



Exame Unificado de Pós-Graduações em Física

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PUBLIC NOTICE

The Physics Graduate Program Commissions of the following institutions:

Instituto de Física - USP
Instituto de Física de São Carlos - USP
Instituto de Física “Gleb Wataghin” - UNICAMP
Instituto de Física Teórica - UNESP
Universidade Federal do ABC - UFABC
Universidade Federal de São Carlos - UFSCar
Universidade Federal do Rio Grande do Sul - UFRGS
Universidade Federal de Minas Gerais - UFMG
Universidade Federal de Pernambuco – UFPE
Universidade Federal do Rio Grande do Norte – UFRN

make public the opening of the application and establish the regulations for the

Unified Physics Exam - EUF - for the first semester of 2017

which is part of the candidates selection exam for the Master Degree and Doctorate Degree courses of several Brazilian universities.

Registration for the exam will be only online, at the address <https://www.faurgs.ufrgs.br/SIAF/EUF>. If there are technical problems at registration, users should try to use other Internet browsers. Persisting the problem, please send message to faurgs.contasareceber@ufrgs.br.

More details about the Unified Physics Exam can be found at: <https://www.faurgs.ufrgs.br/SIAF/EUF> or <http://www.ifsc.usp.br/~posgraduacao/inf/exameUnificado2.php>.

The Unified Physics Exam- EUF - will be used as part of the selection process of the following Brazilian universities associated with the EUF in the 1st semester of 2017:

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
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
UFPA - Universidade Federal do Pará, Belém, PA
UFPE - Universidade Federal de Pernambuco, Recife, PE
UFPEL - Universidade Federal de Pelotas, RS
UFPR - Universidade Federal do Paraná, Curitiba, PR
UFRN - Universidade Federal do Rio Grande do Norte
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:

The registration will be open from **July 13th (from 09:00 - Brazilian – Brasilia – time) to the 10th of August 2016 (until 17:00 - Brazilian – Brasilia – time)**, and must be made online through the link: <https://www.faurgs.ufrgs.br/SIAF/EUF>.

The registration fee for the EUF, in the amount of R\$ 100.00, must be paid in accordance with the instructions on the registration page. In no case the registration fee will be returned. Applicants whose monthly family income is below half the Brazilian Minimum Wage per person may apply for exemption from the registration fee. Applications for exemption must be submitted on the page itself until 29 of July 2016. Only exemption requests accompanied by adequate documentation will be accepted. The result of the request for exemption shall be communicated by e-mail to the applicant no later than August 5, 2016, and then the candidate should proceed with the application process, until the final deadline of August 10, 2016.

The registration for the examination does not imply that the candidate is automatically enrolled in the Graduate Programs that organize the exam. The candidates should register separately in the own selection processes of the Graduate Institutions of their interest. The application to these selection processes must 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.

The examination will be held simultaneously at the locations indicated on the registration page. The candidate must choose only one of these sites at the time of registration. Once the registration is made, the applicants may not change

their selected location for taking the EUF. It is not possible to establish new EUF application sites in Brazil, in addition to the sites already available on the registration page. **However**, if there exist requests and demand for new Exam locations outside Brazil, the Organizing Committee will try to establish these new locations. Candidates who wish to request a new location abroad should make this request in the registration page, following the instructions there, **before 25 July 2016** (up to 23:59 hours - GMT). The organization will make efforts to establish the new suggested location and, if successful, it will appear as one of the possible locations at the registration page, until 05 August 2016 (up to 23:59 hours - GMT). Therefore, the interested applicant should check the registration page after 05 August 2016 to see if the new location requested was made available and proceed with registration. If the requested location has not been made available by that date, the applicant must select one of the available sites, if he/she still has interest in taking the Exam.

We note that the registration process has the final deadline of **10 August 2016**, 17:00 hours – Brazilian (Brasilia) time, for all candidates, including those that requested tax exemption and / or a new Exam location.

THE TESTS

The selection test will be held in two stages, on the **4th and 05th of October 2016**, from 14:00 to 18:00 hours (Brazilian – Brasilia – time) at the locations disclosed in the web page of the Unified Exam: <https://www.faurgs.ufrgs.br/SIAF/EUF>

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

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

Candidates must come to the place of the exam in possession of photo ID, pencil, pen and eraser (the exams will be scanned for grading, so candidates must make sure that their writing is of enough contrast to allow good quality scanning). The use of calculators and other electronic equipment such as mobile phones, tablets, laptops, etc. will not be allowed. The exam will consist only of essay questions. No source of information can be consulted during the exams apart from the ones contained in the exam itself.

Candidates with special needs must state this at the address <https://www.faurgs.ufrgs.br/SIAF/EUF> , informing their special needs, until **25 July 2016** (up to 23h59min – Brazilian – Brasilia – 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

- Newton's laws.
- One-dimensional motion.
- Linear Oscillations.
- Motion in two and three dimensions.
- Newtonian gravitation.

- Variational calculus.
- Equations of Lagrange and of Hamilton.
- Central forces.
- Particle Systems.
- Non-inertial frames.
- Dynamics of rigid bodies.
- 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. Eibson, Introduction to Classical Mechanics, Chapman and Hall, 1987.
- R.A. Becker, Introduction to Theoretical Mechanics, McGraw-Hill, 1954.

2. ELECTROMAGNETISM

- The electrostatic fields in vacuum and in dielectric materials.
- Solution of Laplace and Poisson equations.
- Magnetic fields, steady currents and non-magnetic materials.
- Induced electromotive force and magnetic energy.
- Magnetic materials.
- Maxwell equations.
- Propagation of electromagnetic waves.
- Reflection and Refraction.
- Radiation.
- 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

- Fundamentals of relativity.
- Mechanics of relativistic particles.
- Propagation of light and Newtonian relativity.
- Experiment of Michelson and Morley.
- Postulates of special theory of relativity.
- The Lorentz transformations.
- Causality and Concurrency.
- Energy and relativistic time.
- Thermal radiation, the problem of the black body and the Planck postulate.
- The photon and corpuscular properties of radiation.
- The Rutherford model and the problem of stability of atoms.
- The Bohr model.
- Boltzmann distribution of energy.
- 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. Nussenzveig, Curso de Física Básica IV, (chapter 6), Edgard Blücher.

4. QUANTUM MECHANICS

- Introduction to the fundamental ideas of quantum theory.
- The mathematical apparatus of quantum mechanics of Schrödinger.
- Formalization of Quantum Mechanics. Postulates. Description Heisenberg.
- The one-dimensional harmonic oscillator.
- One-dimensional potentials.
- The Schrödinger equation in three dimensions. Angular momentum.
- Central forces and the Hydrogen atom.
- Spinors in non-relativistic quantum theory.
- Addition of angular momenta.
- Theory of disturbance independent of time.
- 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

- Thermodynamic systems.
- Variables and equations of state, PVT diagrams.
- Labor and first law of thermodynamics.
- Mechanical equivalent of heat.
- Internal energy, enthalpy, Carnot cycle.
- Phase changes.
- Second law of thermodynamics and entropy.
- Thermodynamic functions.
- Practical Applications of Thermodynamics.
- Kinetic theory of gases
- Physical Description of a Statistical System.
- Microcanonical ensemble.
- Canonical Ensemble.
- Canonical Formalism in Classical Gas.
- Grand Canonical Ensemble.
- Ideal Quantum Gas.
- Ideal Fermi Gas.
- 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 ten 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, at the address indicated in the registration form, its final exam score and the percentile 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 the 18th November 2016.

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

OBJECTIONS TO THIS PUBLIC NOTICE

Any possible objection to any aspect of this Public Notice should be sent to the address exam_pg@ifsc.usp.br within up to 3 days after its publication. If properly grounded and sent by an identified sender, the argument will be reviewed by the Organizing Committee. Objections will not be admitted:

- a) without a clear exposition of the reasons;
- b) when filed after the deadline.

Once the period for submitting appeals is over, the Organizing Committee will review them, and send an answer to each of the applicants, informing about the acceptance of the appeal or its rejection. In case of rejection, the response will include a substantiated explanation about the reasons for the dismissal of the appeal. In the hypothesis that the objection to this Public Notice is pertinent, the Organizing Committee will take the necessary steps to correct the illegality.

NULLIFICATION OF QUESTIONS

Any objection against any of the questions in the exams must be entered at the address <https://www.faurgs.ufrgs.br/SIAF/EUF> up to three calendar days after the each exam. The complaint must be adequately based and must be signed, with the physical address of the person sending the complaint being provided. Under these conditions, the organizing committee will evaluate the complaints. 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, the candidates must state their wish to view their corrected exam, at the address <https://www.faurgs.ufrgs.br/SIAF/EUF> . Within another five working days, the organization will 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, posting his/her request at the address <https://www.faurgs.ufrgs.br/SIAF/EUF> . 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

- The applicant should be 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, bringing a valid photo ID;
- The tests can be done in pencil or blue or black ink pen (be aware that the exams will be scanned, so make sure your writing is clear enough);
- Each stage of the examination will last for four (04) hours beginning at 14h (Brazilian – Brasilia –official time);
- It will not be allowed to consult any source or material, except that contained in the exam.
- The use of calculators and/or other electronic equipment such as mobile phones, tablets, electronic diaries or schedulers, will not be allowed.
- Entrance to the examination room is not allowed after 60 minutes of the start of the tests;
- Definitive exit of the exam room will be allowed only after 90 minutes from the start of the examination;
- 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;
- The draft pages used in the exam will not be considered in the grading, only the information entered in the appropriate answer pages;
- Each question must be solved in the appropriate page, marked with the question number, solutions out of the designated spaces will not be considered.

ADDITIONAL INFORMATION:

Graduate Office of: IFSC-USP

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

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