

NUCLEAR ENGINEERING AT FEDERAL UNIVERSITY OF RIO DE JANEIRO (UFRJ)



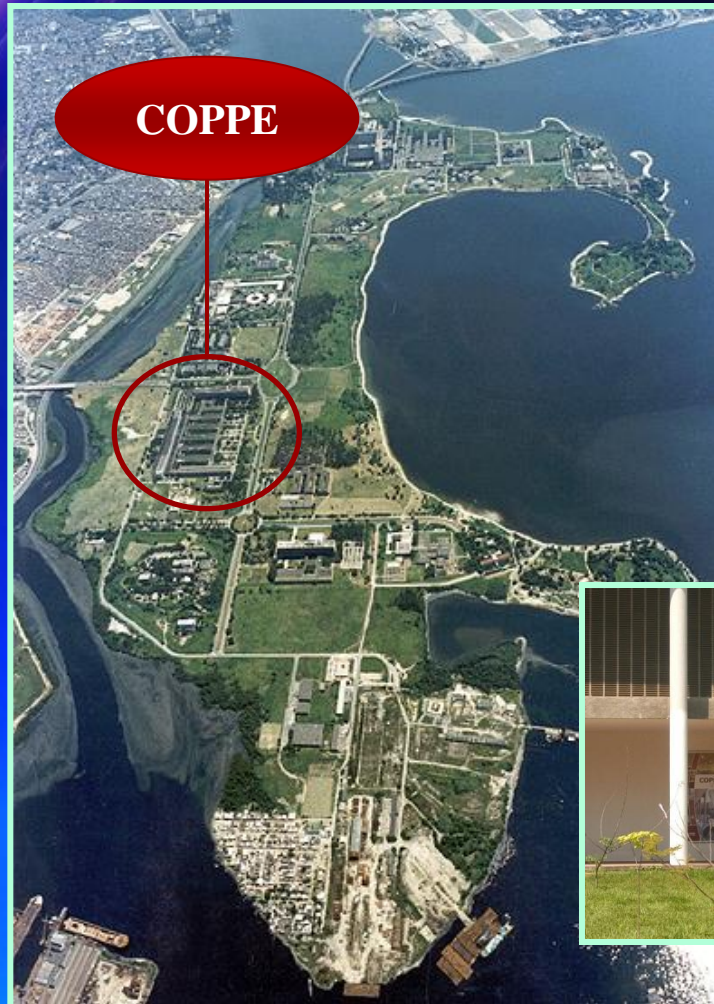
Prof. Alessandro C. Gonçalves

COPPE/UFRJ

December/2012

www.nuclear.ufrj.br

GRADUATE SCHOOL AND RESEARCH IN ENGINEERING (COPPE / UFRJ)



UFRJ

CENTER OF
TECHNOLOGY

COPPE

12 GRADUATE PROGRAMMES

- Biomedical Engineering
- Civil Engineering
- Electrical Engineering
- Energy Planning
- Mechanical Engineering
- Nuclear Engineering



**COPPE
Departments**

- Ocean Engineering
- Chemical Engineering
- Production Engineering
- Metallurgical and Materials Engineering
- Systems and Computer Engineering
- Transport Engineering

NUCLEAR ENGINEERING AT COPPE/UFRJ

37 Technical Staff



**Nuclear
Engineering
Program**

17 Faculty Staff

- DSc
- Full-time

127 Students

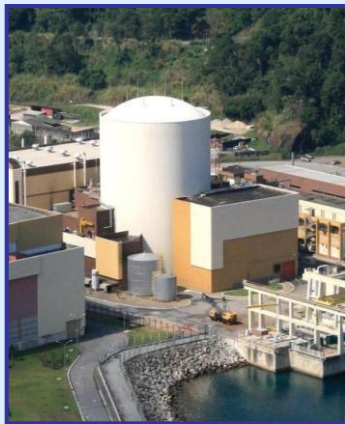
- 31 MSc
- 96 DSc

HISTORICAL DATA

Year	Institution	Nuclear Engineers	
		MSc	DSc
1968	▪ Universidade Federal do Rio de Janeiro (COPPE)	526	264

MAJOR AREAS OF NUCLEAR ENGINEERING AT COPPE

NUCLEAR TECHNOLOGY



Angra 1 NPP



Angra 2 NPP



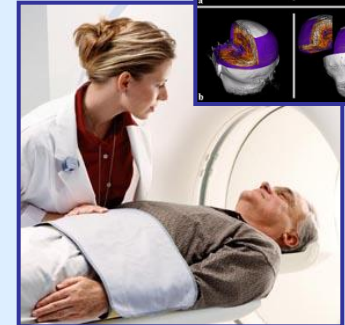
Reactor

RADIOSOTOPES APPLICATIONS



Technetium Generator

Nuclear Medicine



Food Irradiation

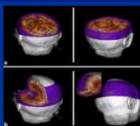
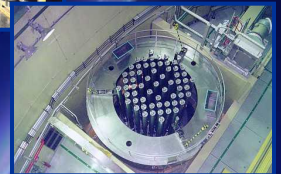
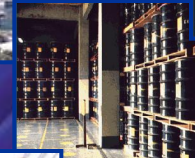


Experimental Data

MAJOR AREAS OF NUCLEAR ENGINEERING AT COPPE

NUCLEAR TECHNOLOGY

- ♦ Reactor Physics
- ♦ Reactor Engineering
- ♦ Nuclear Safety
- ♦ Human Factors Engineering



RADIOSOTOPES APPLICATION

- ♦ Applied Nuclear Physics



STRUCTURE OF THE COURSE

1st Period (March-May)

Reactor Physics I
Reactor Engineering I
Nuclear Physics
Mathematical Methods

2nd Period (June-August)

Numerical Methods
Safety Analysis
Radiological Protection
Major Area Elective Course (1)

3th Period (September-November)

Major Area Elective Course (2)

Each course has 45 hours

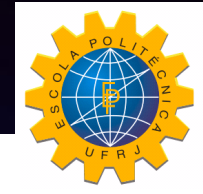
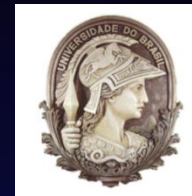
In the 3th period the student starts the research of thesis dissertation.

Maximum time to receive the Master degree: 24 months.

Fellowships: CAPES, CNPq, CNEN.

UNDERGRADUATE NUCLEAR ENGINEERING

37 Technical Staff



**Nuclear
Engineering
Program**

52 Faculty Staff

- DSc
- Full-time

68 Students

HISTORICAL DATA

Year	Institution	Nuclear Engineers BE
2010	▪ Universidade Federal do Rio de Janeiro (POLI/COPPE)	01

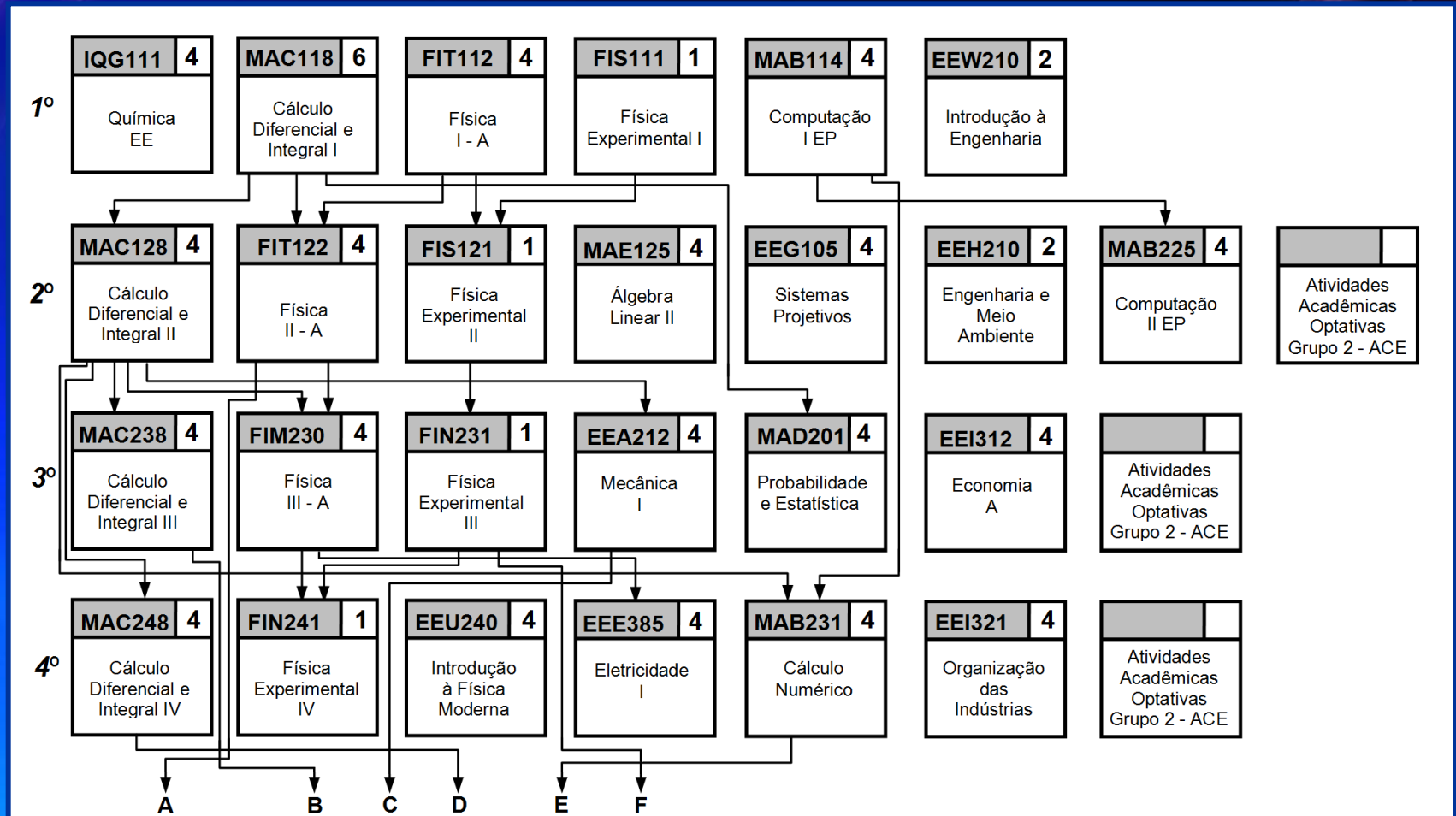
LABORATORIES

THE RESEARCH ACTIVITIES OF DEPARTMENT OF NUCLEAR ENGINEERING ARE DEVELOPED IN FIVE LABORATORIES:

- Laboratory of Process Monitoring
- Nuclear Instrumentation Laboratory Nuclear
- Laboratory of Simulation and Methods in Engineering
- Neutrongraphy in Real Time Laboratory
- Laboratory of Numerical Methods

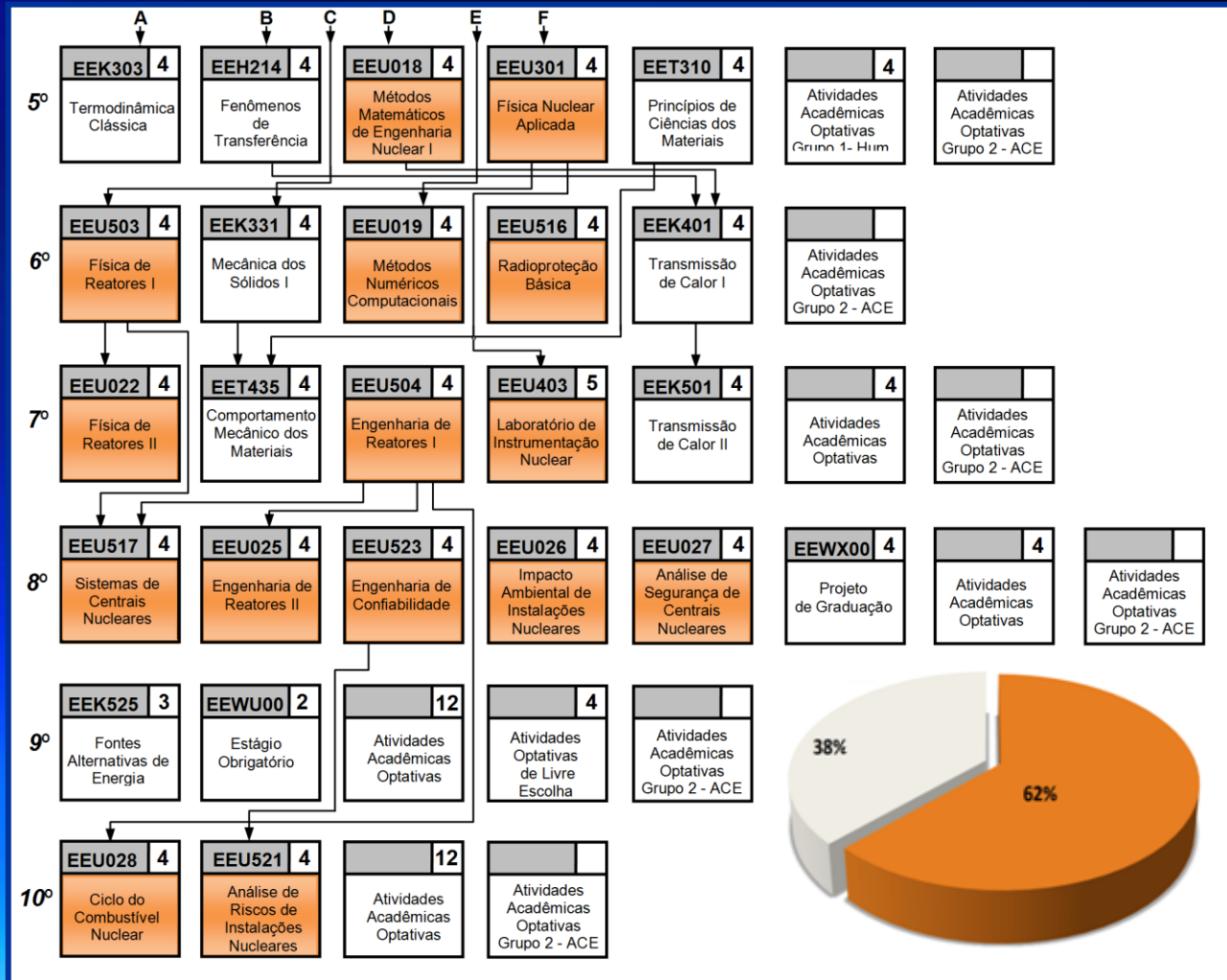
SYCLLABUS

BASIC PROGRAM



SYLLABUS

PROFESSIONAL PROGRAM



TRAINING PROGRAMS

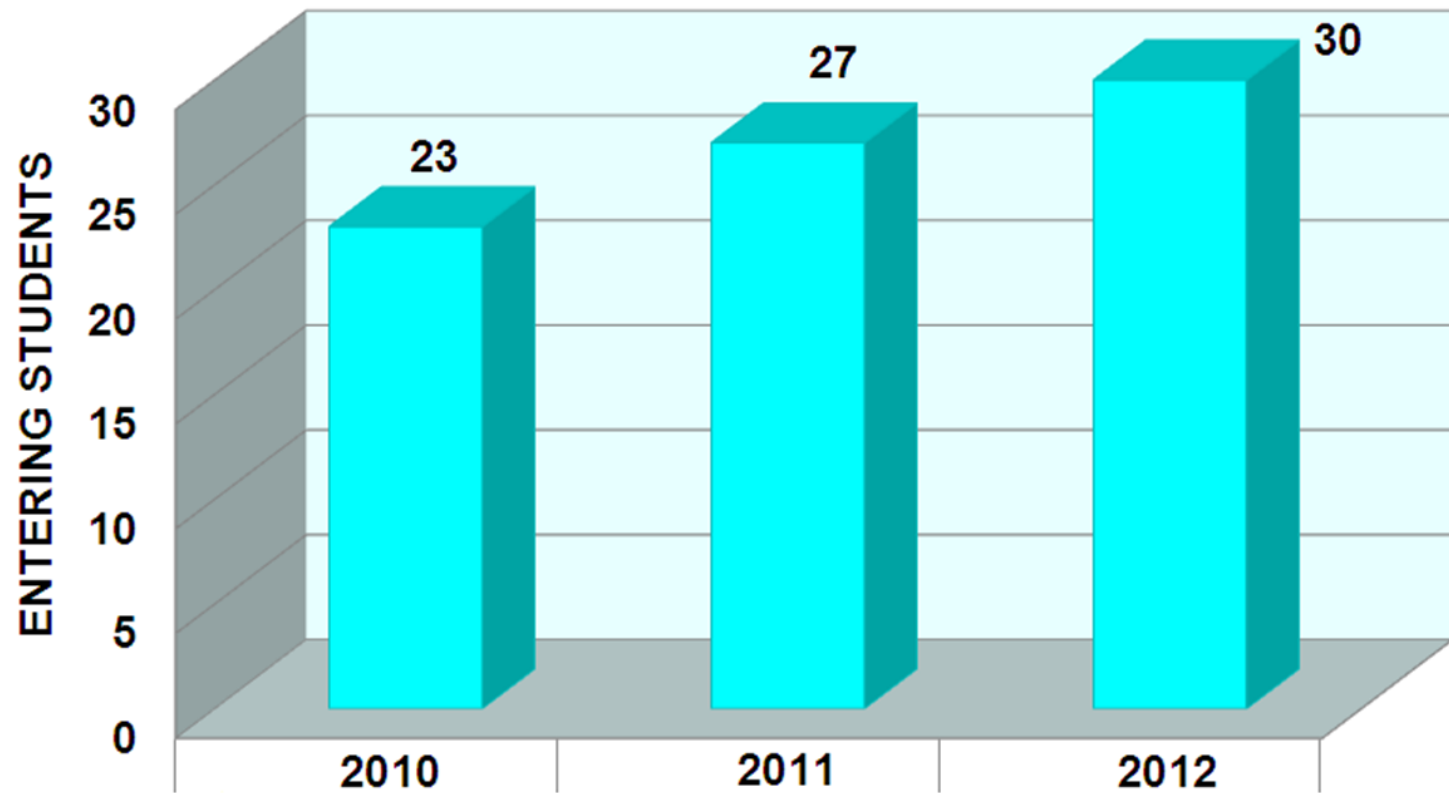
INSTITUTIONAL TRAINING PROGRAMS – 160 HOURS

PARTNERSHIPS

- **Eletrobras Eletronuclear**
- **Indústrias Nucleares do Brasil - INB**
- **Marinha do Brasil**
- **Comissão Nacional de Energia Nuclear - CNEN;**
- **Odebrechet**
- **Westinghouse**

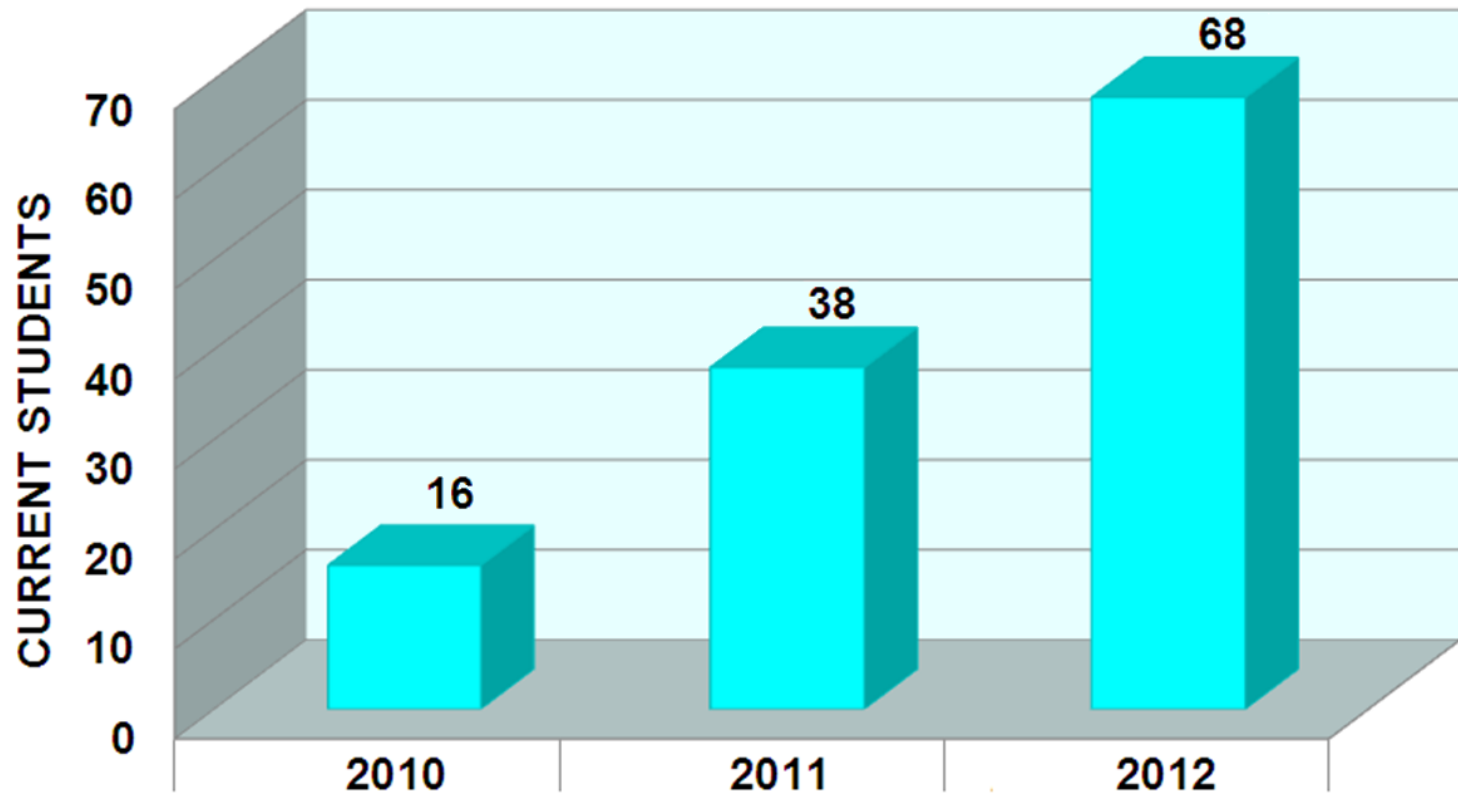
DEMAND FOR UNDERGRADUATE NUCLEAR ENGINEERING

ENTERING STUDENTS

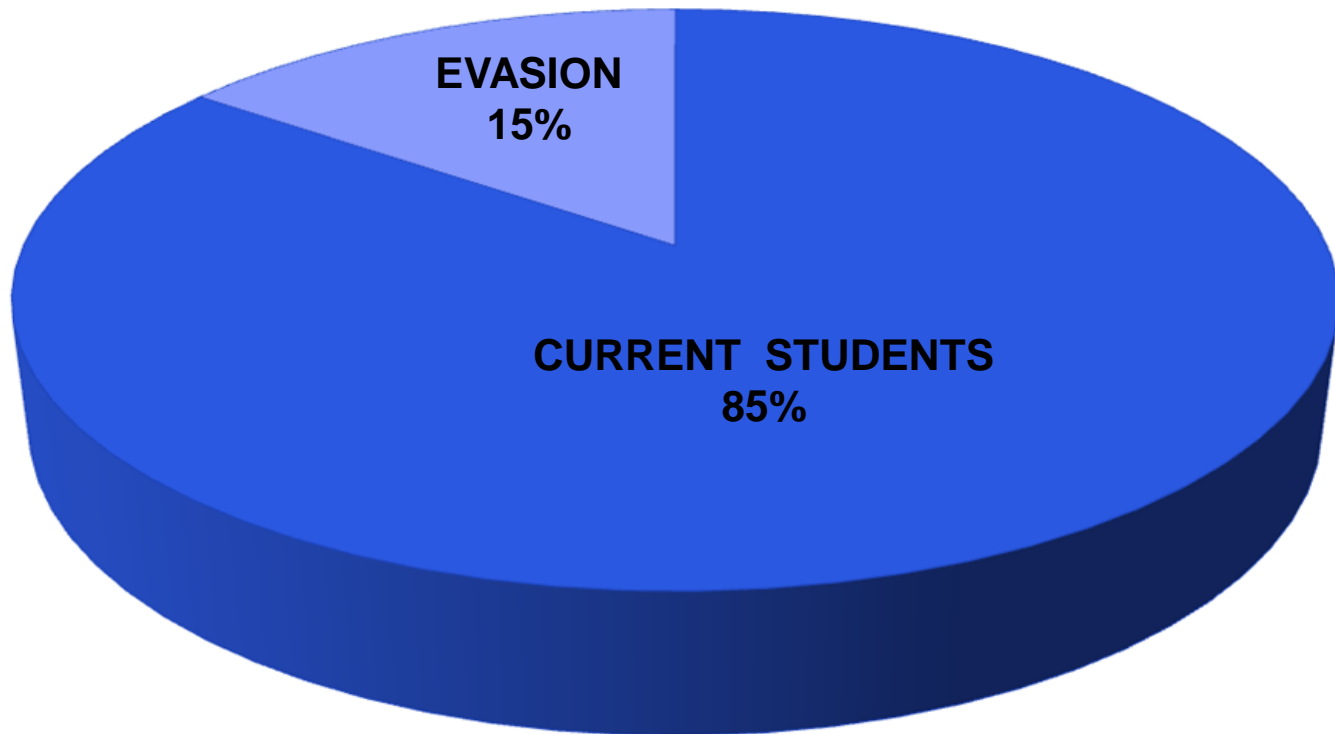


DEMAND FOR UNDERGRADUATE NUCLEAR ENGINEERING

CURRENT STUDENTS

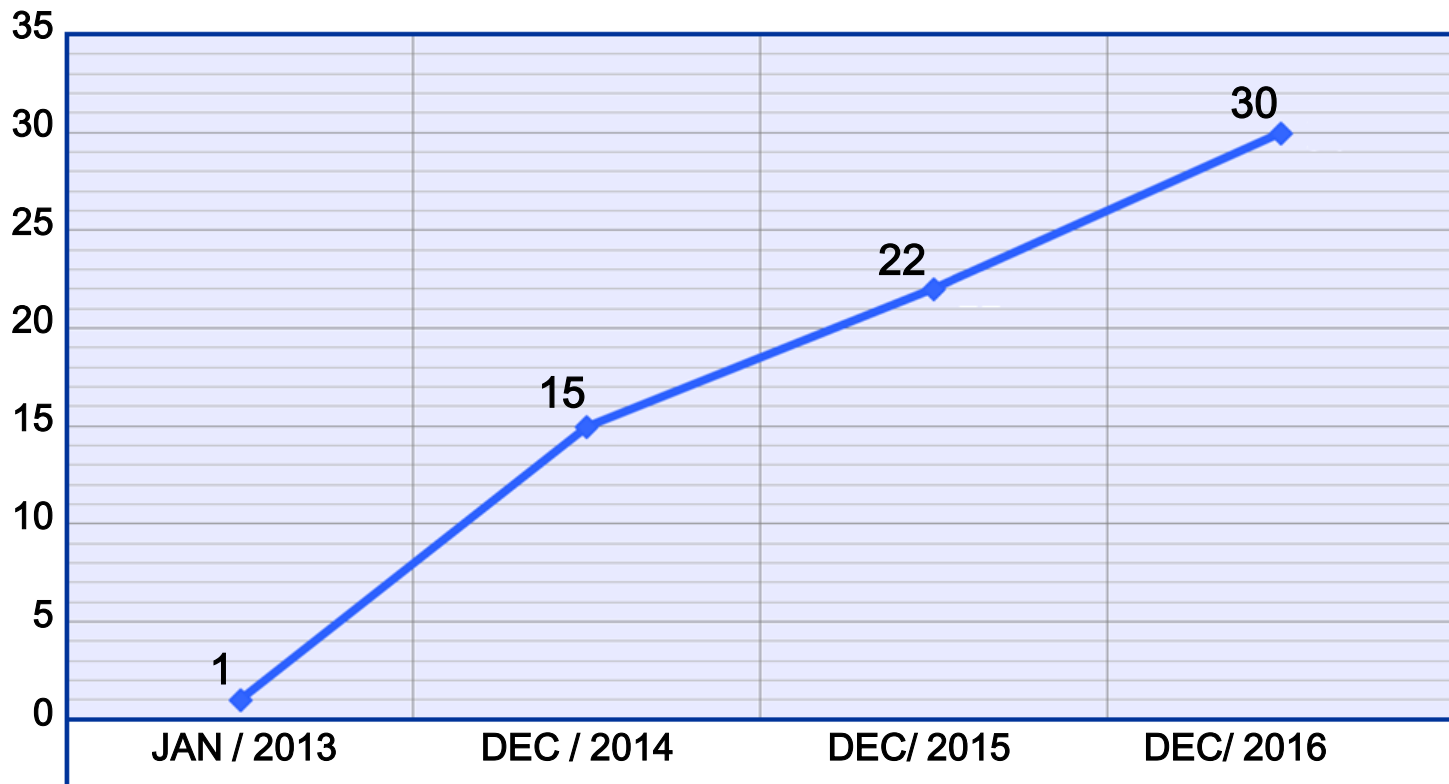


BALANCE OF STUDENTS UNTIL 2012



BALANCE OF STUDENTS UNTIL 2012

PROJECTION OF GRADUATES



BALANCE OF STUDENTS UNTIL 2012

SUMMARY

YEAR	VACANCIES	ENTERING STUDENTS	ATIVOS	EVASION	YEAR OF CONCLUSION	PROJECTION OF GRADUATES
2010	20	23	16	7	DEC / 2014	15
2011	30	27	38	5	DEC / 2015	22
2012	30	30	68	0	DEC / 2016	30

UTILIZATION OF CREDIT UNDERGRADUATE FOR GRADUATE

Reactor Physics I

Review of basic concepts of nuclear physics; Radioactivity; Neutron-nuclear interactions; Microscopic and Macroscopic cross sections; Kinematics of neutron scattering; Effects of nuclear motion on neutron cross section; Nuclear fission; Multiplication factor; The neutron transport equation; The diffusion approximation; The energy-dependent diffusion equation; The criticality condition; Numerical solution of the 1D diffusion equation.

Nuclear Reactor Engineering I

Description of nuclear reactors; Thermal design principles; Heat generation in nuclear reactors; Transport equations for single-phase system; Transport equations for two-phase systems; Thermodynamics of nuclear power conversion system; Thermal analysis of fuel elements; Single-phase fluid mechanics; Single-phase heat transfer; Two-phase fluid mechanics and heat transfer; Single heated channel: Steady state analysis.

UTILIZATION OF CREDIT UNDERGRADUATE FOR GRADUATE

Mathematical Methods for Nuclear Engineering

Real vector spaces; Linear transformations; Matrices; Euclidian spaces; Convergence; Fourier series; Uniform and point convergence; Differentiation and integration of Fourier series; Generalized Fourier series; Legendre, Hermite and Laguerre polynomials; Boundary value problems in ordinary and partial differential equations; Special functions.

Numerical Methods in Nuclear Engineering

Difference equations; Difference and summation operators; Formation of finite difference equations; Stability of difference solutions; Discretization and matrix representation; Numerical solution of differential equations; Numerical integration and solution of ordinary differential equations; Partial differential equations; Parabolic and elliptic operators; The method of Crank-Nicolson Statistical models.

UTILIZATION OF CREDIT UNDERGRADUATE FOR GRADUATE

Design and Safety Analysis of Nuclear Plants

Basic concepts of nuclear power plant design; Description of the primary and secondary circuits; Engineering systems; Barriers to the escape of radioactivity. Reactor protection system; Control mechanisms of a PWR power plant; Nuclear reactor safety; Designing for reactor safety. Probabilistic safety analysis; Risk analysis; Radioactive effluents from nuclear facilities; Waste management.

Radiological Protection

Natural and artificial sources of radiation; Interaction of radiation with matter; Radiation sources; Nuclear events statistic; Basic systems of detection; Nuclear electronic and instrumentation; Gas detector: Geiger-Muller, Proportional counter; ionization chamber; Solid state detector; Scintillators; Biological effects of ionizing radiation; International and national recommendations in radiological protection; Safety of nuclear facilities.

UTILIZATION OF CREDIT UNDERGRADUATE FOR GRADUATE

Nuclear Physics

Properties of the nucleus; Constitution and stability; Nuclear disintegrations; Isotope stable and long lived; Laws of the radioactive transformations; Mean and half-life; Natural radioactivity; Energy balance in the nuclear reactions - Q-value; Threshold energy; Nuclear reactions; Artificial radioactivity; Quantum theory of the alpha disintegration; Interaction of radiation with matter; Nuclear models; Nuclear fission; Particle accelerators.

MAIN COMPETENCIES OF UNDERGRADUATED IN NUCLEAR ENGINEERING

- 1. Solid background in natural sciences and detailed information in development nuclear technology and innovation.**
- 2. Ability to face new problems in order to continue the academic career toward the MSc. and DSc. degree.**
- 3. Domain of the nuclear reactor design, including knowledge on reactor physics, reactor engineering, radiological protection and safety analysis.**

MAIN COMPETENCIES OF GRADUATED IN NUCLEAR ENGINEERING

- 4. Ability to apply advances of science and technology in his professional activities.**
- 5. Ability to perform mathematical calculations, computer simulations and experiments.**
- 6. Ability to give public information in a very simple and precise way.**
- 7. Ethic in the professional activities.**

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THANK YOU FOR YOUR ATTENTION



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