Physics and Technology of Nuclear Reactors Masters\MSc

Postgraduate Masters/MSc degree programme in Physics and Technology of Nuclear Reactors:

The aim of this programme – which began in 1956 – is to provide the necessary background, both in breadth and in depth, for anyone wishing to enter the nuclear industry.

The areas of study and degree of specialisation involved have changed considerably to reflect the increasing sophistication of the field, and yet the overall breadth of the course has been maintained.

Study here and find out why the University of Birmingham was awarded The Times and The Sunday Times University of the Year 2013-14 (http://www.birmingham.ac.uk/news/latest/2013/09/20-sep-Birmingham-announced-as-University-of-the-Year.aspx)

Course fact file

Type of Course: Continuing professional development, taught

Study Options: Full time, part time

Duration: 1 year full-time, 2 years part-time (modular)

Start date: September/October

Related courses

Postgraduate degrees - Birmingham Centre for Nuclear Education and Research (/research/activity/nuclear/postgraduate-taught/index.aspx)

Postgraduate degree courses - School of Physics and Astronomy (/schools/physics/postgraduate/index.aspx)

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School of Physics and Astronomy (/schools/physics/index.aspx)

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Details

The environmental impact from the use of fossil fuels and the uncertainties in their sources of supply has led to many alternative energy sources being proposed and investigated. However, of the non-fossil fuel sources, only nuclear fission power is at present sufficiently developed to provide an economically viable alternative to fossil fuels.

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Studentships are sponsored by the nuclear industry in the UK, and these provide excellent and effective entry routes into careers in this stimulating field for physicists, mathematicians, metallurgists or engineers.

A taught element from September to May is followed by a 14-week project, usually undertaken within the industry.

Related links

- **Postgraduate degree courses - School of Physics and Astronomy (/schools/physics/postgraduate/index.aspx)**
- **Postgraduate degrees - Birmingham Centre for Nuclear Education and Research (/research/activity/nuclear/postgraduate-taught/index.aspx)**

Course structure

Module A Nuclear Instrumentation, Radiation Dosimetry & Protection 03 16356 (20 credits)

- Particle Detectors - 16 lectures *
- Neutron Radiation Physics – 7 lectures*
- Nuclear Electronics - 6 lectures *
- Radiation Dosimetry - 6 lectures *
- Radiological Protection - 12 lectures *
- Statistics - 6 lectures + 5 hours examples *

Module B Radiation Transport, Thermal Hydraulics & Reactor Engineering 03 16367 (20 credits)

- Radiation & Charged Particle Transport - 12 lectures*
- Radiation Shielding - 6 lectures *
- Core Physics and Multiplying Media 1 - 5 lectures
- Multiplying Media 2, (Core Physics) - 23 lectures
- Thermal Hydraulics & Reactor Engineering - 25 lectures
- Environmental Impact of Nuclear Power – 4 lectures*

Module C Reactor Materials, Reactor Systems and N D E 03 16368 (20 credits)

- Metallurgy - 20 lectures
- Reactor Materials - 20 lectures
- Reactor Systems and Safety Analysis - 28 lectures
- Nuclear Fuel Cycle - 4 lectures
- Non-Destructive Testing - 9 lectures

Module D General Paper 03 16369 (20 credits)

- Reactor Kinetics – 12 lectures
- Reactor Control - 26 lectures
- Financial Appraisal - 6 lectures*
- Decommissioning - 6 lectures *
- Industrial Lecture Series - 10 Seminars
- Nuclear Fusion - 10 lectures

Module E Practical Skills (40 credits)

- Physics Laboratory - 120 hours in the Lab*
- Physics Metallurgy Laboratory - 12 hours
- Computing and Numerical Analysis - 45 hours
- Reactor Safety Exercise - One-day exercise
- Seminars & Presentation

Module F Research Project (60 credits)

- Project work and Thesis

* These items are taken in common with other MSc courses in the School.

This programme is also available as a 2-year part-time course.

Modules

Detailed course syllabus

The syllabus and the approximate number of lectures given in each course are as follows:

A-1. Particle Detectors (16 lectures)

Principles and operating characteristics of a variety of nuclear particle detectors (gas-filled, liquid and solid types), including discussions of the following topics: Specific energy-loss for electrons and for light and heavy ions; range-energy relationships. Statistical variations and Fano factor. Pulse formation in gaseous proportional counters; recombination effects: application to charged-particle and neutron detection; position-sensitive detectors and microdosimetry. Pulse-shape discrimination. Scintillation mechanism in organic and inorganic detectors: light -output characteristics and particle identification. Photomultiplier characteristics, time- and energy-resolution limitations.

Application to neutron and photon detection. Principles of semiconductor detectors; energy response; energy resolution and its statistical aspects; timing characteristics and factors that influence them.

Uses and operational characteristics of surface-barrier semiconductor detectors; lithium-drifted and hyperpure germanium detectors; position-sensitive detectors. Neutron spectrometry using semiconductor detectors and scintillation counters. Nuclear emulsions, image plates, and charge-coupled devices.

A-2. Design of Accelerators (5 lectures)

Principles and operation of low-energy accelerators; equations of charged particle motion. DC accelerators, including Cockcroft-Walton, Dynamitron, and Van de Graaff/Pelletron/Laddertron machines; insulated-core transformer and sealed-tube neutron generators; tandem accelerators. Linear accelerators: HILAC and electron linacs. Orbital accelerators: classical fixed-frequency, and AVF (Azimuthally Varying Field) cyclotrons. Spallation and synchrotron radiation sources. Applications of high intensity neutron sources as alternatives to reactors. Decommissioning of accelerators.

A-3. Nuclear Electronics (6 lectures)

Nature of information provided by detectors; pulse shapes and times; preamplifiers (especially charge-sensitive types). Pulse-shaping networks; integration and differentiation time-constants; pole-zero cancellation; delay-line clipping. Relevance to pulse shape and signal-to-noise ratio. Timing from pulses. Discriminators; coincidence units; delay-amplifiers; linear gates; time-to -amplitude converters; types of analogue-to-digital converters (ADC's). Functions, properties and shortcomings of modules. Counting and data-acquisition systems.

A-4. Radiation Dosimetry (6 lectures)

Dosimetric quantities and units; field, interaction, conversion and energy deposition. Deposition processes; interrelationship between quantities. Simple methods for estimation of dose rates around radioactive sources; point gamma and beta. Fano and Bragg-Gray theorems; application of cavity theory to dosimetry of X and gamma-rays, electrons and beta particles. Practical considerations in the design and usage of ionisation chambers. Neutron dosimetry. Significance of LET; determination of LET spectra, mixed-field dosimetry. Fundamentals of microdosimetry. Review of dosimetry techniques; calorimetric, chemical, solid state.

A-5. Radiological Protection (12 lectures)

Development of radiological protection. Quantities and units used in radiological protection. Biological effects, including deterministic and stochastic effects. Risk estimates and a comparison with other occupational risks. International Commission on Radiological Protection (ICRP) : principles and recommendations. External and Internal hazards; control measures and monitoring. Dose calculations. Annual limits on intake. Classification of persons and desigdation of areas. Practical aspects of radiological monitoring systems - electronic dosemeters, TL dosemeters, film badges; neutron dosimetry, solid-state nuclear track detectors, albedo dosemeters, air-sampling methods; internal dose assessment procedures. ICRP Publication 60 and the corresponding NRPB recommendations. U K legislation including the Ionizing Radiation Regulations, 1999. The roles of the various regulatory authorities. Public perception of risk. A debate on the acceptability of man-made radiation exposures.[Dr G Zabierek (University Radiation Protection Adviser) provides an initial session of radiological protection and safety training to go with the beginnings of practical work.]

A-6. Statistics (6 lectures + 5 hours examples)

Summary of statistics concepts: frequency distributions and statistical measures. ypes of distributions which are of interest in physics. Sampling and confidence limits. Tests of hypothesis, Student's t-test and chi-sq test. Curve fitting, least squares and non-linear least squares methods. Levenberg - Marquardt routines. Recommended reporting of the errors in experimental data. Practical exercises.

B-7. Radiation and Charged-Particle Transport (12 lectures)

Areas of Application of Transport Theory: particularly reactors, medicine and applications of radiation. The Boltzmann Equation. Flux and Current: Angular and scalar quantities. Double differential scatting cross sections (scattering kernels) and the kinematics of neutron scatter. Outline of Methods of solution of the Boltzmann Equation: Monte Carlo, SN, PN, Energy multigroup form of the Boltzmann Equation, Dealing with time variation. Angular variation and integrating the Boltzmann Equation over solid angle. Diffusion Theory. Non-linear Transport. Data files: in particular ENDF/B, JEF. Specific issues for Photon transport and Electron transport. Kerma.

B-8. Radiation Shielding (6 lectures)

g -ray and neutron shielding calculations; g -ray attenuation and build-up factors. Treatment of complex geometries; distributed and self-shielded sources. Methods for complex spectra, including X-ray generators and irradiated nuclear fuel.

B-9. Core Physics and Multiplying Media 1, (5 lectures)

Significance of neutrons: The Curve of Binding Energy and its Relation to Fission and Fusion, Number Densities, Cross sections, and Mean Free Paths; Theory of fission: Resonances, The Fission Barrier, The Semi-Empirical Mass Formula, Energy release from Fission; IntroductoryReactor physics and kinetics: Simple Ideas of Reactor Criticality, The Four Factor Formula, Delayed Neutrons. 1-Group Diffusion and the Graphite Stack (An experiment in the Laboratory)

B-10. Multiplying Media 2, (Core Physics) (23 lectures)

The Neutron Transport Equation with Fission Source. A Review of Methods of Solution: Monte Carlo, Angular Variation Simplification, SN and PN, Diffusion Theory. Energy Variation Simplification, Multigroup Methods. Space and Time Simplification, relation to Point-Kinetics. Diffusion Theory. Boundary Conditions. One Group Diffusion Theory. Eigen Functions, Criticality and Buckling. Reflected Reactors. Criticality Calculations, Inner/outer loop iteration methods, Extrapolation methods. Perturbation Theory. Dynamic Methods of Reactivity Measurement. Comments on Spatial Effects in Kinetics. Multigroup Diffusion. Multigroup Perturbation Theory. Fast spectrum Effects: Resonance Integrals, Age Theory. Thermal Spectrum Effects. Heterogeneous Cores: Cell Calculations, Dancoff Factors. Actual Codes: WIMS, Argosy, Panther

B-11. Thermal Hydraulics & Nuclear Engineering (25 lectures)

Heat transfer by conduction, application to fuel elements. Heat transfer by forced convection, empirical correlations, dimensional analysis. Application to gas cooled reactors, maximum can temperature in channel, improvement by finning and by roughening can surface. Flow of compressible fluid with friction losses, pressure drop and pumping power. Thermohydraulic design of core, hotspot factors, gagging, significance of pumping power in gas cooled reactors, criteria for fuel element performance, choice of coolant. Boiling heat transfer, burnout, critical heat flux ratio. Two-phase flow, pressure drop correlations. Liquid metal heat transfer, application to sodium-cooled fast reactors. Pressure vessels, analysis of thick walled steel vessels, prestressed concrete vessels. Boilers, use of temperature-enthalpy diagram. Steam cycles, thermodynamic limitations on efficiency, Mollier diagram, wetness problems, superheat, reheat and feed heating. Safety studies by case history e.g. analysis of can temperature rise and duration of typical depressurisation accident.

B-12. Environmental impact of nuclear power (4 lectures)

Sources of activity from the nuclear fuel cycle: discharges from fuel production plants, nuclear power stations and reprocessing plants during operation and decommissioning. Dispersal of radioactive material and radiological consequences of the Chernobyl and other reactor accidents; comparison with other accidents. Nuclear waste disposal: role of BNFL and NIREX in the UK; current operations and future plans for handling radioactive waste.

C-13. Metallurgy (20 lectures)

Types of bonding. Types of solids. Phases and phase diagrams (including thermodynamics). Crystal structures. Microstructural defects: point defects – nature, migration and diffusion; perfect dislocations - Burgers vectors, loops; partial dislocations and stacking faults, stacking fault tetrahedra. Properties of materials: mechanical behaviour - strength, toughness, creep and fatigue resistance; corrosion. Metallurgy of reactor materials: steels - plain carbon steel and stainless steel; precipitation hardened alloys e.g. zircaloy; uranium dioxide.

C-14. Reactor Materials (20 lectures)

Radiation Damage: The damage event: basic physics of charged particles/solid interactions – Kinchin and Pease model. The displacement cascade and point defect residues. Formation of secondary defects. Microstructural development: time and temperature dependence. Radiation Damage in Reactor Materials: Effect on mechanical properties: strength, toughness, fatigue and creep resistance. Radiation induced segregation and precipitation. Case studies: pressure vessel steel, stainless steel, uranium dioxide, graphite.

C-15. Reactor Systems and Safety Analysis (28 lectures)

Economics of nuclear power: Breakdown of cost and factors affecting it. Comparison with fossil-fuelled plant. World-wide distribution of the reactors and their relative advantages and disadvantages. Possible future developments. Graphite moderated reactors: Magnox reactors: Factors affecting choice of fuel, cladding and moderator. Materials and safety factors affecting temperature and performance. Overall factors affecting thermal efficiency. Emergency shut-down and core-cooling plant. Effects of depressurisation accident. Consequences of on-load refuelling. Steel oxidation. AGRs: Ways in which this reactor overcomes the limitations of Magnox systems. Differences in design arising from different fuel and higher gas temperatures. Fuel and moderator design and performance; radiolysis and graphite corrosion. Emergency shut-down systems. HTGRs: Construction of fuel microspheres and core layout. Fission product retention. Temperature limitations and possible use for process heat plant. Water moderated reactors: PWRs: Main features of plant, including layout and containment. Reactivity control with chemical shims, the Chemical and Volume Control System. Power defect and load-following. Consideration of safety of thick steel vessels. Auxiliary shut-down and emergency core-cooling plant. Loss-of-coolant accidents. Radiolysis and zirconium interaction with water. The Sizewell B design. Use of MOX in PWR plant. BWRs: Differences between PWR and BWR systems and effects on performance and safety e.g. effect of steam on design and operation. Emergency core cooling. Primary containment philosophy. CANDU and SGHWR: Similarities and differences between the two systems. Advantages of use of D_2O and of pressure tube designs; fabrication and problems of pressure tubes. Emergency core cooling. Uranium utilisation.

Other reactor systems: Graphite-moderated but water cooled reactors (e.g. the RBMK, Chernobyl type). Mixed oxide fuels. Fast breeder reactors: Possible breeding cycles. Factors affecting choice of fuel and coolant. Design features arising from use of liquid sodium. Effect of sodium voiding. Overall plant layout. Special instrumentation. Doubling time and breeding ratio. Reactor safety: Methodology of event-tree and fault-tree analysis. Statistical data on component failure rates. Safety related engineering studies. The role of the Nuclear Installations Inspectorate and concepts of Tolerability of Risk. Problem of human intervention. Dispersion analysis; effects of weather, siting and population distribution. Role of instrumentation; redundant logic and fail-safe systems. Discussion of main features and conclusions of the Rasmussen Report. Analysis of the Three Mile Island and Chernobyl accidents.

C-16. Nuclear Fuel Cycle (4 lectures)

Production of Magnox and AGR fuel from "yellow cake": Chemistry of the steps involved in the operations at the Springfields plant (UK). Nuclear fuel enrichment, theory of cascade processes. Reprocessing of spent nuclear fuel: basic chemistry involved in the processes at the Sellafield works (UK) including THORP; outline of other methods such as fluid -bed volatilization. At the heart of reprocessing in BNFL's THORP reprocessing plant, Sellafield.

C-17. Non-Destructive Testing (9 lectures)

The reasons for performing NDT: quality control c.f. Fitness-for-purpose. Surface techniques: dye penetrant, magnetic particle testing. Ultrasonics: principles and practical demonstration. Ultrasonics: automated and advanced techniques. Radiography: principles of techniques and image interpretation. Electromagnetic methods: eddy currents, ACFM and practical demonstration. Other NDT techniques e.g. thermography, acoustic emission. Demonstrating NDT reliability. Applications in nuclear power technology. Summary: Comparison of strengths and weakness of techniques.

D-18. Reactor Kinetics: (12 lectures)

Fission product generation and origins of delayed neutrons. Delayed neutron properties. Point-kinetics, reactivity, solution of the in-hour equation. Temperature dependent reactivity feedback effects in power reactor systems. Reactor start-up and shut-down. Xenon build-up and its importance in reactor operation. Other reactor poisons, including burnable poisons.

D-19. Reactor Control (26 lectures)

Introduction to control theory: Laplace transforms, Bode and Nyquist diagrams, Routh criterion, Root Locus methods. Applications to reactors: delayed neutrons, reactor kinetics equations for one-velocity point model and transport theory. Response to reactivity steps, power transfer function. Linearised reactivity feedback: temperature and void effects, boiling water reactor stability. Fission product poisoning, effects on stability, burnable poisons. Self-limiting, super-prompt reactor excursions, fast and thermal systems. Introduction to stochastic control theory. System optimisation and methods of measurement. Reactor transfer functions from noise analysis.

D-20. Financial Appraisal of projects (6 lectures)

Capital investment. Product identification. Appraisal methods: rate of return, payback, time value of money, discounted cash flow, net present value, internal rate of return, sensitivity analysis. Examples and case studies.

D-21. Decommissioning (6 lectures)

Stages of decommissioning. Government policy and regulatory guidence. Reactor decommissioning- the safestore concept. Decommissioning PIE and other supporting facilities. Radioactive characterization. Decontamination techniques. Dismantling techniques. Radiation protection and safety techniques in decommissioning. Cost estimation and option studies. Financial provision for future decommissioning costs. Examples of typical decommissioning projects. Robotic decommissioning has the benefit of zero operator dose, but at what cost, cost/benefit analysis is a key feature of project management.

D-22. Industrial Lecturer Series (10 seminars)

This series draws on industrial speakers to cover specialised topics of interest (examples include decommissioning, reactor circuit chemistry and stress analysis) to give details of how current problems in materials, safety and design are being tackled, and to give some insight into the structure and mode of operation of the nuclear industry. The organisations providing speakers usually include Nuclear Electric, Magnox Electric, BNFL, National Nuclear Corporation and Rolls Royce and Associates.

D-23 Nuclear Fusion (10 lectures)

Principles of nuclear fusion. Confinement techniques, inertial and magnetic confinement. Plasma dynamics. Tokamaks, Stellerators. Materials damage in fusion. Fusion reactor design, components and systems.

Laboratory Courses: In addition to these lectures, there are two experimental laboratory courses, a 'theoretical laboratory' in numerical analysis and computing, and a group exercise to emphasise teamwork. Further details are as follows:

E-23. Physics Laboratory (120 hours in the Lab.)

The physics laboratory course, occupying one day per week for two terms, is designed to complement lectures, to stimulate discussion on theoretical principles and is related, as far as possible, to the background of the students concerned. The general fields covered include:

1. the behaviour of different detector systems
2. the properties, production and use of radioactive materials
3. neutron slowing down, diffusion and multiplication, and
4. neutron and gamma ray behaviour in shields.

The facilities available in the MSc laboratory for these studies are extensive, including hyperpure germanium, surface-barrier and scintillation detectors, gas proportional and Geiger counters, dosimetry equipment, and neutron moderating assemblies. Computer controlled multi-channel analysers are used for data taking and computational facilities are provided for data analysis, graphics, word-processing and FORTRAN programming; direct network links provide communication with other resources on campus and via the internet.

E-24. Physical Metallurgy Laboratory (12 hours)

Study of the basic structures of metals and alloys using optical microscopy. Deformation and dislocation etch-pitting of LiF crystals. Measurement of the plane strain fracture toughness of an alloy steel. Introduction to transmission electron microscopy; electron damage.

E-25. Computational and Numerical Analysis (45 hours)

Students undertake a course in numerical analysis and computation, during which design studies are made. Involved in the numerical analysis are the techniques of numerical integration and differentiation, curve fitting and function approximation; polynomial representation. (Taylor's and Tchebychev's expansions). Finite-differences and Runge-Kutta methods in solving differential equations, error estimates; approximate integration methods and error estimates. Applications in radiation transport particularly including Monte Carlo Methods. Practical exercises and demonstrations are carried out. The computing element provides an introduction to the facilities available in the laboratory which include word processing, spreadsheets and graphics packages. Emphasis is given to programming in FORTRAN.

E-26. One-day exercise on Nuclear Power Safety

Students are set a problem; they then have one day to organise themselves to tackle it systematically, identify a solution, and to present a report. A member of staff from the industry is usually available to provide advice and feedback at the end of the session.

E-27. Seminar

During the Spring Term all students on the course present a 50 minute seminar on some topic of their own choice within the general field of "energy". This is assessed by the course supervisor as part of the overall assessment relating to the course; however both he and the remainder of the course provide feedback to the student so that the exercise can be used as a means of developing good presentational skills. [NB writing skills are also practised in the tutorial classes]

F-28. Project

During June to September a project is undertaken; for sponsored students this is usually at one of the sponsor's sites. In recent years it has also been possible to arrange industrially based projects for other students as well. The report on the project forms an important component in the assessment for the course.

Fees and funding

Tuition Fees

Tuition fees for 2015/2016 are as follows:

- £6,210 for **home/EU students**
- £17,960 for **international students**

Learn more about **fees and funding (/postgraduate/pgt-fees/fees.aspx)**

Scholarships and studentships

Scholarships may be available, for more information contact the School directly or email **sfo@contacts.bham.ac.uk (mailto:sfo@contacts.bham.ac.uk)**

International students can often gain funding through overseas research scholarships, Commonwealth scholarships or their home government.

Entry requirements

Learn more about **entry requirements (/postgraduate/requirements-pgt/index.aspx)**

International students
We accept a range of qualifications from different countries – learn more about **international entry requirements (/postgraduate/requirements-pgt/international/index.aspx)**
Standard English language requirements (/postgraduate/requirements-pgt/international/index.aspx) apply

How to apply

When clicking on the Apply Now button you will be directed to an application specifically designed for the programme you wish to apply for where you will create an account with the University application system and submit your application and supporting documents online. Further information regarding how to apply online can be found on the **How to apply pages (http://www.birmingham.ac.uk/students/courses/postgraduate/apply-pg/index.aspx)**

Apply now (https://pga.bham.ac.uk/lpages/EPS025.htm)

Related links

Postgraduate degrees - Birmingham Centre for Nuclear Education and Research (/research/activity/nuclear/postgraduate-taught/index.aspx)

Postgraduate degree courses - School of Physics and Astronomy (/schools/physics/postgraduate/index.aspx)

Related news and events

Small nuclear reactors may be the key to a low-carbon future (/university/colleges/eps/news/college/2014/small-nuclear-reactors-low-carbon-future.aspx)

The need for a roadmap for nuclear policy (/news/thebirminghambrief/items/2012/03/The-need-for-a-roadmap-for-nuclear-policy.aspx)

A long-term national commitment to nuclear power is needed by government, a University of Birmingham Policy Commission report warns (/news/latest/2012/06/28-Jun-12-A-long-term-national-commitment-to-nuclear-power-is-needed-by-government,-a-University-of-Birmingham-Policy-Commission-report-warns.aspx)

Learning and teaching

In common with most MSc courses, for the first eight months of the course there are lectures and laboratory classes. Following the examinations in May there is a three month research project, chosen from a wide range of topics within the field.

This project may be conducted at the University or, more frequently, arrangements can be made for this to be undertaken at an establishment within the nuclear industry. This has proved to be a popular option in recent years both in giving students an opportunity to collaborate directly with a part of the industry and in enhancing their employment prospects.

Tutorials

These take place weekly throughout term time, where small-group discussions help to ensure that the material covered in lectures and practical classes is being properly assimilated by the students. Any individual problems encountered by a student in his or her course work may also be raised by them during these tutorials. As the course progresses practice is given in answering examination-style questions and other types of problem. In addition, writing and information gathering skills are practised through the production of essays, while open discussion of the results within a tutorial class permits exercising of powers of interpretation and analysis. The course is introduced to the facilities in the Library, including its bibliographic resources and networks and this knowledge is also practised through tutorial exercises.

Visits

Throughout the academic year visits are made to a variety of nuclear establishments. These usually include a visit to a nuclear power station, BNFL's Springfields and Sellafield works, and to an AEA Technology site. In addition, one day is spent at a training reactor where several experiments on reactor kinetics are performed.

Related research

- **School of Physics and Astronomy research (/research/activity/physics/index.aspx)**

Related staff

Dr Paul Norman (/staff/profiles/physics/norman-paul.aspx)

Dr Mark Read (/staff/profiles/chemistry/read-mark.aspx)

Employability

University Careers Network

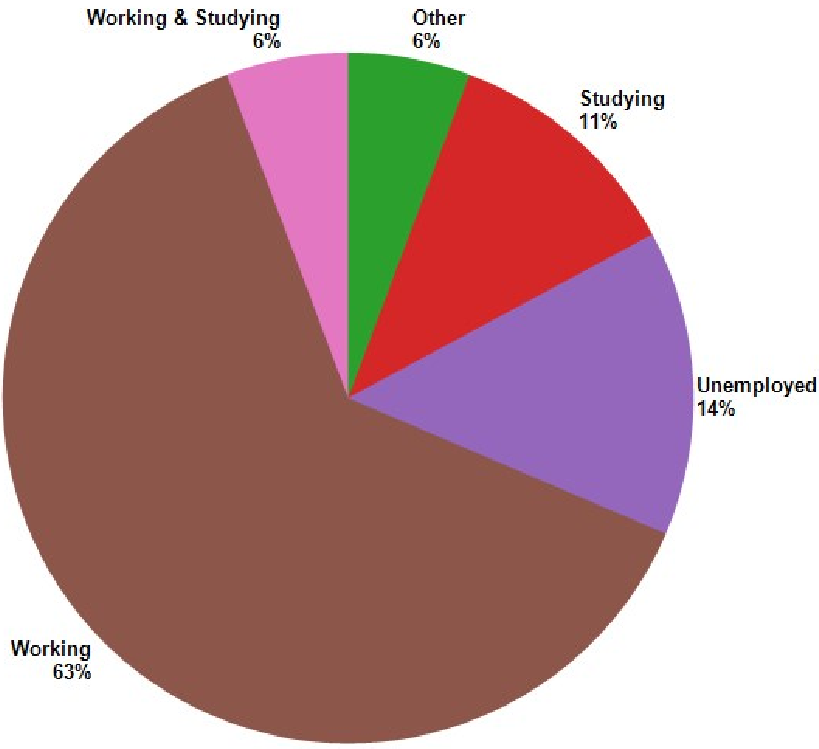
Preparation for your career should be one of the first things you think about as you start university. Whether you have a clear idea of where your future aspirations lie or want to consider the broad range of opportunities available once you have a Birmingham degree, our Careers Network can help you achieve your goal.

Our unique careers guidance service is tailored to your academic subject area, offering a specialised team (in each of the five academic colleges) who can give you expert advice. Our team source exclusive work experience opportunities to help you stand out amongst the competition, with mentoring, global internships and placements available to you. Once you have a career in your sights, one-to-one support with CVs and job applications will help give you the edge.

If you make the most of the **wide range of services (https://intranet.birmingham.ac.uk/as/employability/careers/college/eps/index.aspx)** you will be able to develop your career from the moment you arrive.

Destinations of Leavers from Higher Education (DLHE) 2011/12 (postgraduate taught graduates)

The DLHE survey is conducted 6 months after graduation.



Examples of employers

- Siemens
- Rolls Royce PLC
- Optical Performance Centre
- KPMG
- Microsoft Ltd
- King Edwards Consortium
- J.Sainsburys PLC
- Mondrago Investigations Limited
- Self employed
- NHS

Examples of occupations

- Software Engineer
- Trainee Clinical Scientist
- Technology Graduate
- Secondary School Teacher - Physics
- Research Analyst
- Nuclear Manufacturing Engineer Intern
- Musician
- Recruitment Consultant
- Internet Application Engineer
- Data Analyst

Further study - examples of courses

- MSc Astrophysics
- MSc Computer Science
- MSc Forensic Ballistics
- MSc Medical Imagery
- MSc Nuclear Physics
- MSc Physics and Technology
- MRes Chemical Engineering
- PhD Electronic Engineering
- PhD Physical Sciences

Visit the **Careers section of the University website (https://intranet.birmingham.ac.uk/as/employability/careers/college/eps.aspx)** for further information.