Graduate Apprenticeship Handbook Supplement

HERIOT WATT UNIVERSITY

BSc (Hons) Software Development for Business

Academic Session 2021-22

Table of Contents

1. School and Discipline Information

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1.1.2 Additional Contacts

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Director of Studies, Year 2	Dr Phil Bartie	phil.bartie@hw.ac.uk	0131 451 3416
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1.2 Remote Learning

Graduate apprenticeship programmes at Heriot-Watt will remain accessible remotely. Learners will have the option to attend campus (depending on any restrictions in place) or to access learning from their workplace or home. **Apprentices will not be disadvantaged in any way should they choose to study remotely rather than on campus.**

2. Welcome and Introduction

2.1 Welcome from Head of the School

The School of Mathematical and Computer Science welcomes you warmly to our Graduate Apprenticeship scheme. We are looking forward to the contribution you will make to our School and to shaping this programme. We will help you achieve your potential and make the most of the opportunities the programme will offer you.

On behalf of everyone in the School, I wish every success in your work and your studies.

Professor Beatrice Pelloni Head of School

2.2 Welcome from Academic Head of Computer Science

We are very proud of our Computer Science heritage here at Heriot-Watt University and were the first university in Scotland to launch a BSc degree in Computer Science back in 1966. Today within Computer Science we have a very strong portfolio of undergraduate and postgraduate degree programmes. We pride ourselves on our research-led teaching where advanced courses reflect the many research strengths of the department.

As a student on the Graduate Apprenticeship programme in BSc Software Development for Business, you are part of an exciting new development. We have a long history of working closely with industry, and we are looking forward to developing even closer links through this programme. We believe that the Graduate Apprenticeship initiative will provide unique benefits to all those involved - but most importantly to you as you progress towards your degree through work-based learning.

In an effort to enhance our offering and in response to demand from employers, we are delighted to announce that this year we are introducing two specialist courses, one in 3D Graphics and Animation and another in Intelligent Robotics. These will be options in addition to our standard Year Four course in Strategic Management.

My colleagues and I are looking forward to working with you and supporting you in your studies. I hope that you enjoy your time here at Heriot-Watt.

Dr. Hind Zantout MBCS SFHEA

Head of Computer Science (Teaching)

2.3 The School of Mathematical and Computer Sciences (MACS)

The School of Mathematical and Computer Sciences (MACS) is comprised of three departments, Computer Science (CS), Mathematics (Maths) and Actuarial Mathematics and Statistics (AMS), based at our three campuses: Edinburgh, Dubai and Malaysia. The BSc Software Development for Business, Graduate Level Apprenticeship is a CS programme delivered at the Edinburgh Campus.

2.3.1 School Student Website

This website provides useful information for all current MACS students for each stage of your journey from Enrolment through to Graduation. You will find documentation about your chosen programme and courses, important dates throughout the year, core academic staff and links to useful resources. http://www.macs.hw.ac.uk/students/

2.3.2 Examinations for Taught Courses

It is the apprentice's responsibility to check all relevant examination timetables (including resits) on the Registry web page https://www.hw.ac.uk/students/studies/examinations.htm

Should you be required to be re-assessed in any examinations, you *must* make yourself available to take them. All exams must be taken at the Edinburgh Campus.

Past exam papers from 2016-2019 for taught F2 courses can be found at: https://www.macs.hw.ac.uk/students/cs/past-exam-papers/

2.3.3 Prizes

University Prizes, Years 1, 2 & 3 (£100)

For outstanding merit (In practice an average mark of at least 70% is regarded as the minimum standard). Available to students on any undergraduate course in the Department of Computer Science. There is one prize per academic year per year of study.

Vindhya Liyanage Citizenship Award (£100)

Awarded to a student, or group of students, who have shown exceptional citizenship in their 1st year of study within the Department of Computer Science.

2.3.4 Miscellaneous

Lockers and buildings access cards

Lockers for use by students and apprentices are available at a number of sites in the Earl Mountbatten Building. They are allocated for the duration of each academic year on a first-come, first-served basis. Keys for lockers in the EM Building are available at School's Office EM1.25 for a deposit of £10. In addition, final year students may request extended access to enter the Earl Mountbatten Building until 10pm on weekdays and during the weekends. Apprentices wishing to access the building in those hours should contact Iain McCrone (help@macs.hw.ac.uk).

Mail

Mail (internal and external) to students is delivered to pigeonholes on the first floor of the Earl Mountbatten Building, inside the School Office (EM1.25). Apprentices are advised to check these regularly.

3. BSc (Hons) Software Development for Business GA Programme

3.1 Programme Description

The BSc (Hons) Software Development programme consists of 8 courses per full academic year. Each course is worth 15 Credits, totalling 120 Credits per year. There are three types of course delivery modes, as below. This blended academic and work-based learning ensures apprentices enjoy the best of both academic and commercial worlds.

Taught courses: this type of course will be delivered on-campus (or virtually, depending on government restrictions) via standard methods where apprentices will enjoy campus facilities and mixed with our mainstream students;

Work-based Blended Learning (WBL) courses: course materials will be delivered on-line (through the entire academic year), assisted by on-campus hands-on lab sessions and tutorials, where appropriate. Apprentices' progress will be monitored and assessed on-line and/or via e-assessment; face-to-face and virtual meetings are available, when needed;

Industrial Project (IP) courses: such courses require larger, real/realistic industry-specific project implementation. Normally, they are completed in Semester 3.

3.2 Entry Requirements

Year 1 - 96 SCQF credits at level 6 or Minimum 112 UCAS points, for example:

- SQA Highers at ABBB including Computing or equivalent;
- A-Levels at BBB including Computing or equivalent;
- Int. Baccalaureate 28 points;
- BTEC Extended Diploma (QCF) Level 3 at DDM.
- Foundation Apprenticeship in Software Development in conjunction with SQA Highers at BBB.

Year 2 - 96 SCQF credits at level 7, for example:

- SQA Advanced Highers at BBB including Computing and excellent SQA Highers or Scottish Baccalaureate;
- A-Levels at ABB including Computing;
- Int. Baccalaureate 30 points including Computing at Higher Level 6.
- HNC in a relevant subject area (or a suitable Modern Apprenticeship) with A in graded unit.
- BTEC Extended Diploma (QCF) Level 3 at DDM including sufficient Computing.

Each candidate will be assessed for entry individually and other forms of prior learning or experience will be taken into account if a candidate doesn't hold the exact qualifications listed here.

Advanced entry to second (or third year in extraordinary cases) may be possible if the candidate possesses more advanced prior learning or experience. Interest in advanced entry should be communicated to the Programme Director prior to the commencement of the Programme. Those entering at Stage 2 are expected to be proficient in a high-level programming language, Java is our preference. Direct entrants to Stage 2 must have

appropriate background in object-oriented software design, (web) programming and database technologies. Students from FE Colleges who meet the established conditions for articulation into Stage 2 of the BSc in Computer Systems programme will also satisfy the conditions for articulation into Stage 2 of the SDB Graduate Apprenticeship programme.

3.3 Educational Aims of the Programmes

The programmes aim to produce BSc (Hons) graduates who:

- have a solid foundation in Computer Science fundamentals and are proficient in applying programming techniques in diverse applications;
- are able to operate in a team and in a multidisciplinary context;
- have problem solving skills;
- have the ability to develop innovative solutions to society's practical needs;
- have developed professional competencies of software engineers.

3.4 Programme Delivery

3.4.1 Contact Days

The specific contact days that the apprentices will be released to attend the university are described in the table below:

		Year			
		1	**2**	**3**	**4**
Semester	**1**	Friday	Monday	Monday	Friday
	2	Friday	Monday	Monday	Friday
	3	Friday	Monday	Monday	Friday

Semesters 1 and 2 form part of the traditional academic year (September – December, January – March/May) and as such apprentices will be required to attend university every week on their contact day.

Semester 3 takes place during the summer months (May – August) and as such has a more relaxed attendance requirement. Tutorial classes and ad-hoc lectures will be held (where required by the apprentices) to support the directed learning aspects of some courses, at most for six weeks. On the 'off-week' contact days extra sessions may be arranged to help apprentices to complete a specific piece of work should they have fallen behind for any reason or be experiencing difficulties.

3.4.2 Individual Self-Study Time

In addition to the contact day at the university, apprentices require approximately 0.5 days a week in the workplace to engage in work-based learning activities and undertake courses taught by directed learning.

3.5 Progression and Graduation

The minimum number of credits and grades required to progress through each stage of the programme are as follows:

- Stage 1 to 2 – 120 credits and minimum D grade in the following courses – F27SA,

F27ID, F27CX, F27IR and F27SB;

- Stage 2 to 3 – 240 credits and minimum D grade in the following courses – F28ED, F28SG, F28DA, F28HS, F28LL, F28DD and F28SX;
- Stage 3 to 4 – 360 credits, an overall average of 50% in the first attempt and minimum D grade in the following courses – F29AI, F29NC, F29SY and F29RD.

In years 1, 2 and 3 if an apprentice fails one of the Work-based Blended Learning (WBL) courses they will be given the opportunity to retake the course, typically to be performed in the following semester. In cases where the course is a pre-requisite for another Work-Based Learning course, the start of the latter will be delayed until the re-assessment of the former has been successfully completed. In Year 3, re-assessment is for credit only and the apprentice's overall average (which accounts for 20% of the final degree) cannot improve unless there is a mitigating circumstance. There are no reassessment opportunities for courses in Year 4.

Honours degree classification is determined by performance in:

- Stage 3 averaged over all level 9 courses (20%) at the first attempt;
- The assessed courses in Stage 4 (50%);
- The individual dissertation project in Stage 4 (30%). The BEng award gradings are:

First class	1st	Grade A (average mark of 70% or more for qualifying courses)
Second class (Upper division)	2:1	Grade B (average mark of 60% - 69% for qualifying courses)
Second class (Lower division)	2:2	Grade C (average mark of 50% - 59% for qualifying courses)
Third class	3rd	Grade D (average mark of 40% - 49% for qualifying courses)
Ordinary	Ord	Grade E

The University operates the Heriot Watt Assessment and Progression System (HAPS) which specifies minimum progression requirements. Schools have the option to apply progression requirements above the minimum University requirement, which are approved by the Studies Committees. Students should refer to the programme specific information on progression requirements. You can also contact your Personal Tutor for information.

3.6 BSc Software Development - Programme Structure

Link to Detailed Programme Structured and Progression Rules:
https://www.hw.ac.uk/documents/pams/202021/F211-SDB_202021.pdf

Link to BSc Software Development Programme Overview and Course Descriptors:
https://www.macs.hw.ac.uk/students/cs/ug-programmes/bsc-software-development-for-business/

<table>
<tr><th colspan="3">YEAR 1 – Mandatory Courses</th></tr>
<tr><th>Semester 1</th><th>Semester 2</th><th>Semester 3</th></tr>
<tr><td>Software Development 1 (F27SA)*</td><td>Software Development 2 (F27SB)*</td><td rowspan="2">Industrial Project: Software Development Methods (F27IP)</td></tr>
<tr><td>Intro to Interaction Design (F27ID)</td><td>Enterprise and its Business Environment (C17GE)</td></tr>
<tr><td colspan="3">Intro to Computer Systems (F27CX)</td></tr>
<tr><td colspan="3">Industrial Praxis (F27IX)</td></tr>
<tr><td colspan="3">Internet Technologies 1 (F27IR)</td></tr>
</table>

<table>
<tr><th colspan="3">YEAR 2 – Mandatory Courses</th></tr>
<tr><th>Semester 1</th><th>Semester 2</th><th>Semester 3</th></tr>
<tr><td>Intro to Data Structures and Algorithms (F28SG)*</td><td>Hardware-Software Interface (F28HS)*</td><td rowspan="2"></td></tr>
<tr><td>Experimental Design (F28ED)*</td><td>Data Structures and Algorithms (F28DA)*</td></tr>
<tr><td colspan="3">Programming Languages (F28LL)</td></tr>
<tr><td colspan="3">Database Management (F28DD)</td></tr>
<tr><td colspan="3">Introduction to Software Design (F28SX)</td></tr>
<tr><td colspan="3">Internet Technologies 2 (F28IR)</td></tr>
</table>

* Course assessed via examination (in whole or in part)

<table>
<tr><th colspan="3">YEAR 3 – Mandatory Courses</th></tr>
<tr><th>Semester 1</th><th>Semester 2</th><th>Semester 3</th></tr>
<tr><td>Artificial Intelligence and Intelligent Agents (F29AI)†</td><td>Accounting for Managers (C38GA)†</td><td rowspan="2">Industrial Project: Software Quality (F29IP)</td></tr>
<tr><td colspan="2">Operations Management (C18GO)</td></tr>
<tr><td colspan="3">Software Engineering (F29SY)</td></tr>
<tr><td colspan="3">Professional Development (F29RD)</td></tr>
<tr><td colspan="3">Digital Enterprise Services (F29DS)</td></tr>
<tr><td colspan="3">Computer Network and Communications (F29NC)</td></tr>
</table>

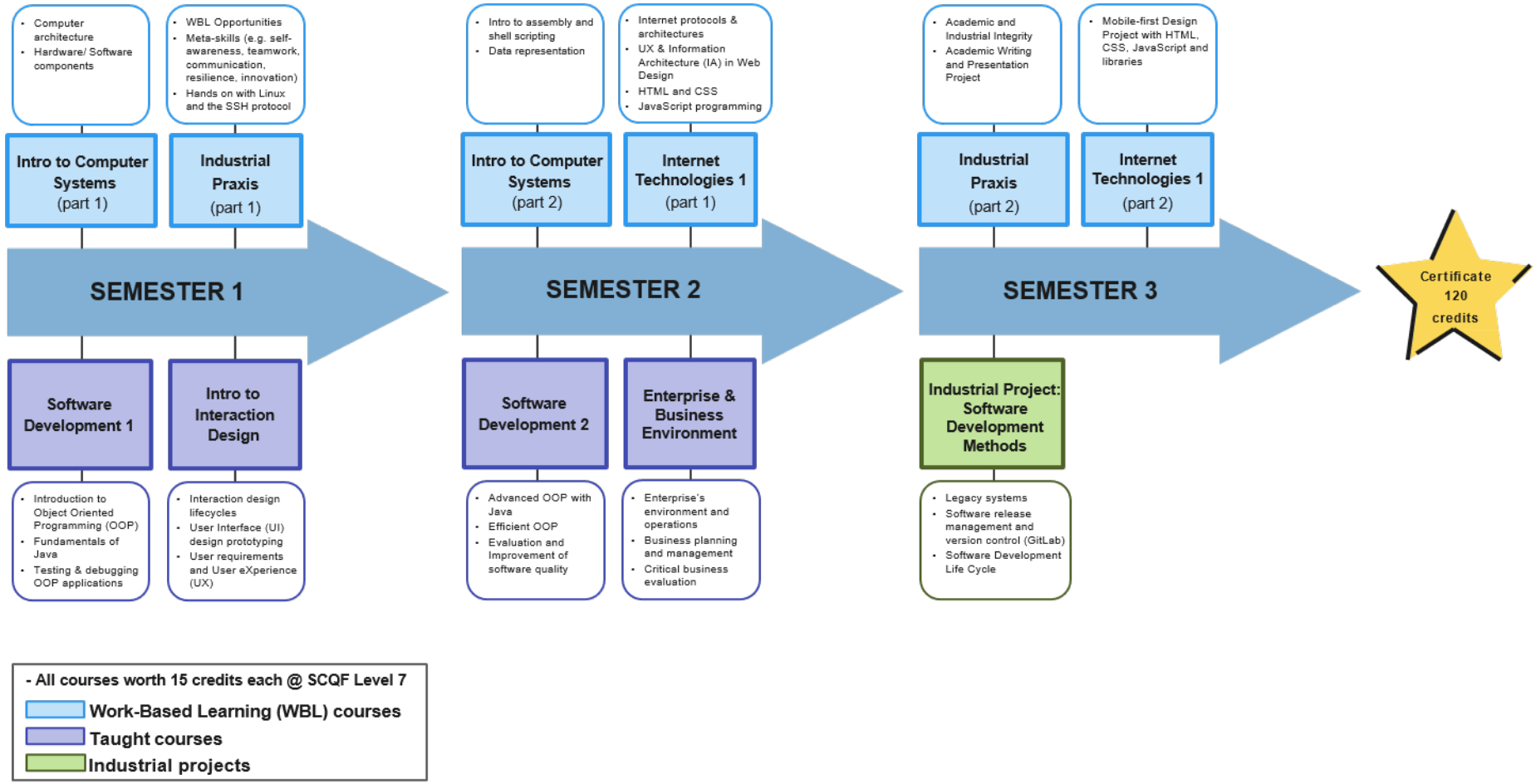
<table>
<tr><th colspan="3">YEAR 4 – Mandatory Courses</th></tr>
<tr><th>Semester 1</th><th>Semester 2</th><th>Semester 3</th></tr>
<tr><td>Computer Network Security (F20CN)†</td><td colspan="2">Industrial Project: Design and Implementation (F20PQ)</td></tr>
<tr><td colspan="2">Industrial Project: Research Methods and Requirements Engineering (F20PP)</td><td></td></tr>
<tr><td>Data Mining and Machine Learning (F20DX)</td><td>Mobile Communications and Programming (F20MX)</td><td rowspan="2">Industrial Project: Testing and Presentation (F20PR)</td></tr>
<tr><td></td><td>Project Management (C19GP)</td></tr>
</table>

<table>
<tr><th colspan="2">YEAR 4 – Optional Courses (choose one)</th></tr>
<tr><th>Semester 1</th><td rowspan="4">These three optional courses are offered under the following understanding:
• By default, students are automatically enrolled in C19GS and this is the expected path for most students.
• F20GA and F20RO are not work-based learning courses. If either of these courses is chosen the employer must allow the student time to attend their chosen course on the dates and times scheduled for regular CS students, which may be different from the usual SDB contact day (see page 6).
• F20GA and F20RO typically require 10 hours per week of teaching and self-study per course during termtime.
• F20GA and F20RO require a high-level knowledge of introductory concepts in robotics and programming or, software programming.
• If a student wishes to take F20GA or F20RO then their choice must first be formally approved both by their employer and their academic tutor.</td></tr>
<tr><td>Strategic Management (C19GS)</td></tr>
<tr><td>3D Graphics and Animation (F20GA)</td></tr>
<tr><td>Intelligent Robotics (F20RO)</td></tr>
</table>

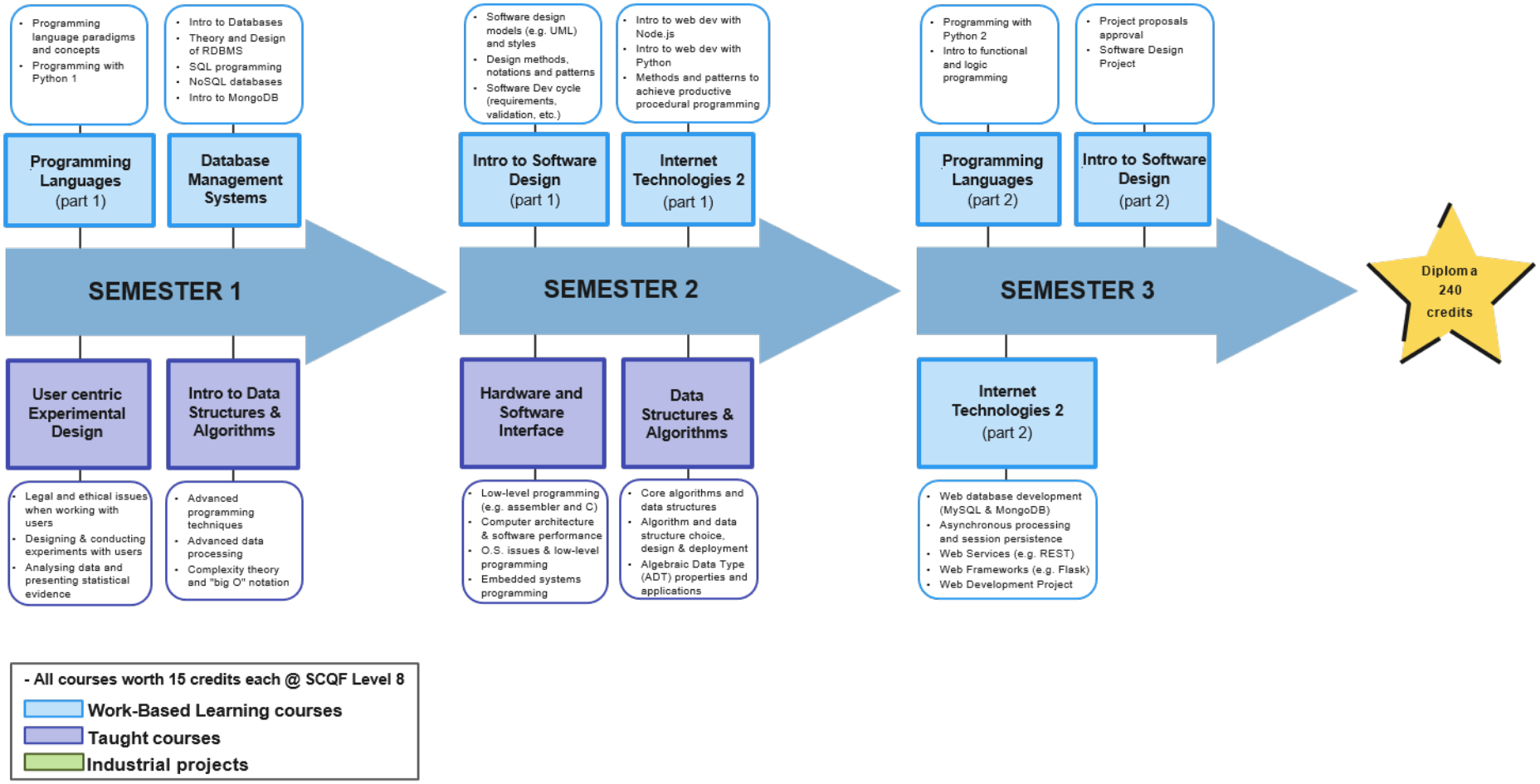
† Course assessed via examination (in whole or in part)

3.7 Course Catalogue

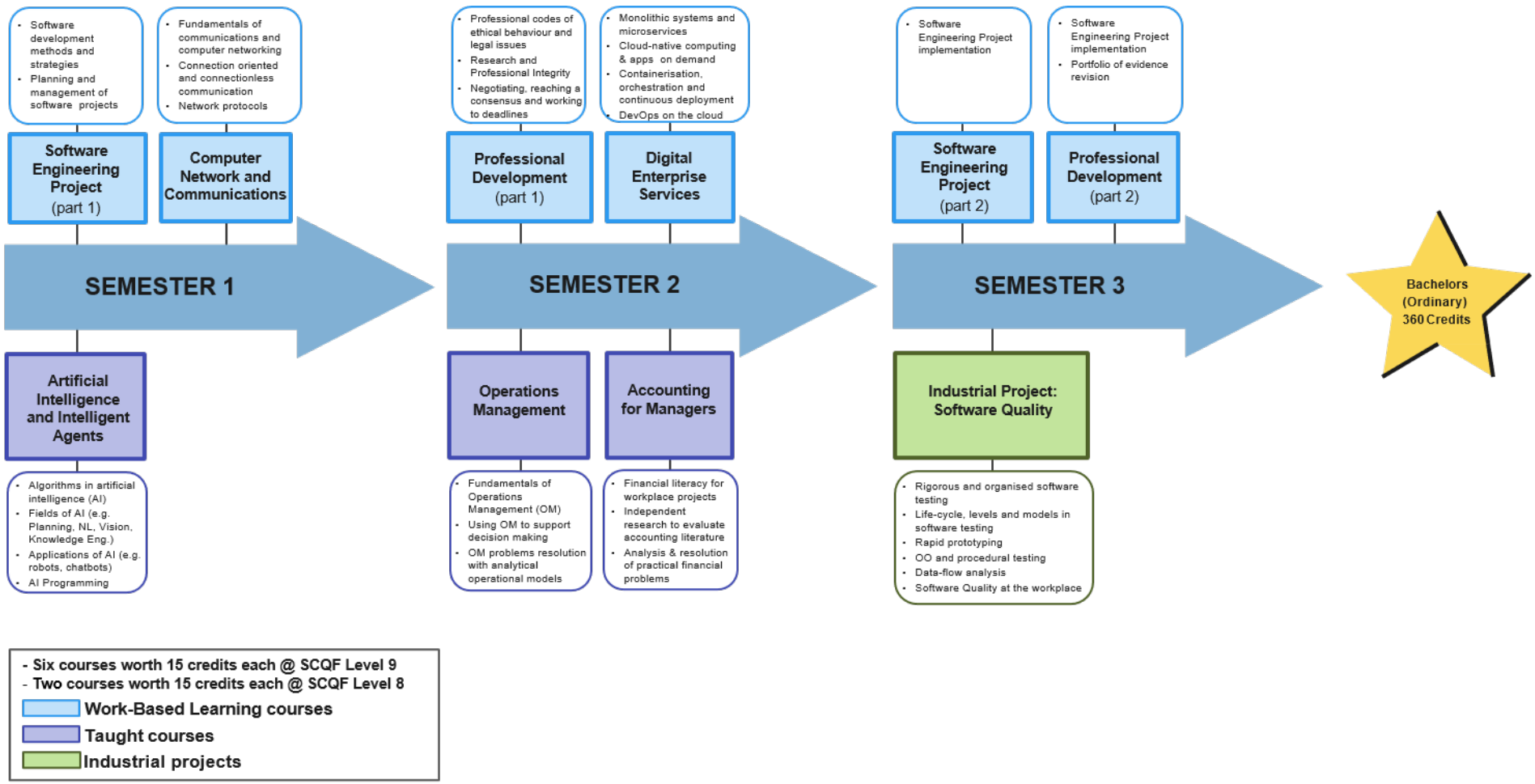
First Year



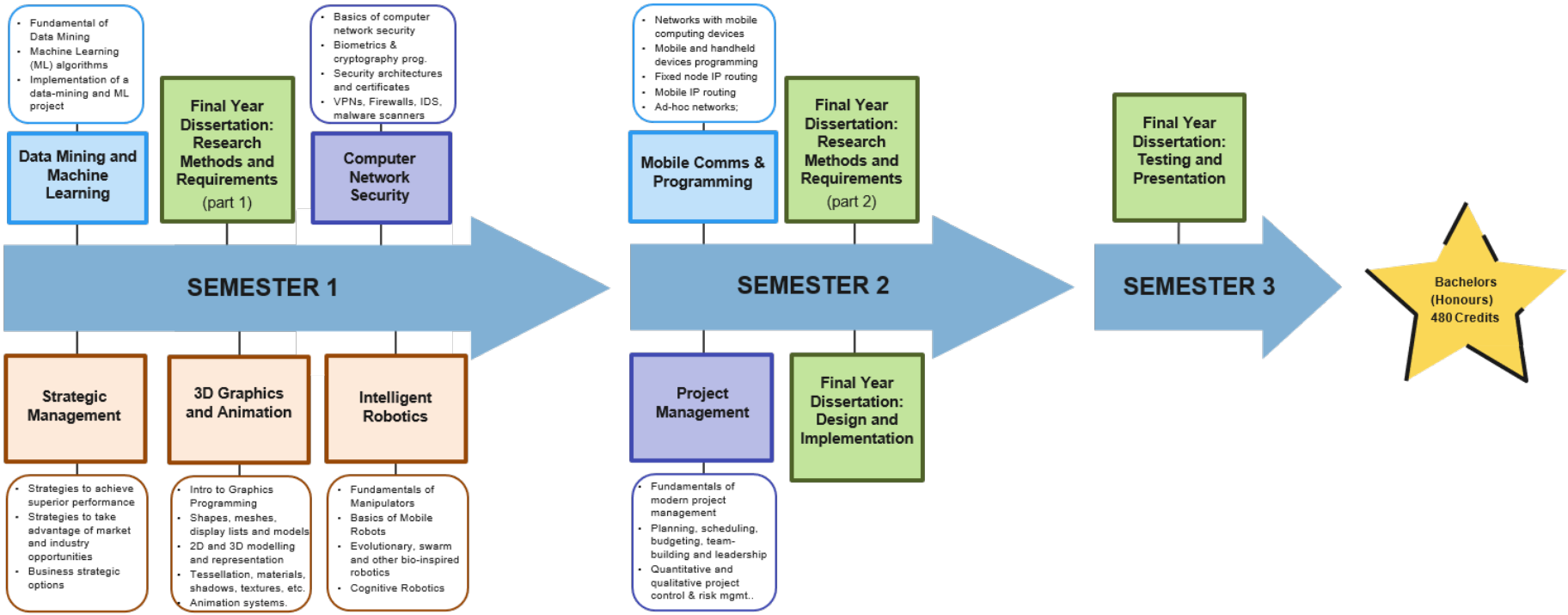
Second Year


Programming language paradigms and concepts
Programming with Python 1
Intro to Databases
Theory and Design of RDBMS
SQL programming
NoSQL databases
Intro to MongoDB
Programming Languages (part 1)
Database Management Systems
SEMESTER 1
User centric Experimental Design
Intro to Data Structures & Algorithms
Legal and ethical issues when working with users
Designing & conducting experiments with users
Analysing data and presenting statistical evidence
Advanced programming techniques
Advanced data processing
Complexity theory and "big O" notation
Software design models (e.g. UML) and styles
Design methods, notations and patterns
Software Dev cycle (requirements, validation, etc.)
Intro to web dev with Node.js
Intro to web dev with Python
Methods and patterns to achieve productive procedural programming
Intro to Software Design (part 1)
Internet Technologies 2 (part 1)
SEMESTER 2
Hardware and Software Interface
Data Structures & Algorithms
Low-level programming (e.g. assembler and C)
Computer architecture & software performance
O.S. issues & low-level programming
Embedded systems programming
Core algorithms and data structures
Algorithm and data structure choice, design & deployment
Algebraic Data Type (ADT) properties and applications
Programming with Python 2
Intro to functional and logic programming
Project proposals approval
Software Design Project
Programming Languages (part 2)
Intro to Software Design (part 2)
SEMESTER 3
Internet Technologies 2 (part 2)
Web database development (MySQL & MongoDB)
Asynchronous processing and session persistence
Web Services (e.g. REST)
Web Frameworks (e.g. Flask)
Web Development Project
Diploma 240 credits
- All courses worth 15 credits each @ SCQF Level 8
Work-Based Learning courses
Taught courses
Industrial projects

Third Year


Software development methods and strategies
Planning and management of software projects
Fundamentals of communications and computer networking
Connection oriented and connectionless communication
Network protocols
Software Engineering Project (part 1)
Computer Network and Communications
SEMESTER 1
Artificial Intelligence and Intelligent Agents
Algorithms in artificial intelligence (AI)
Fields of AI (e.g. Planning, NL, Vision, Knowledge Eng.)
Applications of AI (e.g. robots, chatbots)
AI Programming
Professional codes of ethical behaviour and legal issues
Research and Professional Integrity
Negotiating, reaching a consensus and working to deadlines
Monolithic systems and microservices
Cloud-native computing & apps on demand
Containerisation, orchestration and continuous deployment
DevOps on the cloud
Professional Development (part 1)
Digital Enterprise Services
SEMESTER 2
Operations Management
Fundamentals of Operations Management (OM)
Using OM to support decision making
OM problems resolution with analytical operational models
Accounting for Managers
Financial literacy for workplace projects
Independent research to evaluate accounting literature
Analysis & resolution of practical financial problems
Software Engineering Project implementation
Software Engineering Project implementation
Portfolio of evidence revision
Software Engineering Project (part 2)
Professional Development (part 2)
SEMESTER 3
Industrial Project: Software Quality
Rigorous and organised software testing
Life-cycle, levels and models in software testing
Rapid prototyping
OO and procedural testing
Data-flow analysis
Software Quality at the workplace
Bachelors (Ordinary) 360 Credits
- Six courses worth 15 credits each @ SCQF Level 9
- Two courses worth 15 credits each @ SCQF Level 8
Work-Based Learning courses
Taught courses
Industrial projects

Fourth Year


Fundamental of Data Mining
Machine Learning (ML) algorithms
Implementation of a data-mining and ML project
Data Mining and Machine Learning
Final Year Dissertation: Research Methods and Requirements (part 1)
Basics of computer network security
Biometrics & cryptography prog.
Security architectures and certificates
VPNs, Firewalls, IDS, malware scanners
Computer Network Security
SEMESTER 1
Strategic Management
Strategies to achieve superior performance
Strategies to take advantage of market and industry opportunities
Business strategic options
3D Graphics and Animation
Intro to Graphics Programming
Shapes, meshes, display lists and models
2D and 3D modelling and representation
Tessellation, materials, shadows, textures, etc.
Animation systems.
Intelligent Robotics
Fundamentals of Manipulators
Basics of Mobile Robots
Evolutionary, swarm and other bio-inspired robotics
Cognitive Robotics
Networks with mobile computing devices
Mobile and handheld devices programming
Fixed node IP routing
Mobile IP routing
Ad-hoc networks;
Mobile Comms & Programming
Final Year Dissertation: Research Methods and Requirements (part 2)
SEMESTER 2
Project Management
Fundamentals of modern project management
Planning, scheduling, budgeting, team-building and leadership
Quantitative and qualitative project control & risk mgmt..
Final Year Dissertation: Design and Implementation
Final Year Dissertation: Testing and Presentation
SEMESTER 3
Bachelors (Honours) 480 Credits
- Six or seven courses worth 15 credits each @ SCQF Level 10
- One or two courses worth 15 credits each @ SCQF Level 9
Work-Based Learning courses
Taught courses
Optional courses (choose one)
Final Year Dissertation