College of Science and Engineering
School of Biological Sciences
November 2013

Proposal for a new postgraduate programme

MSc/Diploma in Biochemistry

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THE UNIVERSITY OF EDINBURGH
PROGRAMME SPECIFICATION FOR
MSc/Diploma in Biochemistry

1) Awarding Institution: University of Edinburgh
2) Teaching Institution: School of Biological Sciences
3) Programme accredited by: N/A
4) Final Award: MSc/Diploma
5) Programme Title: Biochemistry
6) UCAS Code: N/A
   Relevant QAA Subject Benchmarking Group(s):
7) Postholder with overall responsibility for QA: Prof A. Aitken
8) Date of production/revision: November 2013
9) External Summary (200-250 words)

This programme aims to attract UK, EU and overseas students to Edinburgh to an academically-challenging and career-developing MSc programme studying biological systems at the molecular and cellular level. Biochemistry is fundamental to most areas of life-science; it has a major impact on modern medical research and is essential in the pharmaceutical, nutrition, forensic, bioengineering, agricultural and environmental industries. The programme is designed to produce highly skilled and motivated biochemists that are suitable for entry into employment in life-sciences industry or for further academic research.

Students will be taught to apply chemical and physical principles to biological molecules in complex living systems in order to expand their understanding of the molecular basis of the processes which take
place within these organisms. Through a combination of taught courses, practical skills training and laboratory-based research, students will explore the structures, dynamics, interactions and metabolic pathways of biological molecules, from small molecules to large macromolecular complexes.

Students will enhance their career prospects by acquiring knowledge of contemporary biochemistry from world experts in the field, by being trained in advanced analytical and presentation skills, and by having independent research experience in a modern, world-class laboratory. The School of Biological Sciences offers an excellent research-rich environment in which to develop as scientists and entrepreneurs.

The programme aims to develop:

- knowledge and understanding of biochemistry and awareness of the current state of research
- enhanced practical skills in biochemical methods
- ability to design, perform and record experiments independently
- analytical skills to interpret data accurately and critically
- ability to communicate biochemical information effectively in a wide range of contexts

10) **Educational aims of programme:**

The MSc in Biochemistry aims to give students an in-depth knowledge of biochemistry theory and enhanced practical skills to produce a trained intellect that is capable of independent, critical thinking.

The programme aims to develop skills in:

- Knowledge and understanding of biochemistry and methodology
- Practical skills in the laboratory, biocomputing and literature research
- Awareness of current state of biochemical research and what questions are being tackled by the contemporary biochemist
- Science communication – written and oral
- A range of generic transferable skills

The programme aims to teach theoretical principles and current knowledge of molecular structures and biochemical pathways through lectures, interactive workshops and tutorials, literature analysis and practical skills training. The students will learn how to design, perform and document experiments in a laboratory; how to draw quantitative conclusions from experimental data and how to present results and theoretical knowledge. All students will develop the level of understanding that will allow engagement in debates on current topics in a broader context.

11) **Programme outcomes:**

11a) **Knowledge and understanding**

The taught components, the learning of independent study skills and the laboratory experiences aim to provide a fertile combination of mechanisms for student to gain knowledge and understanding in:

- theoretical principles of the physics and chemistry of biological molecules and their activities
- structures of biological macromolecules and macromolecular assemblies
- how and when molecules interact, and the significance in terms of biological function
- metabolic pathways, enzyme mechanisms and energetics
- contemporary biochemical methods and of state-of-the art technology
- how biochemistry relates to real biological problems and its applications in research and industry

11b) **Graduate attributes: Skills and abilities in Research and Enquiry**

A combination of essay writing, literature reviews, practical skills training and an independent research project aim to provide the student with skills in:

- ability to independently design, perform and record laboratory-based research
- critical analysis to interpret biochemical data accurately
searching, reading and critical analysis of literature
bioinformatic database searching and analysis
exchanging ideas and knowledge/skills with scientific colleagues

11c) Graduate Attributes: Skills and abilities in Personal and Intellectual Autonomy

The development of critical thinking lies at the core of the intellectual training provided in the Biochemistry MSc programme. Students develop an increasing competence to deal with intellectual concepts and scientific discussion, and to evaluate contradictory arguments through essay writing, group-work and laboratory research.

Students will acquire the ability to:

- Take responsibility, and identify effective strategies, for their own learning
- Summarise and interpret the work of others in the context of previous work and likely developments in biochemistry
- Evaluate the strength and weaknesses of scientific evidence, thereby being able to arrive at independent conclusions
- Understand the relative value of different scientific approaches
- Organise complex arguments and draw these together into a coherent conclusion
- Consider and understand scientific theories in biochemistry
- Formulate, investigate and discuss questions
- Build on existing biochemical knowledge to suggest new directions for investigation
- Understand the relevance and importance of explaining scientific ideas and the impact of science to the wider community
- Acquire knowledge of opportunities and career pathways for professional development.

11d) Graduate Attributes: Skills and abilities in Communication

Communication skills will be developed throughout the programme to ensure the student attains and recognises the value of:

- Effective and coherent writing skills, through essays, exam questions, research project proposal and dissertation
- Oral communication skills, through group discussions, poster and paper presentations
- Confidence in interaction with peers, with research fellows in the laboratory and with supervisors
- Communicating with the wider public, policy makers and other practitioners.

11e) Graduate Attributes: Skills and abilities in Personal Effectiveness

- Learning independent study techniques, such as literature reading.
- Working independently on the creation of essays and reports.
- Effective team-working skills - collaborating efficiently and productively with peers in the process of learning and presenting conclusions
- Confidence to undertake and to present scholarly work that demonstrates an understanding of the aims, methods and considerations, and ability to form conclusions
- Organisational skills - managing workload efficiently and effectively
- Ability to analyse individual strengths and weaknesses through the feedback provided.
- Time management skills
- Problem solving skills
- Analytical skills

11f) Technical/practical skills
Technical and practical skills in biochemistry will be acquired through taught practicals and computer-based workshops, and in the independent research project, including:

- Ability to design and conduct experiments in the laboratory
- Confidence in the use of state-of-the-art instrumentation
- Practise and record accurate observation
- Numeracy and statistical analysis
- Computing skills – bioinformatics, database, experimental modelling programmes
- Analysis of graphs, figures and tables
- Good laboratory practice – health and safety

### Programme structure and features

#### Entry Requirements:
Students should possess a UK University undergraduate degree or its equivalent outside the UK (usually at least a 2:1 honours degree or its equivalent). Candidates are expected to possess a strong background in one or more of the following areas: biochemistry, biological sciences with some chemistry component, chemistry with biological chemistry components. Other scientific backgrounds will also be considered on a case-by-case basis.

The minimum requirements for non-native speakers of English are:

- IELTS Academic Module 6.5 (with at least 6.0 in each section)
- TOEFL-iBT 92 (with no score lower than 20 in each section)
- Pearson Test of English 61 (with no score lower than 56 in each section)
- Cambridge CPE Grade C (ONLY for applicants who do NOT need Tier 4 visas to enter UK)
- Cambridge CAE Grade B (ONLY for applicants who do NOT need Tier 4 visas to enter UK)

However, because much of these courses involve presentations and the rapid production of research write-ups, students with the minimum language requirements may find the language expectation demanding. We therefore recommend that students should reach:

- IELTS 7.0
- TOEFL 100

Students who do not have this level of English are recommended to take one of the summer English language courses in "English for Academic Purposes" at the University of Edinburgh's English Language Teaching Centre (ELTC) prior to starting the degree programme in September. Further details can be found at: [http://www.ed.ac.uk/schools-departments/english-language-teaching/](http://www.ed.ac.uk/schools-departments/english-language-teaching/).

#### Modes of Study:
The programme is full time, running from mid September to the end of August, with graduation taking place end of November/beginning of December.

#### Progression and Exit Awards:
Students who gain >=50% overall and >=50% in at least 80 of the 120 credits in the final overall assessment of the taught stage at the end of May can proceed to the dissertation stage, and carry out a full-time research project from June – August.

Students who gain >=40% overall and >=40% in at least 80 of the 120 credits in the final overall assessment who do not qualify to proceed will be awarded the Diploma and leave in June.

To be awarded the MSc, students must successfully complete both the taught and dissertation stages. Students may elect to exit at the end of the taught stage with the award of Diploma.
**Curriculum:**

The taught component of the programme will comprise 120 credit points made up of compulsory and optional courses, valued at 10 or 20 credit points, which will be split between the first and second semesters. The remaining 60 credits will be for a full-time research project culminating with a dissertation in the third semester.

A summary of the proposed course options available, with credit points and levels, is given below. Additional 10 credit elective courses will be developed subject to demand and teaching expertise.

### Compulsory Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>SCQF Level</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGBI XXX</td>
<td>Biochemistry 1 – Enzymes and Metabolism</td>
<td>20</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>PGBI XXX</td>
<td>Biochemistry 2 – Intermolecular Interactions</td>
<td>20</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>PGBI11041</td>
<td>Biophysical Chemistry</td>
<td>10</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>PGBI XXX</td>
<td>Project Proposal and Literature Review</td>
<td>10</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>PGBI XXX</td>
<td>Research Project</td>
<td>60</td>
<td>11</td>
<td>3</td>
</tr>
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</table>

### Optional Courses

<table>
<thead>
<tr>
<th>Code</th>
<th>Course Name</th>
<th>Credits</th>
<th>SCQF Level</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGBI11029</td>
<td>Applicable Mathematics</td>
<td>10</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>BITE10001</td>
<td>Enzymology and Biological Production</td>
<td>10</td>
<td>10</td>
<td>1</td>
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<tr>
<td>BITE10010</td>
<td>Gene Expression and Microbial Regulation</td>
<td>10</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>PGBI11051</td>
<td>Information Processing in Biological Cells</td>
<td>10</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>PGBI11023</td>
<td>Molecular Modelling and Database Mining</td>
<td>10</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>PGBI11026</td>
<td>Preparative Methods for Structural Biology</td>
<td>10</td>
<td>11</td>
<td>1</td>
</tr>
<tr>
<td>PGBI11092</td>
<td>Tools for Synthetic Biology</td>
<td>10</td>
<td>11</td>
<td>1</td>
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<tr>
<td>PGBI11094</td>
<td>Applications of Synthetic Biology</td>
<td>10</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>PGBI11006</td>
<td>Bioinformatics</td>
<td>10</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>PHY511040</td>
<td>Biological Physics</td>
<td>10</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>PGBI11049</td>
<td>Commercial Aspects of Drug Discovery</td>
<td>10</td>
<td>11</td>
<td>2</td>
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<tr>
<td>BILG11005</td>
<td>Detailed Characterisation of Drug or Ligand Interactions Using SPR</td>
<td>10</td>
<td>11</td>
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<tr>
<td>PGBI11088</td>
<td>Drug Discovery</td>
<td>10</td>
<td>11</td>
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<tr>
<td>PGBI11040</td>
<td>Functional Genomic Technologies</td>
<td>10</td>
<td>11</td>
<td>2</td>
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<tr>
<td>PGBI11021</td>
<td>Protein Structure Determination</td>
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<td>11</td>
<td>2</td>
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</table>

**Assessment:**

The programme will be assessed by a combination of in-course assessment (both continuing assessment and written examinations) and an MSc dissertation prepared from the major research project. Examinations will be held at the end of the semester in which the course is completed. Students reaching a satisfactory standard in course assessment will be allowed to continue to the MSc, and will be required to submit a dissertation on an approved topic by mid August. The weighting given to each course will be according to its credit points.
13 Teaching and Learning Methods and Strategies

Teaching and Learning strategies employed at the University of Edinburgh consist of a variety of different methods appropriate to the programme aims. The graduate attributes listed above are met through a teaching and learning framework (detailed below) which is appropriate to the level and content of the programme.

Teaching and Learning Activities include:

- Lectures
- Tutorials
- Workshops
- Presentations
- Laboratory work – practical skills training and research project
- Literature and database searching
- Discussion Groups/Project Groups
- Seminars

Examples: Students will have practical skills training and will attend problem-, and computer-based tutorials and workshops. Those students progressing to MSc level will carry out their own research project at the frontier of knowledge and can make a genuine contribution to the progress of original research. This also involves reviewing relevant papers, analysing data, writing a dissertation and giving a presentation.

Facilities

Students have access to reading rooms and computer rooms within the school, and to the library on the same campus.

Innovative Learning Week

The University of Edinburgh Innovative Learning Week is scheduled in Week 6 of Semester 2. During this week ‘normal’ teaching is suspended which provides space outwith the curriculum for staff and students to explore new learning activities. Some examples of the types of activities held in Biological Sciences were workshops, peer-assisted learning activities, public engagement activities, careers events and field trips.

14 Assessment Methods and Strategies

Courses are assessed by a diverse range of methods. This often takes the form of formative assessment, which provides the student and teacher with on-going feedback, as well as summative assessment, which is submitted for credit, including:

- Essays; students are provided with written feedback
- Assessed Problems; students are provided with written feedback
- Oral Presentations and project work; feedback is provided by peers and staff
- Written Degree Examinations; students have the opportunity to meet with course organisers to view their examination scripts.
- Multiple Choice Tests
- Project Reports and Presentations; students are provided with written feedback.

15 Career Opportunities

Biochemistry MSc graduates have a wide range of career options and are recruited by both the established pharmaceutical industry and NHS (clinical biochemistry). Employers are from a
diverse range of life-science biotechnology companies, including analytical and bioengineering, agricultural, aquaculture and environmental industries.

Equally this qualification is an excellent preparation for a career in academic research and we expect many students to continue to PhD level.

16 Other Items (note this was originally Section 13)

The MSc in Biochemistry complements and enhances the existing choice of Masters programmes offered by the School of Biological Sciences at the University of Edinburgh. Many aspects of Biochemistry are taught within these programmes and, since they share a common structure, this provides the student with a wide range of educational opportunity through the optional courses.

The programme is intended for high calibre students with a biology/chemistry background who wish to obtain advanced and more focused education in Biochemistry, with enhanced practical, analytical and communication skills to enable them to pursue a career in biochemical research or in industry.

Students will be encouraged to integrate themselves with the vibrant postgraduate student body (MSc, MRes and PhD students) based in the King’s Buildings campus, and to take full advantage of their time within the social and intellectual sphere of a leading European University.

The Programme Director of the MSc in Biochemistry also adopts the role of Personal Tutor to each student on the programme, providing them with both academic and pastoral guidance. Throughout a student’s time at the University, the Programme Director guides the student in choice of courses and provides general support. Courses are administered and run through Teaching Organisations. These produce detailed handbooks for new students and also advise students on assessment and general university policy and regulations.

Proposed New Courses for MSc/Diploma in Biochemistry

Full course proposals, for the new compulsory courses outlined below, will be submitted to the next Board of Studies for approval.

Biochemistry I – Enzymes and Metabolism: 20 credits, semester 1

This core course will cover all aspects of enzymology by exploring one or two metabolic pathways in depth; it will be taught by lectures and workshops with assignments of literature and data-base searching, computer-based modelling of pathway fluxes and practical skills training. Summative assessment of the course will comprise examination at end of semester 1 and in-course assessment of project work.

Proposed topics:
- Metabolic pathways
- Enzymology: mechanisms, kinetics, allostery, structures, regulation, feedback, substrate channelling
- Interrelationships between metabolic pathways
- Metabolic compartmentalisation
- Glycolysis
  - parasite vs human - relevance for disease and disease control/drug design
  - moonlighting enzymes
- Fatty acid/lipid metabolism
- Isoprenoid biosynthesis
  - Mevalonate pathway vs DXP pathway - evolution of 2 distinct pathways
  - bioengineering: significant natural product synthesis;
  - plant/bacterial natural products - carotenoids, antibiotics, insecticides
- Non-ribosomal synthesis, polyketides, fatty acid synthesis, acyl carriers

Proposed Project work:
- Collation data for a given pathway from different organisms: bacteria, mammalian, parasites, fungi.
- In silico modelling of fluxes, exploring effects of interference
Practical - using model system, test effects found in silico - enzyme assays; cloning, expression and purification of same enzyme from different species. This work will be done in collaboration with the Edinburgh Protein Production Facility.

Biochemistry II – Intermolecular Interactions: 20 credits, semester 2
This course will follow the theme on from Biochemistry II; it will be taught by lectures and workshops exploring in depth, intermolecular interactions in metabolic pathways in terms of function, such as signalling, regulation and transcriptional control. The methods used to study these interactions in the research laboratories in Edinburgh will be taught through workshops and practical classes, using proteins made in Semester 1. Summative assessment of the course will comprise examination at end of semester 2 and in-course assessment of project work.

Proposed topics:
- protein:protein, e.g in signalling: phosphorylation, redox
- protein:small molecule: natural substrates, co-factors, metals, drug binding,
- DNA-protein: DNA repair and recombination; transposition, DNA footprinting/mapping RNA – protein; translational control
- protein:l lipid: membranes
- protein:carbohydrate

Proposed Project work:
- Workshops/practical sessions on methods associated with lectures:
  - e.g in silico methods plus X-ray/SAXS/ EM, crosslinking, ChIP/pyCRAC/CLIP, biochemical assays, SPR/ITC, fluorescence, CD, DLS.

Project Proposal and Literature Review: 10 credits, semester 2
Students will be taught how to prepare a grant proposal and will undertake a review of the literature on a theme relevant to the student’s allocated research project. In consultation with the project supervisor, the students will develop the details of a laboratory-based research project and write this up as a mock grant proposal. The written proposal will be assessed for 100% of the course mark.

Research Project and Dissertation: 60 credits, semester 3
Students will conduct a full-time, supervised, independent research project in an area related to the programme. Students will be expected to develop a suite of research skills, including practical, analytical and reporting expertise as well as organisational, experimental design and communication skills. Assessment will be by written dissertation (100%), although the supervisor will include assessment of your performance during the project.