for his/her evaluation (documents written in languages other than Italian and English must be accompanied by a summary in one of the above languages).

According to art. 46 and 47 of D.P.R. n. 445/2000, Italian citizens and EU citizens are allowed to submit self-declarations. Non-EU citizens legally residing in Italy are allowed as well, only with reference to information and facts that can be certified or attested by Italian public bodies.

6. **Applications with missing information will not be considered valid.** Integrations to the application after the call deadline will not be accepted in whatsoever circumstance.
7. The School and the University of Pisa are entitled to check the truthfulness of the declarations and the documentation submitted by the candidates and may require the submission of original documents. In case of false statements, the School can decide at any time, by justified Rector Decree, the exclusion of the candidate from the selection procedure without prejudice to the resulting criminal law liability.

Art. 4 **Applications by EU Candidates**

1. Applicants are requested to apply online at: <https://www.santannapisa.it/en/master-degree-bionics/call-for-admission-2023-2024> by **July 28, 2023 at 11 am (CEST)**. In case of any problem with the online application, please contact the Honours Students and Master Degrees Office (+39.050883372; 39.050883203, e-mail: lm.call@santannapisa.it).
2. The submission procedure consists of the following phases:
 - a) web registration to online services ESSE3, filling in the requested data;
 - b) acquisition (by receiving an e-mail) of username (login) and access code (password) that will allow you to enter the system again to complete the application, as well as to changes to personal data;
 - c) access to online Services ESSE3 with the credentials received. Save login and change password on the first login;
 - d) access the Reserved Area at the link <https://sssup.esse3.cineca.it/Home.do>; from the drop-down menu at the top right. Continue in the section "Student services" and then "Applications". Enter the procedure "Select type of Course" and select the competition for which you want to apply to proceed with the online application as indicated in the different screens;
 - e) at the end of the procedure, the candidate must receive a second e-mail, confirming the registration for the selection procedure, bearing the identification code that will be associated with the candidate throughout the selection. If this e-mail is not received, it means that the application has not been successful.
3. In the application form, the candidates must provide (through a self-declaration):
 - a) family name, first name, place and date of birth, nationality, gender, marital status;
 - b) a declaration that the candidate has never been convicted for a criminal offence;
 - c) a declaration that the candidate holds an academic degree, as per Article 2. Applicants must specify the degree title, the University or educational institute that awarded the degree, the degree course duration, the mark achieved (if applicable), the academic year

in which the candidate started his/her undergraduate studies and the graduation date. Candidates who have not graduated yet shall declare the expected graduation date (that cannot be beyond December 15, 2023);

- d) the Cumulative Grade Point Average of the Bachelor's Degree;
 - e) a declaration of knowledge of English language (and other foreign languages, if any) specifying the duration of language studies and the certification(s) obtained;
 - f) the permanent address, phone number and mailing address (if different), where applicants wish to receive paper communications concerning their application. Applicants shall immediately contact the School if these addresses will change as for the e-mail address, that is compulsory for the application purposes.
4. Applicants shall include in the application the following documents (all in pdf format and named as follows):
- a) **Surname_Name_CV.pdf**: a copy of their complete *Curriculum Vitae et Studiorum* (in English) describing their education pathway, their cultural and professional experiences, prizes, publications, achievements and all other information that might help in the evaluation of the candidate;
 - b) **Surname_Name_Certificate.pdf**: a copy of the Degree Certificate (if applicable) and its translation if written in language other than English or Italian;
 - c) **Surname_Name_Transcripts.pdf**: the academic transcripts with the full list of courses and grades (in English or Italian) of the Bachelor's Degree. This list shall contain information regarding credits, units (or equivalent) received, the grades received for each class taken, and the date in which the final examination was taken (if applicable). A certified copy of the mentioned information should be provided by the University and attached by the applicant;
 - d) **Surname_Name_Thesis**: a short summary (5 pages max) of the Bachelor Thesis, or a short summary (5 pages max) of the ongoing Thesis activity, if this has been not completed, yet. In case the Bachelor does not include a real Thesis, in this document the candidate must report a summary of projects or other relevant didactic activities carried out and useful to complete his/her Bachelor pathway. This document must be produced in English. It will be evaluated in terms of both content and care in the preparation of a professional document;
 - e) **Surname_Name_Passport.pdf**: a copy of a valid passport or any other international ID;
 - f) **Surname_Name_English.pdf** (not mandatory): if available, a copy of an English Language knowledge certification (at least intermediate B2 level);
 - g) **Surname_Name_Other.pdf** (not mandatory): a copy of any other document or information that the applicant deems suitable/useful for his/her evaluation (documents written in languages other than Italian and English must be accompanied by a summary in one of the above languages).
5. According to art. 46 and 47 of D.P.R. n. 445/2000, Italian citizens and EU citizens are allowed to submit self-declarations. Non-EU citizens legally residing in Italy are allowed as well, only with reference to information and facts which can be certified or attested by Italian public bodies.

6. **Applications with missing information will not be considered valid.** Integrations to the application after the call deadline will not be accepted in whatsoever circumstance.
7. The School and the University of Pisa are entitled to check the truthfulness of the declarations and the documentation submitted by the candidates and may require the submission of original documents. In case of false statements, the School can decide at any time, by justified Rector Decree, the exclusion of the candidate from the selection procedure without prejudice to the resulting criminal law liability.

Art. 5 **Selection of Applicants**

1. Applicant selection will involve, in both sessions, the evaluation of all submitted documents and an interview. The selection process aims to evaluate each applicant's background and abilities, assessing the potential and the attitude that are required when attending an interdisciplinary and innovative educational programme, such as the M.Sc. in Bionics Engineering.
2. The Selection Committee is jointly nominated by the Director of the Department of Information Engineering of the University of Pisa and the Director of the BioRobotics Institute, and appointed with a School's Rector decree.
3. The final assessment will be on a 100 point scale, of which:
 - a. up to 70 points for the evaluation of the candidate's CV and other titles;
 - b. up to 30 points for the interview evaluation.
4. The evaluation of titles will be focused on the *curriculum vitae et studiorum* of the candidates and on the other documents submitted by the candidate. The evaluation will take into account the credits actually earned by the student at the application time and the intensity of the candidate's university activity. Admission to the interview is granted with a score of at least 49/70 points.
5. For non-EU applicants, the interviews will be held via videoconference (using Zoom, Microsoft Teams or similar tools at the Examination Board's discretion) at Italian Embassies, Consulates or other locations identified by the Selection Committee in order to ensure the fulfillment of the applicants' identification procedures. If the interview is not attended at Embassies or Consulates, the candidate must exhibit to the Committee members, before starting the interview, the ID submitted in the online application.
6. For EU applicants, the interviews will be held in Pisa at the School premises. Candidates may ask the Selection Committee to hold the interview through videoconference (using Zoom, Microsoft Teams, or similar tools at the Selection Committee's discretion), in case of proper and justified reasons. In this case, the candidate must exhibit to the Committee members, before starting the interview, the ID submitted in the online application.
7. A candidate not attending the interview within the scheduled slot assigned will be excluded from the final ranking list.

If the interview is held through 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 Examination Board will examine the candidates' profiles on the basis of the submitted titles and will verify the existence of solid background knowledge as per Annex 1, as well as the candidate's English knowledge level.

Applicants shall obtain at least 21/30 points 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 eligible for admission to the Master's Degree Programme.

Art. 6 **Selection schedule and results**

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

a) Non-EU Candidates

Deadline for applications	March 3, 2023 (at 11.00, CEST)
Assessment of submitted documentation and candidates' admission to the interviews	within March 10, 2023
Interviews	March 15, 16 and 17, 2023
Publication of the final list of candidates admitted to the Master Degree	within March 25, 2023

b) EU Candidates

Deadline for applications	July 28, 2023 (at 11.00, CEST)
Assessment of submitted documentation and candidates' admission to the interviews	within August 4, 2022
Interviews	August 30 and 31, September 1, 2023
Publication of the final list of candidates admitted to the Master Degree	within September 8, 2023

2. The results will be published on <https://www.santannapisa.it/en/master-degree-bionics/call-for-admission-2023-2024>, with the list of the applicants admitted to the interviews and all information regarding the place, time and date of the interviews. The final list of admitted candidates will be published on the same website.

Art. 7 **Ranking Lists and Admitted Applicants**

1. With a School's Rector Decree a final merit ranking is approved following the submission of the official acts by the Examination Board.

2. Winners are nominated with a Rector's Decree according to the ranking in order to assign all of the places available for each selection.
3. If a candidate renounces the position offered, the next eligible candidate in the ranking list will be selected.
4. Non-EU admitted candidates will be requested to send their written consent to the Honours Students and Master Degrees Office and they must contact the relevant Italian Embassy or Consulate in order to pre-enroll in the "Laurea Magistrale in Bionics Engineering (LM-21)" programme offered by the University of Pisa. Pre-enrolment terms and conditions are reported on the website: <http://www.studiare-in-italia.it/studentistranieri/>.
5. Applicants that have not graduated yet, as referred on art. 2, points 2 and 3, are admitted under condition. Their matriculation is in fact conditional upon the gaining of the Bachelor's degree and the submission of the corresponding documentation no later than the given deadlines.

Art. 8 **Matriculation**

1. Admitted applicants shall matriculate at the University of Pisa according to the terms and conditions, which will be communicated after the publication of the ranking list. Admitted applicants holding a non-Italian degree shall enclose, with the matriculation application, their original academic title, the official translation of the degree in Italian, the relevant consular legalization of the foreign title, along with the "*Dichiarazione di Valore*" (Declaration of Value) issued by the Italian diplomatic representative in the country to which the educational system of the university issuing the diploma belongs.
As an alternative, if the degree was issued along with a "Diploma Supplement", it will be possible to submit this document, legalized by the relevant authorities, instead of the "*Dichiarazione di Valore*".

Art. 9 **Tuition fees and Contributions**

1. Tuition fees depend on the student's family income and country, according to the rules of the University of Pisa (please see the webpage: www.unipi.it/tuition-fees).
2. Students may apply for the contributions provided by the "*Azienda della Regione Toscana per il Diritto allo Studio Universitario*" (DSU - Student's Support Office). The annual call for contributions is published in July at <https://open.toscana.it/web/ardsu/-/foreign-students>.
3. The University of Pisa, founded in 1343, is amongst the top institutions in the majority of international rankings. According to the latest Academic Ranking of World Universities (ARWU) 2021 the University of Pisa is ranked between 151st and 200th in the world and is the 4th in Italy. According to the QS World University Ranking 2021, the University of Pisa ranks 383th worldwide and it is the 7th in Italy. The University of Pisa offers scholarships to the top international students, who will enroll for the academic year 2023/2024 in the degree programs

taught in English. Scholarships will be awarded evaluating the following factors: CV, Interview, CGPA (Cumulative Grade Point Average) and country of origin of the applicant, giving priority to the less economically advantaged countries. Each scholarship will consist of:

- a) First year: 6 thousand euros net and exemption from University fees
- b) Second year: 8 thousand euros net and a reduction of 50% of the University fees if the student has obtained at least 36 ECTS with an average grade of at least 25/30.

More info at <https://www.unipi.it/contribution>.

4. This Master's Degree is part of the "Invest your Talent in Italy" scholarship programme, which is aimed at supporting students coming from the following countries: Armenia, Azerbaijan, Brazil, Colombia, Egypt, Ethiopia, India, Indonesia, Iran, Ghana, Kazakhstan, Mexico, People's Republic of China, South Korea, Tunisia, Turkey, Vietnam. Scholarships are awarded to students accepted by the Master's Degree programme and are funded by the Ministry of Foreign Affairs and International Cooperation (MAECI). More info at www.unipi.it/iyt-maeci.
5. For other subsidies on the basis of international agreements of the University of Pisa, please log onto <https://www.unipi.it/index.php/internazionalizzazione>.

Person in charge of the Procedure:

Francesca Gattai, Responsible of the U.O. Honours Students and Master's Degrees e-mail: francesca.gattai@santannapisa.it.

Treatment of Personal Data

The acquired personal data will be processed, stored and communicated in compliance with the relevant European and national legislation (Reg. 679/2016 and Legislative Decree 196/2003) for an indefinite period as provided for in the School's Conservation Summary and in compliance with advertising principles. and transparency for the proper functioning of the Public Administration. Interested parties may at any time assert their rights towards the School, and, in



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particular, the right to access their personal data, to request its correction, updating and cancellation, if incomplete, erroneous or collected in violation of the law, as well as to oppose their treatment for reasons recognized by the law, as well as to request their cancellation, transformation into anonymous form or blocking of data processed in violation of the law, including those that do not need to be kept for the purposes for which the data was collected or subsequently processed, by making a request to the Sant'Anna School of Advanced Studies, U.O. Honours Students and Master's Degrees, Piazza Martiri della Libertà 33, Pisa, e-mail: lm.call@santannapisa.it. It is the right of the interested party to lodge a complaint with the supervisory authority for the processing of personal data. For further clarifications and information, you can contact the Data Protection Officer of the Scuola Superiore Sant'Anna at the following e-mail address: dpo@santannapisa.it. The provision of data is necessary for participation in the evaluation process.

Measures of Prevention of Corruption

The Scuola Superiore Sant'Anna 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 "Transparency in Administration" of the School website at: <http://santannapisa.it/it/ateneo/amministrazione-trasparente/amministrazione-trasparente>.

REGULATORY REFERENCES:

Equivalence and recognition of foreign degrees: art. 2, L. 148/2002; art. 6, DM 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 PROGRAM IN BIONICS ENGINEERING, ACADEMIC YEAR 2023-2024

Candidate's profile: requested capabilities and background

The courses of the Master's Degree Program in Bionics Engineering consider as a pre-requisite a solid background in terms of methodology and scientific/technological knowledge, which typically features the Bachelor programs in Biomedical Engineering or equivalent ones.

It is expected that the applicants possess 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 overall educational/technical pathway. Moreover, questions could be made in the form of problems (even unstructured ones), to test the candidate's reasoning ability.

In general, the basic concepts and principles of bioengineering are necessary, in particular concerning:

- Mathematics, physics and statistics;
- Basic knowledge of mechanics and fabrication technologies,
- Basic knowledge of electronics and signal processing;
- Basic knowledge of computer science;
- Basic knowledge of chemistry and materials science.