

Nuclear Security Education

Nuclear Engineering Program

Nuclear Engineering Department

Universidade Federal do Rio de Janeiro

Nuclear Engineering Program

Alberto Luiz Coimbra Institute of Graduate
School and Research in Engineering – COPPE

Universidade Federal do Rio de Janeiro

Prof. Fernando Carvalho da Silva

Coordinator of Nuclear Engineering Program

Nuclear Engineering Department
Escola Politécnica
Universidade Federal do Rio de Janeiro - UFRJ

Jose Antonio Carlos Canedo Medeiros
Head of Nuclear Engineering Department
Vice-Coordinator of Nuclear Engineering Program
canedo@Imp.ufrj.br

Nuclear Engineering (Graduate) Program PEN/COPPE/UFRJ

- MISSIONS:
 - Graduate Education at MSc and DSc level to provide highly qualified human resources in nuclear engineering.
 - Develop basic and applied research in nuclear engineering.
- ACTIVITIES:
 - Teaching, Research, Technological development, and Extension (certificate programs)
- M.Sc. Program:
 - Beginning in 1968.
- D.Sc. Program:
 - Beginning in 1979.

Faculty

Ademir Xavier da Silva	D.Sc., 1999 (COPPE/UFRJ)	(PQ-1B)
Alessandro da Cruz Gonçalves	D.Sc., 2010 (COPPE/UFRJ)	
Antonio Carlos Marques Alvim	Ph.D., 1976 (MIT)	(PQ-1B)
Aquilino Senra Martinez*	D.Sc., 1983 (COPPE/UFRJ)	(PQ-1A)
Delson Braz	D.Sc., 1997 (COPPE/UFRJ)	(PQ-2)
Eduardo Gomes Dutra do Carmo	D.Sc., 1988 (COPPE/UFRJ)	(PQ-2)
Fernando Carvalho da Silva	D.Sc., 1989 (COPPE/UFRJ)	(PQ-1B)
Inayá Corrêa Barbosa Lima	D.Sc., 2006 (COPPE/UFRJ)	
José Antonio Carlos Canedo Medeiros	D.Sc., 2005 (COPPE/UFRJ)	
José de Jesús Rivero Oliva	D.Sc., 1996 (CEADEN, Cuba)	
Nilson Costa Roberty	D.Sc., 1985 (COPPE/UFRJ)	(PQ-1C)
Paulo Fernando F. Frutuoso e Melo	D.Sc., 1993 (COPPE/UFRJ)	(PQ-1C)
Ricardo Tadeu Lopes	D.Sc., 1988 (COPPE/UFRJ)	(PQ-1A)
Roberto Schirru	D.Sc., 1991 (COPPE/UFRJ)	(PQ-1B)
Su Jian	D.Sc., 1993 (COPPE/UFRJ)	(PQ-1B)

Adjunct Faculty

Edgar Francisco Oliveira de Jesus (UERJ) D.Sc., 1997 (COPPE/UFRJ) (PQ-1D)

* CEO of Industrias Nucleares do Brasil - INB

MSc. and DSc. Courses

M.Sc. Dissertations and D.Sc Theses
(1969 – 2015)

M.Sc. 573

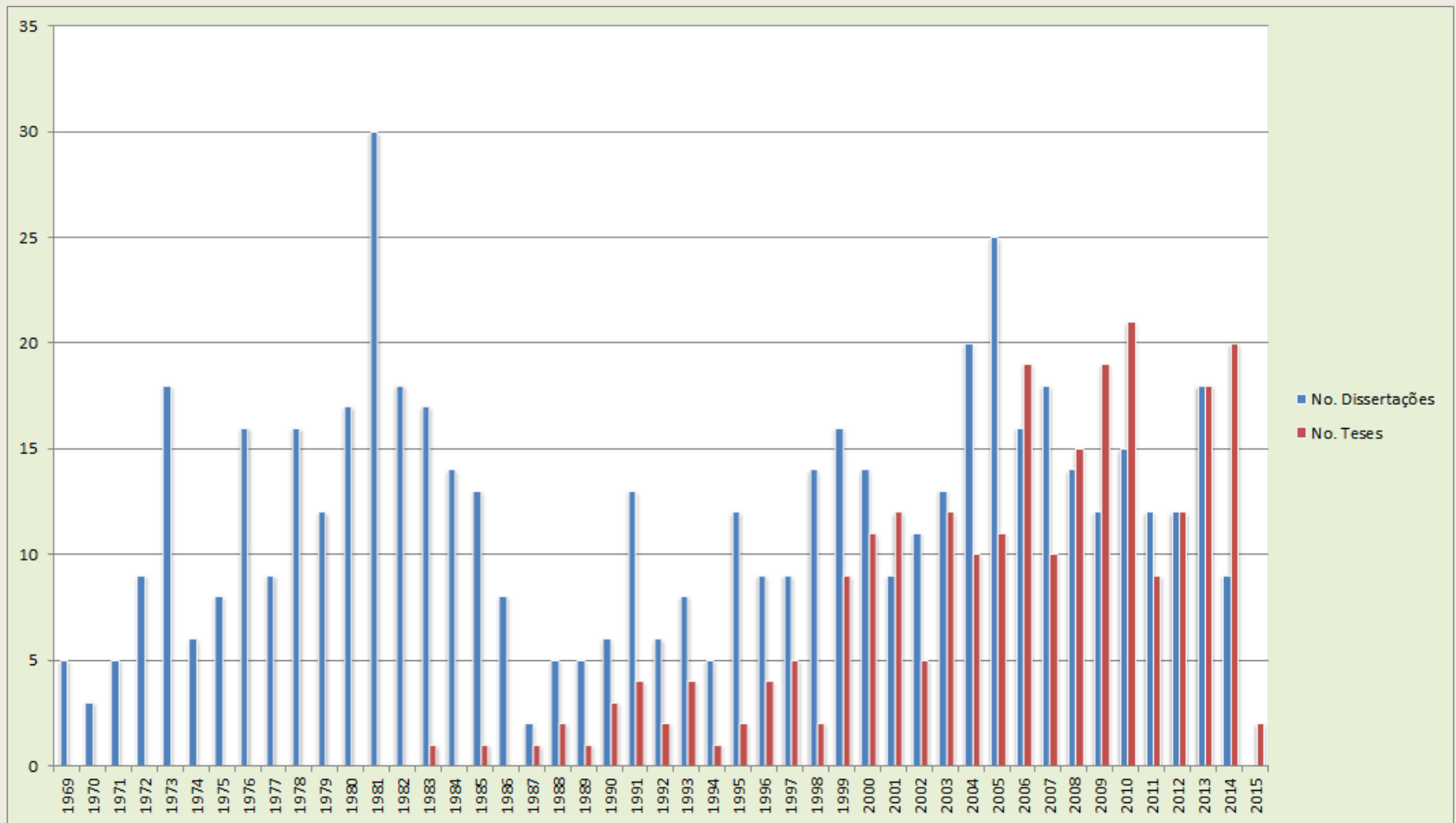
D.Sc. 270

Current enrolled graduate students

M.Sc. program - 42

D.Sc. program - 102

MSc. and PhD Degrees per year



PEN - Research Areas

- Reactor Physics (3)
- Reactor Engineering (3)
- Applied Nuclear Physics (4)
- Safety Analysis (3)
- Human Factor Engineering (2)

MSc. Program Overview

- 8 courses (360 h)
- Seminar (within 2 years)
- Dissertation
- 24 months (expected); 36 months (maximum)

DSc. Program Overview

- 4 courses (180 h)
- Qualification Exam (within 3 years)
- Thesis
- 48 months (expected); 60 months (maximum)

Sandwich Doctorate Program

- 4 courses in Brazil
- Qualification Exam in Brazil
- 12 months research in a foreign university
- Thesis defense in Brazil
- Fully funded by Brazilian funding agencies (CNPq, CAPES, FAPERJ)

- There is a reverse Sandwich Doctorate Program for students from foreign universities

MSc. Curriculum: Reactor Physics

<p>1st Term</p> <p>Mar 2nd 2015 to Jun 5th 2015</p>	<p>CON726 Reactor Physics I</p> <p>CON737 Reactor Engineering I</p> <p>CON710 Nuclear Physics</p> <p>CON761 Monitoring and Safety of Nuclear Power Plants</p>
<p>2nd Term</p> <p>Jun 15th 2015 to Sept 11th 2015</p>	<p>CON714 Radiological Protection</p> <p>CON702 Numerical Methods for Nuclear Engineering</p> <p>CON727 Reactor Physics II</p> <p>CON728 Solution Techniques for Multigroup Diffusion Equation</p>

Prof. Alessandro da Cruz Gonçalves

Prof. Aquilino Senra Martinez

Prof. Fernando Carvalho da Silva

MSc. Curriculum: Reactor Engineering

1st Term Mar 2 nd 2015 to Jun 5 th 2015	CON726 Reactor Physics I CON737 Reactor Engineering I CON710 Nuclear Physics CON761 Monitoring and Safety of Nuclear Power Plants
2nd Term Jun 15 th 2015 to Sept 11 th 2015	CON714 Radiological Protection CON702 Numerical Methods for Nuclear Engineering CON836 Reactor Engineering II CON703 Mathematical Methods I CON837 Finite Elemental Method I Elective (as the 8th course)

Prof. Eduardo Gomes Dutra do Carmo
Prof. Nilson Costa Roberty
Prof. Su Jian

MSc Curriculum: Applied Nuclear Physics

<p>1st Term</p> <p>Mar 2nd 2015 to Jun 5th 2015</p>	<p>CON726 Reactor Physics I</p> <p>CON737 Reactor Engineering I</p> <p>CON710 Nuclear Physics</p> <p>CON761 Monitoring and Safety of Nuclear Power Plants</p>
<p>2nd Term</p> <p>Jun 15th 2015 to Sept 11th 2015</p>	<p>CON714 Radiological Protection</p> <p>CON712 Ionizing Radiation Detection</p> <p>CON749 Applied Probability Models</p> <p>CON716 Nuclear Techniques of Measurements</p> <p>CON717 Fundamentals of Dosimetry</p> <p>CON718 NDT with com Ionizing Radiation</p> <p>CON819 Problem Simulation by Monte Carlo Methods</p> <p>CON820 Physics of X-ray Imaging</p>

Prof. Ademir Xavier da Silva

Prof. Delson Braz

Prof. Inayá Corrêa Barbosa Lima

Prof. Ricardo Tadeu Lopes

Edgar Oliveira de Jesus (Adjunct Faculty)

MSc Curriculum: Safety Analysis

1st Term Mar 2 nd 2015 to Jun 5 th 2015	CON726 Reactor Physics I CON737 Reactor Engineering I CON710 Nuclear Physics CON761 Monitoring and Safety of Nuclear Power Plants
2nd Term Jun 15 th 2015 to Sept 11 th 2015	CON714 Radiological Protection CON702 Numerical Methods for Nuclear Engineering CON747* Fundamentals of Safety Analysis CON749 Applied Probability Models

Prof. Antonio Carlos Alvim
Prof. José de Jesús Rivero Oliva
Prof. Paulo Fernando F. Frutuoso e Melo

MSc Curriculum: Human Factors Engineering

1st Term Mar 2 nd 2015 to Jun 5 th 2015	CON726 Reactor Physics I CON737 Reactor Engineering I CON710 Nuclear Physics CON761 Monitoring and Safety of Nuclear Power Plants
2nd Term Jun 15 th 2015 to Sept 11 th 2015	CON714 Radiological Protection CON702 Numerical Methods for Nuclear Engineering CON760 Artificial Intelligence in the NPP operation CON762 Computational Methods I

Prof. Roberto Schirru

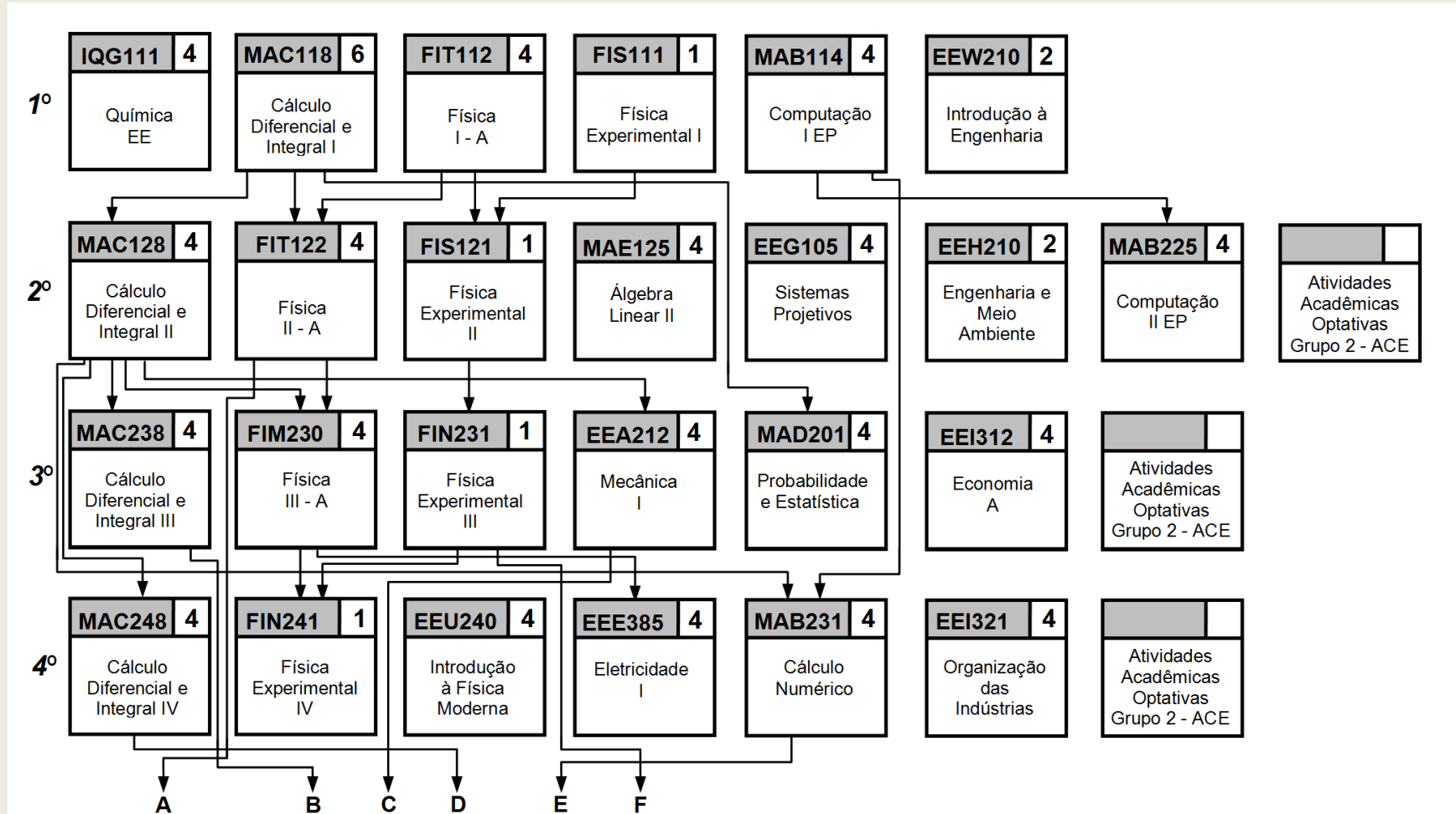
Prof. José Antonio Carlos Canedo Medeiros

Nuclear Engineering (Undergraduate) Department DNC/POLI/UFRJ

- CREATION:
 - Integrated since 1986
- MISSIONS:
 - Undergraduate Education to provide engineers with a solid scientific, technic and professional qualification
 - Enable engineers do develop new technologies and stimulate critic and creative action for identification and solving problems
- ACTIVITIES:
 - Teaching, Research, Technological development
- NUCLEAR ENGINEERING COURSE:
 - Creation: 2009 - Beginning: 2010.
 - First completion under graduate students: 1 in 2013, 9 in 2014.

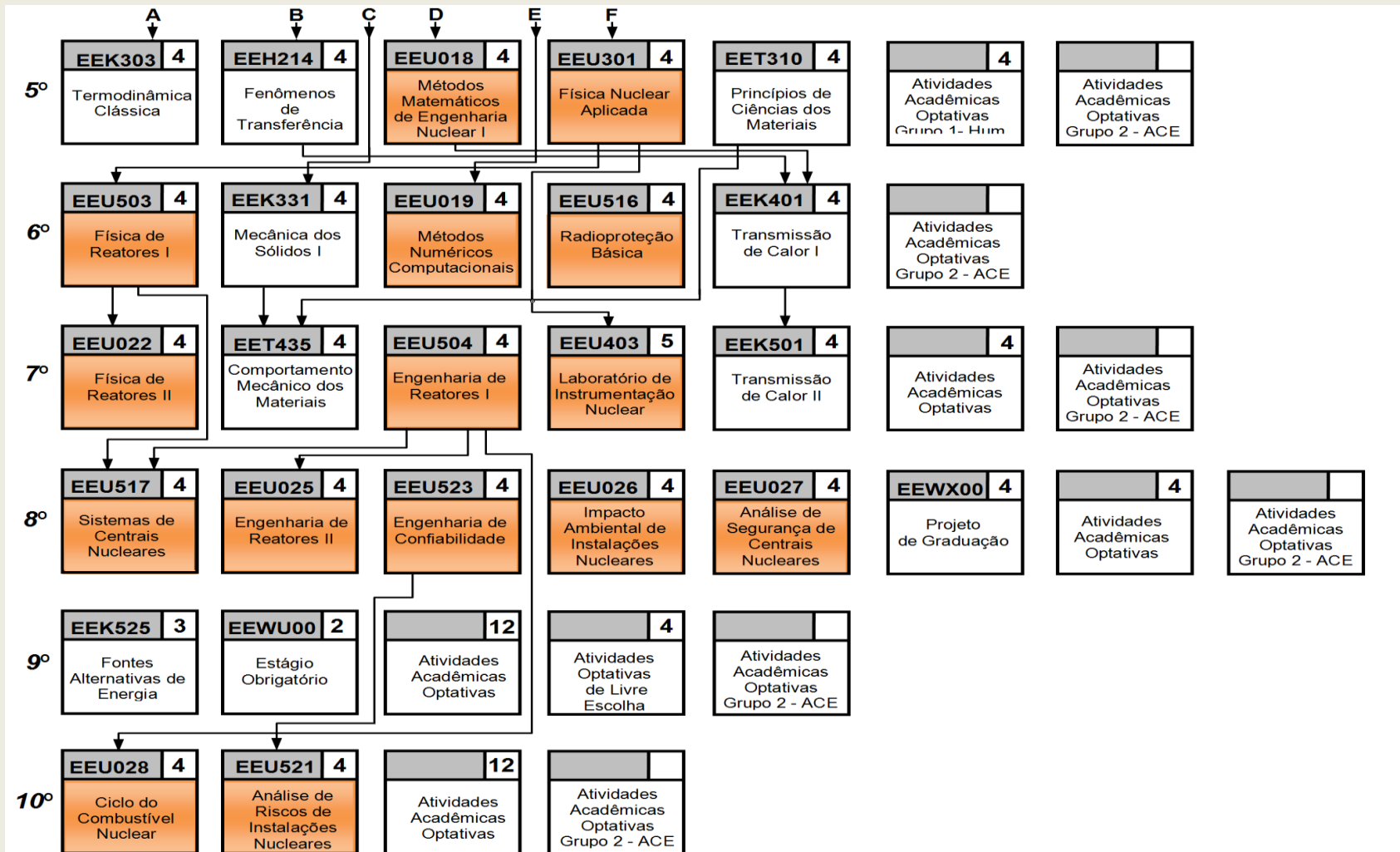
Curriculum: U.G. Nuclear Engineering

Basic Cycle



Curriculum: U.G. Nuclear Engineering

Professional Cycle



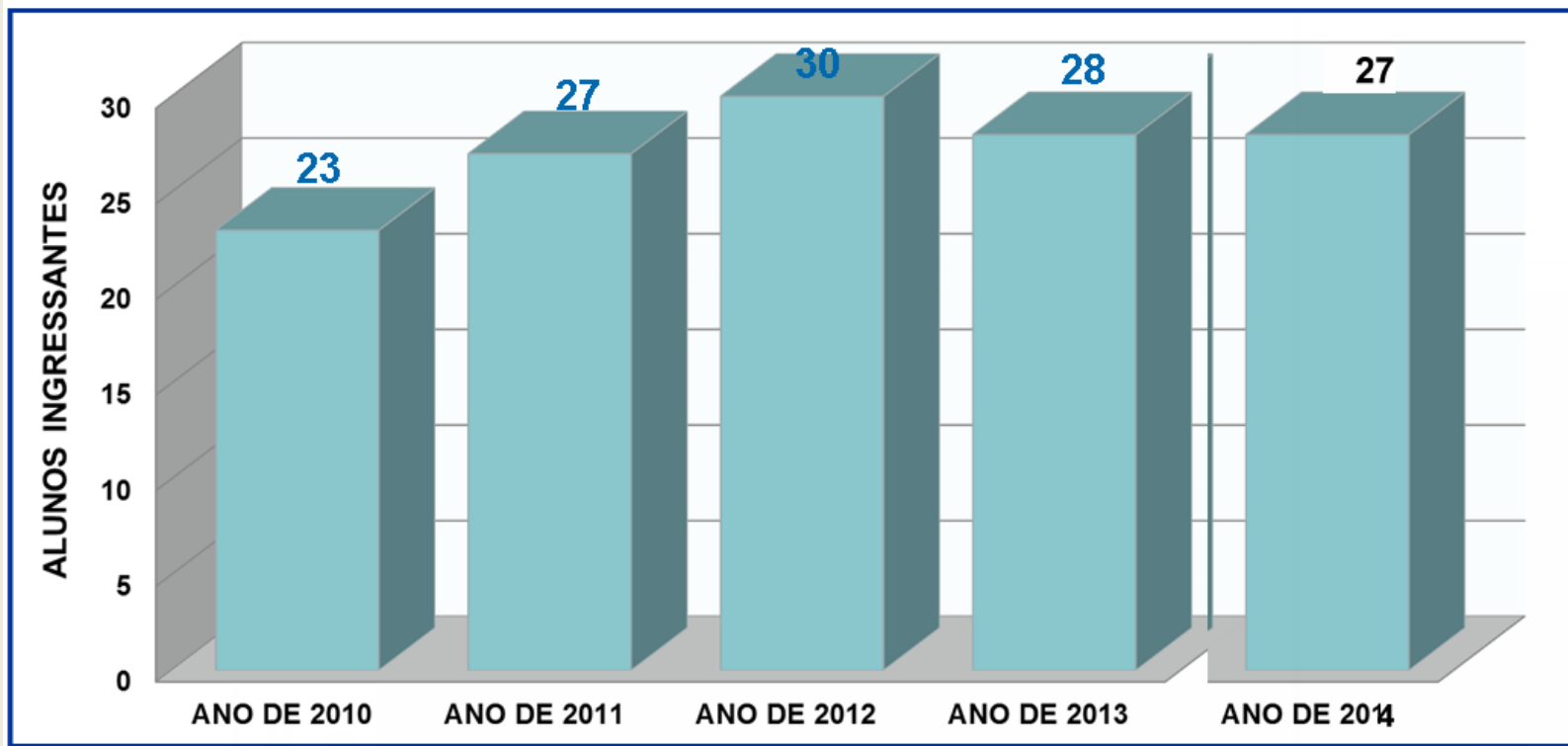
Curriculum: U.G. Nuclear Engineering

	Crédits	Hours
Compulsory Courses	178	2880
Internship and Final Project	6	340
Free Choice Optative Academic Activities	4	60
Optative Academic Activities (Humanities)	4	60
Optative Academic Activities (Group 2)		405
Optative Academic Activities (Conditioned)	32	480
Totals	224	4225

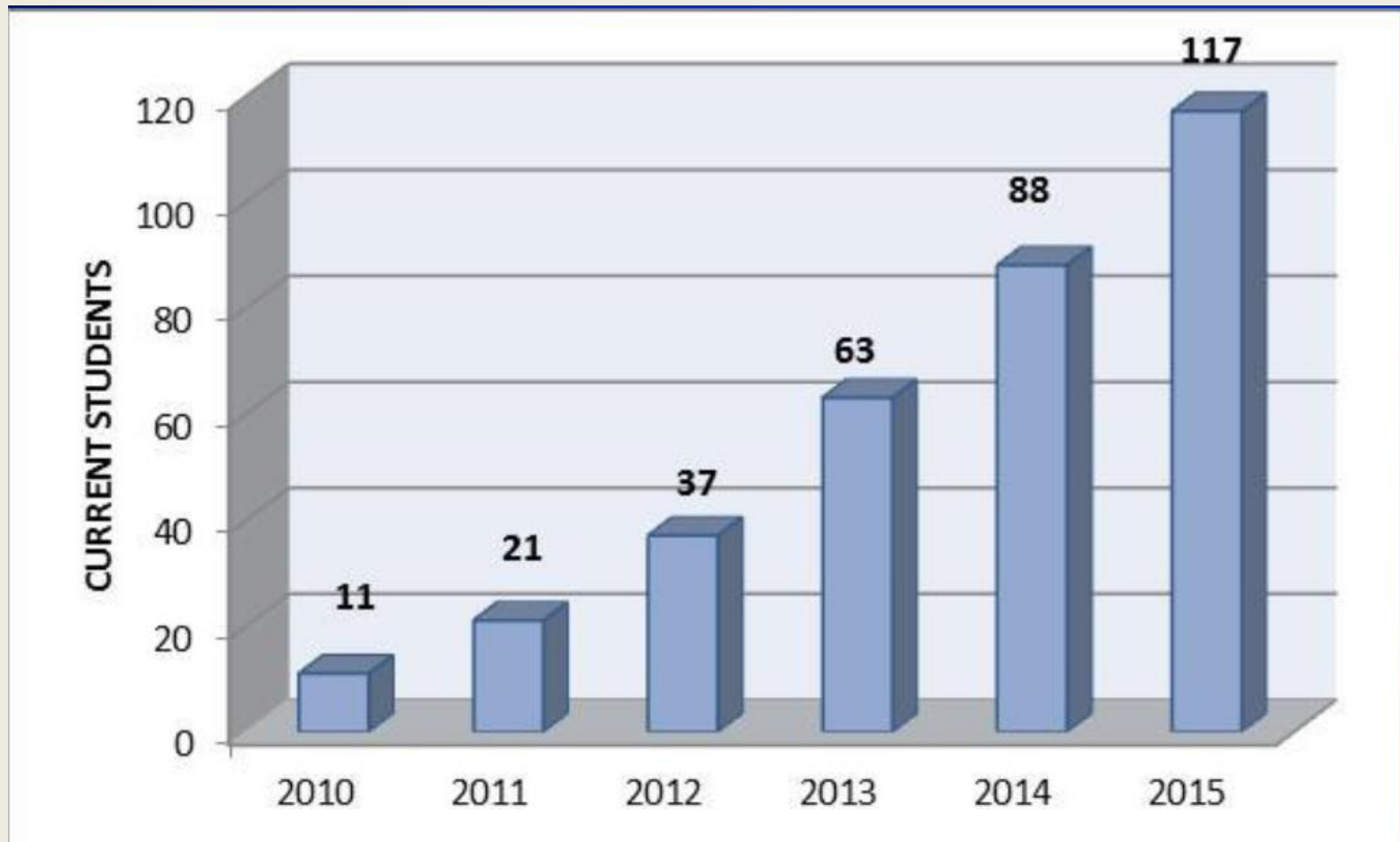
DNC – Offer of Places

YEAR	AVAILABLE PLACES	ENTERING STUDENTS	ACTIVE STUDENTS	DATE OF CONCLUSION	PROJECTION OF GRADUATE STUDENTS
2011	30	27	21	DEC / 2015	11
2012	30	30	37	DEC / 2016	15
2013	30	28	63	DEC / 2016	22
2014	30	27	88	DEC / 2016	19
2015	30	30	117	DEC / 2016	30

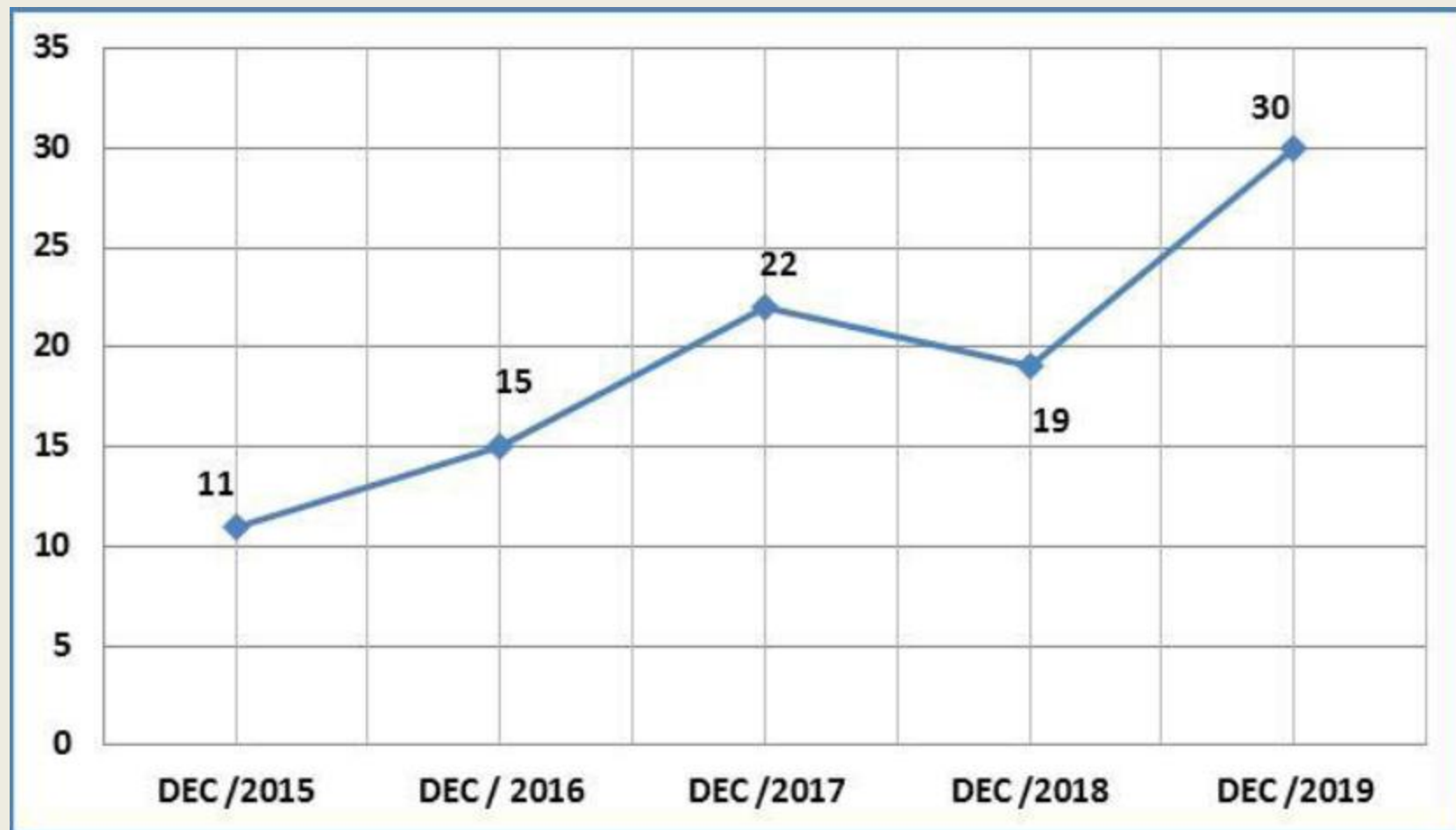
DNC – Incoming Students



DNC – Current Students



DNC – Expected Conclusions



PEN/DNC - Laboratories

- Laboratory of Nuclear Instrumentation (LIN);
- Laboratory of Process Monitoring (LMP);
- Laboratory of Simulation and Engineering Methods (LASME);
- Laboratory of Real–Time Neutron Radiography (LNRTR).
- Laboratory of Numerical Methods (LMN);
- IEN (Institute of Nuclear Energy) – Thermo Hydraulic Laboratory (Collaboration)

Laboratory of Nuclear Instrumentation



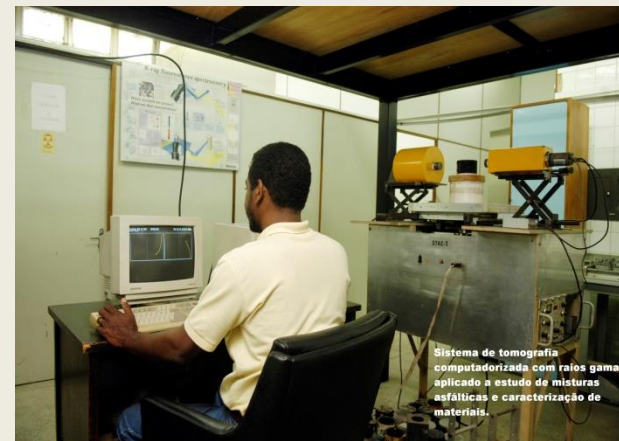
Sistema de microradiografia e microtomografia em tempo real aplicado a estudos médicos, arqueométricos, novos materiais, integridade de sensores, microeletrônica e interação rocha-fluido.



Sistema de leitura de Imagem-Plata para Radiografia Digital aplicado a aplicações biológicas, inspeção de corrosão e incrustações em dutos e arqueometria.



Sistema de leitura de Imagem-Plata de alta resolução para Radiografia Digital aplicado a inspeção de corrosão em dutos e soldas em situações offshore.

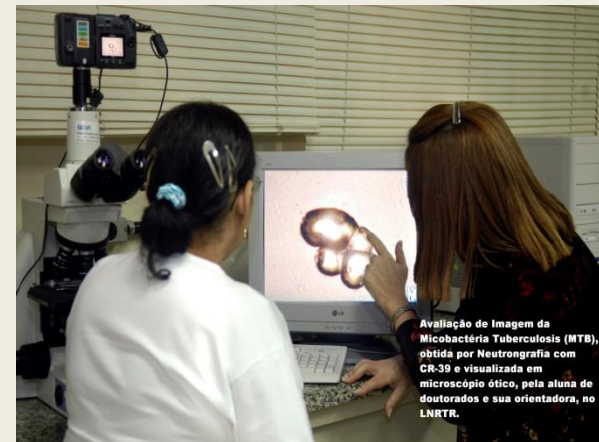


Sistema de tomografia computadorizada com raios gama aplicado a estudo de misturas asfálticas e caracterização de materiais.

Laboratory of Process Monitoring



Laboratory of Real-Time Neutron Radiography



Laboratory of Simulations and Methods In Engineering



Laboratory of Numerical Methods



IEN - Laboratory of Themohidraulic Experiments



Two-phase flow loops



Two-phase flow loops



Under construction

IEN – Taylor Bubbles in Vertical/Inclined Tubes



IEN – Natural Circulation Circuit



U. and G. MSc. and DSc., Job Opportunities

- Faculty at universities
- Government labs (IEN, IRD, IPEN, CDTN, etc)
- Utility (Eletronuclear)
- Uranium mining and fuel Company (INB)
- Heavy equipment company (NUCLEP)
- Navy project (AMASUL)
- Oil industries (Petrobras)
- High schools and technical schools
- Others

PEN/DNC – Cooperations

- National Companies and Institutes
 - Eletronuclear (ETN)
 - Industrias Nucleares do Brasil
 - Comissão Nacional de Energia Nuclear (CNEN)
- International Companies
 - Rosatom
 - Areva
 - Westinghouse (*)

PEN/DNC – Nuclear Engineering (1st-S) Concerns

- The 1st -S
- Safety Issues
- Nuclear/Radioactive Installations
 - Design
 - Operation
 - Maintenance

PEN/DNC - Nuclear Security (2nd-S) Activities

- III Nuclear Engineering Week (NEW) in 2013
- Texas A&M University (TAMU, PNS) - Claudio Gariazzo
- Texas A&M Invitation 3 Professors to Visit TAMU (April)
 - Prof. Su Jian
 - Prof. Paulo Fernando F. Frutuoso e Melo
 - Prof. Fernando Carvalho da Silva (Coordinator of PEN)
- Organization of the Nuclear Security Week Workshop
 - Prof. Su Jian
 - DSc. Debora Trombeta
- IAEA Invitation
 - Prof. Su Jian (Viena)
 - DSc. Debora Trombeta (TAMU, Viena and Indonesia)

UFRJ-TAMU Nuclear Security Week – 28/09 a 02/10/2015

- Organization and Sponsorship: UFRJ and PNS
- A one week work shop of lectures and with exercises at last day
- Lectures
 - TAMU(PNS)
 - CNEN
 - ETN
 - Brazilian Army
 - INB
 - SNL
 - CDTN
 - IPEN
 - Brazilian Navy
- About 60 enrolled participants received the certificate of participation

UFRJ-TAMU Nuclear Security Week – 28/09 a 02/10/2015

	Monday, 28 Sept.	Tuesday, 29 Sept.	Wednesday, 30 Sept.	Thursday, 1 Oct.	Friday, 2 Oct.
08:30-09:00	BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST	BREAKFAST
09:00-09:45	Introductions [Su – UFRJ & Gariazzo – TAMU]	Nuclear Security Design [Gariazzo – TAMU]	Alarms Assessment/Access Delay/Response [Chirayath – TAMU]	Vulnerability Assessments [Sternat – SNL]	Insider Threat Table Top Exercise [TAMU & SNL]
09:45-10:00	<i>BREAK</i>				
10:00-10:45	Threats to Nuclear Security [Gariazzo – TAMU]	Facility Characterization & Target Identification [Chirayath – TAMU]	Response Strategies [Gariazzo – TAMU]	Insider Threat Mitigation [Gariazzo – TAMU]	
10:45-11:00	<i>BREAK</i>				
11:00-11:45	Design Basis Threat [Sternat – SNL]	PPS Performance Objectives/Intrusion Detection Sensors [Sternat – SNL]	Adversary Sequence Diagrams [Sternat – SNL]	Scenario Development and Insider Analysis [Chirayath – TAMU]	Certificate Presentation
11:45-14:00	LUNCH	LUNCH	LUNCH	LUNCH	CLOSING LUNCH [provided by UFRJ]
14:00-14:45	Welcome Speech and Nuclear Security Culture [Su – UFRJ & Chirayath – TAMU]	Nuclear Security Education and NSSEP at TAMU [Gariazzo – TAMU]	TAMU Nuclear Security Research Activities [Chirayath – TAMU]	Nuclear Security Research and Capabilities at SNL [Sternat – SNL]	
14:45-15:00	<i>BREAK</i>				
15:00-15:45	Cultural Influence on Nuclear Security: A Brazilian Perspective [UFRJ]	The CNEN role in Nuclear Security [CNEN-TBD]	Nuclear Forensics in Brazil [IPEN/CNEN]	Security of Radioactive Sources (NS11) [Chirayath – TAMU]	
15:45-16:00	<i>BREAK</i>				
16:00-16:45	Development of monitoring systems for nuclear power plants [Electronuclear-TBD]	Nuclear Security of Large Events [MIE]	TBD [Brazilian Army]	Nuclear Security at Fuel Cycle Facility [INB]	
16:45-17:00	<i>Closing Announcements</i>	<i>Closing Announcements</i>	<i>Closing Announcements</i>	<i>Closing Announcements</i>	
17:00-18:00	RECEPTION		UFRJ-TAMU Engagement Next Steps [UFRJ & TAMU]		

PEN/DNC – Next Steps to Nuclear Security

- Establish cooperation with Texas A&M University for internship and or courses for students and professors.
- Promote special courses for graduation and undergraduation courses with participation of Texas A&M professors.
- Prepare professors to teach nuclear security disciplines.
- Include security disciplines in the graduation and undergraduation courses to introduce the students to the culture of security.
- Augment the interaction with other institutes involved with the security of nuclear installations.
- 3rd – S?

Nuclear Engineering Graduate Programs 2013

NUCLEAR ENGINEERING	UFRJ	UNIVERSIDADE FEDERAL DO RIO DE JANEIRO	M/D
NUCLEAR TECHNOLOGY	USP	UNIVERSIDADE DE SÃO PAULO	M/D
NUCLEAR SCIENCES AND TECHNOLOGIES	UFMG	UNIVERSIDADE FEDERAL DE MINAS GERAIS	M/D
NUCLEAR ENERGY TECHNOLOGIES	UFPE	UNIVERSIDADE FEDERAL DE PERNAMBUCO	M/D
SCIENCES AND TECHNOLOGIES OF RADIATIONS, MINERALS AND MATERIALS	CDTN	CENTRO DE DESENVOLVIMENTO DA TECNOLOGIA NUCLEAR	M/D
NUCLEAR SCIENCES AND TECHNOLOGIES REACTOR ENGINEERING	IEN	INSTITUTO DE ENGENHARIA NUCLEAR	M
NUCLEAR ENGINEERING	IME	INSTITUTO MILITAR DE ENGENHARIA	M

Meeting

PEN/COPPE – Prof. Fernando Carvalho

TAMU – Dr. Hassan

TAMU – Prof. Paulo Barreto

IPEN – Prof. Jorge Eduardso de Souza Sark

CEIP - Prof. Togzhan Kassenova

PNS – Pria Sethi

PNS – Prof. Sunin

IAEA – Dr. Dimitry Nikonov

WINS – Daniel Johnson

Thank you!
Questions?

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