



Exame Unificado de Pós-Graduações em Física

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Public Notice

The Physics Graduate Program Commissions of the following institutions:

1. Instituto de Física - USP
2. Instituto de Física de São Carlos - USP
3. Instituto de Física “Gleb Wataghin” - UNICAMP
4. Instituto de Física Teórica - UNESP
5. Universidade Federal do ABC - UFABC
6. Universidade Federal de São Carlos - UFSCar
7. Universidade Federal do Rio Grande do Sul - UFRGS
8. Universidade Federal de Minas Gerais - UFMG
9. Universidade Federal de Pernambuco - UFPE

make public the opening of the application and establish the regulations for the candidates selection exam for the Master Degree and Doctorate Degree courses, for the 2nd semester of 2016.

If there are technical problems at registration, users should try to use other Internet browsers. Persisting the technical problem send message to exam_pg@ifsc.usp.br

Web page of the Unified Exam: <http://www.ifsc.usp.br/~posgraduacao/inf/exameUnificado2.php>

The Unified Postgraduate Examination in Physics - EUF - will be used as part of the selection process of the following Brazilian universities associated with the EUF in the 2nd semester of 2016:

[ITA - Instituto Tecnológico da Aeronáutica, São José dos Campos, SP](#)

[UEL - Universidade Estadual de Londrina, PR](#)

[UEPG - Universidade Estadual de Ponta Grossa, Ponta Grossa, PR](#)

[UESC - Universidade Estadual de Santa Cruz, PROFISICA, Ilhéus, BA](#)

[UFABC - Universidade Federal do ABC, Santo André, SP](#)

[UFAL - Universidade Federal de Alagoas, AL](#)

[UFAM - Universidade Federal do Amazonas, AM](#)

[UFG - Universidade Federal de Goiás, GO](#)

[UFMG - Universidade Federal de Minas Gerais, Belo Horizonte, MG](#)

[UFMT - Universidade Federal do Mato Grosso, Cuiabá, MT](#)

[UFPE - Universidade Federal de Pernambuco, Recife, PE](#)

[UFPEl - Universidade Federal de Pelotas, RS](#)

[UFPA - Universidade Federal do Pará, Belém, PA](#)

[UFPB - Universidade Federal da Paraíba, João Pessoa, PB](#)

[UFPR - Universidade Federal do Paraná, Curitiba, PR](#)

[UFRGS - Universidade Federal do Rio Grande do Sul, RS](#)

[UFSC - Universidade Federal de Santa Catarina, SC](#)

[UFSCar - Universidade Federal de São Carlos, São Carlos, SP](#)

[UFU - Universidade Federal de Uberlândia, MG](#)

[UNB - Universidade de Brasília, DF](#)

[UNESP - Universidade Estadual Paulista, IGCE, Rio Claro, SP](#)

[UNESP - Universidade Estadual Paulista, IFT, São Paulo, SP](#)

[UNICAMP - Universidade de Campinas, IFGW, Campinas, SP](#)

[UNILA - Universidade Federal da Integração Latino-Americana, Foz do Iguaçu, PR](#)

[UNICSUL - Universidade Cruzeiro do Sul, SP](#)

[UNIFEI - Universidade Federal de Itajubá, MG](#)

[USP - Universidade de São Paulo, FFCLRP, Ribeirão Preto, SP](#)

[USP - Universidade de São Paulo, IFSC, São Carlos, SP](#)

[USP - Universidade de São Paulo, IFUSP, São Paulo, SP](#)

About the registration:

1. The registration will be open from day January 11th (from 09:00 - Brazilian official time) to the 5th of February 2016 (until 17:00 - Brazilian official time), and must be made online through the link: http://www.ifsc.usp.br/~posgrad/exame_pg/inscricao_euf

2. The registration for the examination does not imply that the candidate is automatically enrolled in the Graduate Programs that organize the exam. The candidate should register separately in the Graduate Institutions Programs of interest. The application to the Programs of interest shall be made according to the specific rules of each institution/program within the timelines required by them. This information will be available on the pages of the Graduate Services of each institution/program.

3. The exam application validation for the candidates who have requested the option "I want to enter another country", for which the deadline is the **22/01/2016** (until the 23h59min - Brazilian official time), shall be defined until 29/01/2016 (until 23:59 - Brazilian official time) when the applicant should check on its status at the registration area. In the case that the indicated mentor has validated the application, but the applicant did not receive the application protocol, it will mean that the requested examination place has not been made possible. In this situation the applicant must select one of the available sites, if there is still interest in participating in the exam. In case the proposed mentor did not validate the application, the candidate will not receive the application protocol.

4. We point out that the registration process has a deadline for the procedures described above, namely: choice of location outside Brazil and validation by the indicated mentor until the 05/02/2016 at 17h00min - Brazilian official time.

THE TESTS

The selection test will be held in two stages, on the **05th and 06th of April of 2016**, from the 14:00 to 18:00h (Brazilian official time) at the locations disclosed in the web page of the unified exam: <http://www.ifsc.usp.br/~posgraduacao/inf/exameUnificado2.php>:

The candidate may take the tests in an institution and enroll in the Graduate Program of another institution of his/her choice.

For foreign examination locations, see instructions bellow.

The organizing committee is establishing the necessary contacts to apply the test at the same time in locations properly distributed in Brazil and overseas. These locations are listed on the registration page of the EUF. The candidate should choose only one of these sites at the time of registration. It is not allowed to establish new application sites of the EUF exam, besides the sites available on the registration page, except abroad. Requests for new sites abroad may be placed until the **22nd January 2016** (until 23h59min - Brazilian official time), when the option "I want to enter another country" will be removed from the registration page. When choosing the option "I want to enter another country", the application will not automatically consolidated. The new locations, if consolidated, will be forwarded by email to the candidate until **29/01/2016** (until 23h59min - Brazilian official time). However, since the application of the examination abroad depends on the collaboration of other institutions not directly involved with the examination, the organizing committee cannot guarantee in advance if and where it will happen. If "new locations" are not made possible until 23h59min (Brazilian official time) of the **29th January 2016**, indicating the impossibility of the official exam application at the requested location, the applicant that requested these new sites will be informed by email and should make their applications, if the candidate still has interest, choosing one of the sites available on the registration page of the EUF, until the deadline date, with the indicated mentor validation, that is, until 17h00min of the 05th of February 2016 (Brazilian official time).

Once enrolled in the EUF, the candidate cannot change the chosen location of the examination.

Candidates come to the place of the exam in possession of photo ID, pencil, pen and eraser (the use of calculators and other electronic equipment such as mobile phones, tablets, etc. will not be allowed). The exam will consist only of essay questions.

Candidates with special needs must contact the organizing committee at the address exam_pg@ifsc.usp.br, informing their special needs, until 31st March 2016 (up to 23h59min - Brazilian official time).

PROGRAMME OF THE EXAM

The exams will be on five general areas of the Physics Undergraduate Program, namely, (1) Classical Mechanics (2) Electromagnetism (3) Modern Physics, (4) Quantum Mechanics (5) Thermodynamics and Statistical Physics. The topics of each area and recommended reading are:

1. Classical Mechanics

- a) Newton's laws.
- b) One-dimensional motion.
- c) Linear Oscillations.
- d) Motion in two and three dimensions.
- e) Newtonian gravitation.
- f) Variational calculus.
- g) Equations of Lagrange and of Hamilton.
- h) Central forces.
- i) Particle Systems.
- j) Non-inertial frames.
- k) Dynamics of rigid bodies.
- l) Coupled oscillations.

Bibliography:

- J. B. Marion and S. T. Thornton, Classical Dynamics of Particles and Systems, 4th Edition, Harcourt, 1995.
- K. R. Symon, Mechanics, 3rd Edition, Addison-Wesley, 1971.
- D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vols. 1&2, LTC/Wiley, 2008
- H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vols. 1&2, Blucher, 2002.
- T.W.B. Kibble, Classical Mechanics, Imperial College Press, 2004.
- A.P. French e M.G. Ebison, Introduction to Classical Mechanics, Chapman and Hall, 1987.
- R.A. Becker, Introduction to Theoretical Mechanics, McGraw-Hill, 1954.

2. Electromagnetism

- a) The electrostatic fields in vacuum and in dielectric materials.
- b) Solution of Laplace and Poisson equations.
- c) Magnetic fields, steady currents and non-magnetic materials.
- d) Induced electromotive force and magnetic energy.
- e) Magnetic materials.
- f) Maxwell equations.

- g) Propagation of electromagnetic waves.
- h) Reflection and Refraction.
- i) Radiation.
- j) Electromagnetism and Relativity.

Bibliography:

- D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice-Hall, 1981.
- D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vols. 3&4, LTC/Wiley, 2008
- H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vols. 3&4, Blucher, 2002.
- J. R. Reitz, F. J. Milford, R. W. Christy, Fundamentals of Electromagnetic Theory, , 3rd Edition, 1982.
- R.K. Wangsness, Electromagnetic Fields, Wiley, 1986.
- E.M. Purcell, Berkeley Physics Course, Electricity and Magnetism, Edgard Blücher,
- J.B. Marion e M.A. Heald, Classical Electromagnetic Radiation, Brooks/Cole (1995).

3. Modern Physics

- a) Fundamentals of relativity.
- b) Mechanics of relativistic particles.
- c) Propagation of light and Newtonian relativity.
- d) Experiment of Michelson and Morley.
- e) Postulates of special theory of relativity.
- f) The Lorentz transformations.
- g) Causality and Concurrency.
- h) Energy and relativistic time.
- i) Thermal radiation, the problem of the black body and the Planck postulate.
- j) The photon and corpuscular properties of radiation.
- k) The Rutherford model and the problem of stability of atoms.
- l) The Bohr model.
- m) Boltzmann distribution of energy.
- n) Atoms, Molecules and Solids.

Bibliography:

- R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles 2nd Edition, Wiley, 1985.
- D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vol. 4, LTC/Wiley, 2008
- H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vol. 4, Blucher, 2002.
- Tipler e R.A. Llewellyn, Modern Physics. 3rd Edition, LTC, 2003.
- W. Rindler, Introduction to Special Relativity, Oxford Univ. Press, 1991.
- A.P. French, Special Relativity, W.W. Norton (1968).
- S.T. Thornton e A. Rex , Modern Physics for scientists and engineers, Brooks Cole, 2005.
- R.A. Serway, C.J. Moses e C.A. Moyer, Modern Physics, Brooks Cole, 2004.
- J. Leite Lopes, Introdução à Teoria Atômica da Matéria, Ao Livro Técnico, 1959.
- H.M. Nussensveig, Curso de Física Básica IV, (chapter 6), Edgard Blücher.

4. Quantum Mechanics

- a) Introduction to the fundamental ideas of quantum theory.
- b) The mathematical apparatus of quantum mechanics of Schrödinger.

- c) Formalization of Quantum Mechanics. Postulates. Description Heisenberg.
- d) The one-dimensional harmonic oscillator.
- e) One-dimensional potentials.
- f) The Schrödinger equation in three dimensions. Angular momentum.
- g) Central forces and the Hydrogen atom.
- h) Spinors in non-relativistic quantum theory.
- i) Addition of angular momenta.
- j) Theory of disturbance independent of time.
- k) Identical particles.

Bibliography:

- D.J. Griffiths, Introduction to Quantum Mechanics, 2nd edition, Pearson, 2004.
- C. Cohen-Tannoudji, B. Diu, F. Laloë, Quantum Mechanics, Vols. I and II, 1st Edition, Wiley, 1977.
- S. Gasiorowicz, Física Quântica. Guanabara Dois, 1979.
- E. Merzbacher, Quantum Mechanics 3rd Edition, Wiley 1997.
- R.H. Dicke e J.P. Wittke, Introduction to Quantum Mechanics, Addison Wesley, 1961.
- Levin, Quantum Chemistry, Prentice-Hall, 1991.

5. Thermodynamics and Statistical Physics

- a) Thermodynamic systems.
- b) Variables and equations of state, PVT diagrams.
- c) Labor and first law of thermodynamics.
- d) Mechanical equivalent of heat.
- e) Internal energy, enthalpy, Carnot cycle.
- f) Phase changes.
- g) Second law of thermodynamics and entropy.
- h) Thermodynamic functions.
- i) Practical Applications of Thermodynamics.
- j) Kinetic theory of gases
- k) Physical Description of a Statistical System.
- l) Microcanonical ensemble.
- m) Canonical Ensemble.
- n) Canonical Formalism in Classical Gas.
- o) Grand Canonical Ensemble.
- p) Ideal Quantum Gas.
- q) Ideal Fermi Gas.
- r) Bose-Einstein.

Bibliography:

- S.R.A. Salinas - Introdução à Física Estatística . Edusp, 1998.
- F. Reif. Fundamentals of Statistical and Thermal Physics. 1st edition. Mc Graw Hill, 1965.
- D. Halliday, R. Resnick, e J. Walker, Fundamentos de Física, 8a. edição, Vol. 2, LTC/Wiley, 2008.
- H. Moysés Nussenzveig, Curso de Física Básica, 4a. edição, Vol. 2, Blucher, 2002.
- F. W. Sears and G. L. Salinger. Thermodynamics, Kinetic Theory, and Statistical Thermodynamics , 3rd Edition. Addison Wesley.1975.
- H.B. Callen, Thermodynamics ,Wiley, 1960
- R. Kubo, Statistical Mechanics, North-Holland, 1965
- M. W. Zemansky - Calor e Termodinâmica, Ed. Guanabara Dois, 1978.

GRADING OF THE EXAMS AND PUBLICATION OF THE RESULTS

The exams will be graded according to the official Solution Booklet and the correction criteria, which will be published at the EUF web site in due course, before the publication of the results. Each candidate will be given a final score between 0 to 10, with an accuracy up to the second decimal place, reflecting its performance in the exam. The nine Graduate Course Commissions involved in the organization of the exam will have access to all the grades, but the same shall not be published *in totum*. Each candidate will receive by email, to the address indicated in the registration form, its final exam score and the quartiles in which their grades, in each of the five subjects, were classified.

The deadline for the release of the final scores of the examination for the candidates and the Graduate Programs Coordinators will be May 25th, 2016.

The tests will be discarded 2 months after the publication of the results.

NULLIFICATION OF QUESTIONS

Any objection against one of the questions in the exams must be sent to the electronic mail address exam_pg@ifsc.usp.br up to three calendar days after the exam. The complaint must be adequately based and must be signed, with physical address of the person sending the complaint provided. Under these conditions, the complaints will be evaluated by the organizing committee. In the case of one of the questions being annulled, the score associated with that question will not be considered and the grades will be normalized in order that the maximum possible score is 10. Objections to questions will not be considered if they are presented:

- a) without a supporting argument;
- b) after the deadline of three calendar days.

After three calendar days after the exams, the organizing committee will analyze the objections received and send the result of the analysis to the complaining candidate.

REVIEW OF THE GRADES

Once the results of the examination are published, candidates may request a review of their grades through a written request, adequately justified. For this, the candidate must proceed as follows. Within three working days after the publication of the results, these candidates must state their wish to view their corrected exam, sending a message to the email address exam_pg@ifsc.usp.br. Within another five working days, the organization shall send copies of the candidates' exam to the electronic address informed at the registration. The candidate will have then another five working days to submit an official requirement of grade revision, sending a message to the email address exam_pg@ifsc.usp.br. The request must be based on the official Solution Booklet and the correction criteria published at the EUF site and must be presented in a clear and concise way, stating clearly why there is a need to change the grade attributed. Revision requests will not be accepted:

- a) if there is no argument presented for the review requested;
- b) after the deadline established above.

The organizing committee will analyze the requests made and send the result of the analysis to the respective applicants, to the email address provided at registration.

THE USE OF RESULTS

Each Graduate Program will use the results of the examination for the selection and ranking of candidates according to their own criteria. Acceptance or non-acceptance into a program does not imply acceptance or non-acceptance in another program.

THE APPLICATION OF THE EXAM

1. The applicant should appear at the place of examination in both days at least 30 minutes prior to the start of the exam for checking documents and signing the attendance list, fitted with a valid photo ID;
2. The tests can be done in pencil or blue or black ink pen;
3. Each stage of the examination will last for four (04) hours beginning at 14h (Brazilian official time);
4. It will not be allowed to query any materials except that contained in the exam material.
5. The use of calculators and/or other electronic equipment such as mobile phones and schedulers will not be allowed.
6. Entrance to the examination room is not allowed after 60 minutes of the start of the tests;
7. Definitive exit of the exam room will be allowed only after 90 minutes from the start of the examination;
8. The candidate can go to the bathroom only after 90 minutes from the start of each exam and accompanied by one of the exam supervisors;
9. The draft pages used in the exam will not be considered in the grading, only the information entered in the appropriate answer pages;

ADDITIONAL INFORMATION:

Graduate Office of: IFSC-USP

Web page: <http://www.ifsc.usp.br/~posgraduacao>

Av. Trabalhador São-carlense, 400 - Centro - 13566-590 - São Carlos, SP, Brazil

POBox 369,

ZIP Code: 13560-970, São Carlos, SP

e-mail: exam_pg@ifsc.usp.br

Telephone: +55(16) 3373-9777/ 3373-8808

Graduate Office of: Instituto de Física “Gleb Wataghin” da Unicamp, IFGW/UNICAMP

Web page: www.ifi.unicamp.br

Rua Sérgio Buarque de Holanda, 777

Cidade Universitária Zeferino Vaz

Barão Geraldo

ZIP Code: 13083-859 - Campinas SP, Brazil

Fax: +55(19) 3521-4142.

Graduate Office of: Instituto de Física da USP

Web page: <http://www.if.usp.br/pg>

POBox 66318,

ZIP Code: 05314-970, São Paulo, SP, Brazil

e-mail: cpgusp@if.usp.br

Telephone: +55(11) 3091-6901

Fax: +55(11) 3091-6700

Graduate Office of: IFT-UNESP
Web page: <http://www.ift.unesp.br>
Rua Bento Teobaldo Ferraz 271, Bloco II,
ZIP Code: 01140-070 São Paulo, SP, Brazil
e-mail: secpos@ift.unesp.br
Telephone: +55(11) 5627 7233 e 5627 7232

Graduate Office of: Physics of Federal University of São Carlos - UFSCar
Web page: <http://www.ppgfis.df.ufscar.br/>
Rod. Washington Luis, km 235
POBox 676,
ZIP Code: 13.565-905, São Carlos, SP, Brazil
e-mail: ppgf.ufscar@outlook.com
Telephone: +55(16) 3351-8225
Fax: +55(16) 3351-8464

Graduate Office of: Physics of Federal University of the ABC - UFABC
Web page: <http://fisica.ufabc.edu.br/>
Campus Santo André, Bloco B, 4º Andar
Rua Santa Adélia, 166,
ZIP Code: 09210-170, Santo André, SP, Brazil
e-mail: ppg.fisica@ufabc.edu.br
Telephone: +55 (11) 4996-0087/4996-0047/4996-0099

Graduate Office of: IF-UFRGS
Web Page: www.if.ufrgs.br/pos
Av. Bento Gonçalves, 9500 – Prédio 43.176 - sala 204 - Campus do Vale
PO Box 15051 - Zip Code 91501-970 - Porto Alegre/RS, Brazil
E-mail: cpgfis@if.ufrgs.br
Telephone: +55(51) 3308.6435 / 3308.6493

Graduate Office of: Physics of UFMG
Web Page: www.fisica.ufmg.br/posgrad/
Instituto de Ciências Exatas
PO Box 702 - Zip Code 31270-901 - Belo Horizonte/MG, Brazil
E-mail: pgfisica@fisica.ufmg.br
Telephone: +55(31) 3409-5637

Graduate Office of: Physics of UFPE
Web Page: www.ufpe.br/ppgfisica
Departamento de Física, CCEN, UFPE
Av. Professor Luiz Freire, s/n
Cidade Universitária, 50670-901, Recife-PE, Brasil
E-mail: posgrad.df@ufpe.br
Telephones: +55-81- 2126.7640, +55-81- 3271.8450