**Nuclear Science and Technology 0827**

**1.Overview**

Department of Nuclear Science and Technology in Xi’an Jiaotong University was established as the Department of Engineering Physics in 1958. Master degree authorization was granted in 1981. Doctor authorization on Nuclear Reactor Engineering and Safety was granted in 1986. Primary level Doctor degree authorization and Post-doctor fellowship were accredited in 2003. 26 monograghs and textbooks were published and 23 national and ministerial prizes were awarded. In the past 3 years, 30 students got Ph.D. degree; 78 Master degree; and 296 Bachelor degree. Now there are 28 faculties, and several laboratories, such as Liquid Metal Sodium Loop, High Temperature High Pressure Thermal-Hydraulics Loop, Nuclear Power Plant Simulation System, Nuclear Radiation Detection & Analysis System, Accelerator Mass Spectrometer, and Nuclear Engineering Computational Physics etc. The research fields include Reactor Physics, Neutronic Analysis, Reactor Thermal- Hydraulics, Reactor Kinetics, Control and Simulation, Nuclear Power System Safety, Nuclear Technology & Applications, Reactor Maintainance, Structure & Material, etc. It has developed into a comprehensive cradle for scientific research, engineer cultivation in the nuclear energy industry in China. It has comprehensive international communication and cooperation all over the world. It successfully hosted the 18th ICONE (International Conference On Nuclear Engineering) and many international workshops.

**2.Objectives**

The program aims to cultivate talents with comprehensive ability and help them develop morally, intellectually, physically and aesthetically.

Through the training of PhD, students should master solid and broad basic theories, systematic in-depth professional knowledge, have the ability to undertake independent scientific research and teaching, gain innovative achievements in Nuclear Science and Technology, have a rigorous and realistic scientific attitude and work style, and strive to resolve sci-tech difficulties.

For Master students, apart from mastering solid and broad basic theories, systematic in-depth professional knowledge, they have to get familiar with the sci-tech developing trend of the research areas as well as gain the ability to undertake scientific research or special technologies independently.

**3. Research Areas**

a. Nuclear Reactor Physics Analysis

b. Thermal-fluid Dynamics of Nuclear Reactor

c. Nuclear Reactor Safety Analysis

d. Nuclear Reactor Dynamics & Control

e. Fault Detection and Reliable Analysis of Nuclear Power Equipment

f. Radiation Physics and Technology

g. Nuclear Logging Technology

h. Transient Radiation Physical Process Diagnosis

i. Radiation Effects in Materials and Devices

j. Application of Accelerator Mass Spectrometry

**4. Length of Study Period**

The full-time scheme lasts for two or three years for master students and three to six years for PhD students.

**5. Training Mode**

For PhD candidates, group training mode with supervisor as the top priority should be conducted in the program or united training with other universities, institutes, factories and enterprises can also be adopted to absorb people with high title to participate in the guidance. During the process, based on the demand of the program and students’personalities, supervisors should make plan and direct PhD candidates in the field of dissertation, document searching, survey, scientific research, thesis writing and defense, strengthening students’ ability of self-study, operation, expression and writing.  
For Master students, training mode with supervisors as the top priority should be conducted in the program or united training with other universities, institutes, factories and enterprises can also be adopted to absorb people with high title to participate in the guidance. The process includes course learning and academic dissertation. In accord with the program demand and students’ personalities, supervisors should make plan and direct master students in the field of dissertation, paperwork, thesis writing and defense, strengthening students’ ability of self-study, operation, expression and writing.

**6. Graduate Study**

**Table3** Curriculum structure of Ph.D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Module** | **Course Code** | **Course Title** | **Credits** | **Minimum Requirement** |
| **Communicaiton** | 272004  LITE6102 | Comprehensive Chinese | 2 | 4 |
| 272003  LITE6101 | The Outline of China | 2 |
| **Degree Courses** | 032009  PHYS7107 | Applied Nuclear Physics | 2 | 4 |
| 032011  PHYS7102 | Neutron Physics | 2 |
| 032021  NUCL6105 | Neutron Diffusion Theory and It’s Numerical Methods | 2 |
| 032030  NUCL6109 | Numerical Analysis of Thermal Hydraulics in Nuclear Reactors | 2 |
| 032027  NUCL6107 | Nuclear Reactor Safety Analysis | 2 |
| **Optional** |  | Students can select any course at the list of GraduateSchool |  | 4 |
| **Compulsory** | 001999  BXHJ8003 | Academic Activities (Lectures) | 2 | 8 |
| 001994  BXHJ8001 | Mid-term Assessment | 6 |
| **Thesis** | BXHJ8006 |  | 60 | 60 |
| **Total** | | |  | 80 |

**Table4** Curriculum structure of Master

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Course Module** | **Course Code** | **Course Title** | **Credits** | **Minimum Requirement** |
| **Communicaiton** | 272004  LITE6102 | Comprehensive Chinese | 2 | 4 |
| 272003  LITE6101 | The Outline of China | 2 |
| **Degree Courses** | 032009  PHYS7107 | Applied Nuclear Physics | 2 | 6 |
| 032011  PHYS7102 | Neutron Physics | 2 |
| 032021  NUCL6105 | Neutron Diffusion Theory and It’s Numerical Methods | 2 |
| 032030  NUCL6109 | Numerical Analysis of Thermal Hydraulics in Nuclear Reactors | 2 |
| 032027  NUCL6107 | Nuclear Reactor Safety Analysis | 2 |
| **Optional** |  | Students can select any course at the list of GraduateSchool |  | 12 |
| **Compulsory** | 001997  BXHJ6003 | Academic Activities | 1 | 4 |
| 001994 | Mid-term Assessment | 3 |
| **Thesis** | BXHJ6008 |  | 25 | 25 |
| **Total** | | |  | 51 |

**7. Academic Dissertation**

**Master Thesis**:Master thesis should be finished independently by students under the guide of supervisors. The thesis, which should be prepared at least 1 year, must be systematic and complete with new insights. The topics should be identified with the help of supervisors and through reading documents and doing investigation.  
The thesis should be concise, rigorous and accurate in theoretical guidance and computation. The presentation should be conducted with a pragmatic scientific attitude.  
At least two paper reviewers with senior titles who get familiar with the paper are needed. The other should come from other departments. For instance, if the paper focuses on software design or development, one of the reviewers should be familiar with it and do the acceptance. The defence can only be conducted with the agreement of the reviewers. If one reviewer disagrees, another one should be employed; if two reviewers reject, the defence can only be conducted after reapplying through revising the paper.  
Thesis need review and defence. When presenting an oral defense, graduates are supposed to answer questions related to the thesis, including professional basic theory and specialized knowledge.

**PhD Dissertation**:PhD dissertation should be completed under the guidance of supervisors and research topic and scope need to be identified through document reading and investigation. Candidates should take the advantage of strong points of their supervisors and themselves, combining the scientific task to make creative achievements.  
Students should prepare materials at the beginning of the second semester and identify the preliminary topic at the end of it. The proposal report must be finished and read out at the conference of teaching and research section so as to seek for opinions. At the beginning of the third semester, final topic and paper work plan should be identified and worked out including main contents in different periods, requirements and completion deadlines, etc.  
During the process of scientific research which costs nearly one semester, PhD candidates should present a progress report on the meeting organized by different departments.  
Each PhD candidate is required to publish a dissertation as the primary author or the second author (the supervisor being the primary author) with Xi’an Jiaotong University as the signed unit in periodicals in accord with the demand of the GraduateSchool or periodicals at even higher levels. The dissertation should be closely related to the graduate thesis.  
The workload, number and form of graduate thesis should be in line with the demand of the dissertation of XJTU. The dissertation should be concise, rigorous and accurate in theoretical guidance and computation. The presentation should be conducted with a pragmatic scientific attitude.  
Five paper reviewers with senior titles who get familiar with the paper are needed. At least two experts are from other departments. The defence can only be conducted with the agreement of the reviewers. If one reviewer disagrees, another one should be employed; if two reviewers reject, the defence can only be conducted after reapplying through revising the paper.  
When presenting an oral defense, with pragmatic attitudes, graduates are supposed to answer questions related to the thesis, including professional basic theory and specialized knowledge.

**8. Research Centers**

**1) Institute of Nuclear Energy**

Institute of Nuclear Energy, corresponding to the second-level discipline of Nuclear Energy Science and Engineering, mainly focuses on the research of nuclear engineering. This institute includes four research groups, reactor physics group, reactor thermo-hydraulics group, reactor safety group, and reactor instrumentation & control group. It was awarded as one of the two national key disciplines by the Ministry of Education of China. During its 55 years of history, the institute has made significant achievements on both education and research. It has overtaken more than 100 national research projects including National 863 program, National Natural Science Foundation of China, ITER program, and so on. The average funding of each year is around 20M RMB. More than 500 technical papers are published in recent years. The research area covers:

* Advanced core design including SuperCritical Water-cooled Reactor(SCWR), Molten Salt Reactor (MSR), Accelerator-Driven Subcritical System (ADS), Fast Breeding Reactor (FBR), Fusion Reactor (ITER), etc.
* Numerical computational methods on neutron transport, thermo-hydraulics, fluid dynamics, reactor system analysis, NPP simulation, etc.
* Software development for reactor core design and safety analysis,
* Experimental study on heat transfer of two-phase flow.

**2) Instituteof Nuclear Technology(INT)**

Institute of Nuclear Technology, Xi'an Jiaotong University mainly focuses on the research of nuclear technology application. The research interest in INT spans a wide range of nuclear technology, mainly including radiation effects, accelerator mass spectrometry application, radiation shielding materials, radiation detection technology, radioisotope battery, reconstruction of radioactive source term and environmental impact assessment in nuclear accidents, and radiation protection. Since its establishment in 2006, it has obtained many achievements in scientific research and educating students. So far, the institute has been financially supported by more than 30 programs, from National "863" program, National Natural Science Foundation of China (NSFC), contracts from companies, and international cooperation programs.

**9. Description of Courses**

**(1)032009 Applied Nuclear Physics**

**Credits：2**

**Prerequisites: Nuclear Physics**

The course involves the basic knowledge of applied nuclear physics and its application fields. It includes the following contents: introduction of nuclear technology and its application, radiation sources, nuclear instruments, nuclear analysis technology, isotope traced technology, radiation process and nuclear medicine, etc.

**(2)032011 Neutron Physics**

**Credits：2**

**Prerequisites: Nuclear Physics**

The course involves the basics of neutron physics. It includes the following contents: the intrinsic properties of neutron and classification; the neutron sources; the collisions of neutrons with nuclei; the stable isotope chart and reactions involving neutrons; the models of nuclei and nuclear reactions; the scattering of neutrons; the slowing down of neutrons; the distribution of slow neutrons in a medium; the neutrons in nuclear fission; the neutrons in nuclear fusion; the detection and measurement of neutron; the application of neutron.

**(3)032021 Neutron Diffusion Theory and It’s Numerical Methods**

**Credits：2**

**Prerequisites:**

**Reactor physics analysis**

**Nucleonics**

**Computing Method**

This course pays main attention to the fundament theory of the neutron diffusion equation and the solving methods about it. It includes the source iteration process of the multi-group neutron diffusion equation, the finite difference method, the finite element method and the nodal method for solving the neutron diffusion equation, the numerical method of the kinetics equation and the perturbation theory.

**(4)032030 Numerical Analysis of Thermal Hydraulics in Nuclear Reactors**

**Credits：2**

**Prerequisites:**

**Nuclear Reactor Thermal-Hydraulic Analysis**

**Heat Transfer**

**Fluid Mechanics**

**Boiling Heat Transfer and Vapor-Liquid Two-Phase Flow or by permission**

This course presents the basic physical models and computational methods using in nuclear reactor thermal-hydraulic analysis. It includes the following contents: coolant flow and heat transfer; thermal-physical properties for fuel, coolant and structure materials; accessorial models for pump, steam generator, pressurizer etc.; numerical analysis techniques of two-phase flow; steady state and transient numerical analysis on nuclear power systems; computational methods and analysis on two-phase flow instability; introduction to some commercial software applied in nuclear reactor analysis.

**(5)032027 Nuclear Reactor Safety Analysis**

**Credits：2**

**Prerequisites:**

**Nuclear reactor thermal hydraulics analysis**

**Nuclear reactor physics analysis**

**Nuclear Power plant components and systems**

The course involves the main fields of nuclear reactor safety. It includes the following contents: nuclear safety goals, numerical method for point kinetics model and 3D time-space kinetics model, description for two-phase homogeneous, drift flux and two-fluid model, basic theory for numerical method of two-phase flow models and their application, introduction of typical safety analysis codes.The numerical experiments will be carried out in the Lab of Nuclear Power Plant Operation and Accident Analysis.