SPRINGBOARD+
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Additional information on ICT skills conversion courses

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AN tÚDARÁS um ARD-OIDEACHAS

Introduction

This document provides additional detailed information to course providers who wish to submit an ICT skills conversion course proposal(s) as part of Springboard+ 2017.

The ICT skills action plan 2014-2018 aims to establish Ireland as the most attractive location in the world for ICT skills availability. Key actions in the plan include increasing the number of people in Ireland with high level ICT skills, via mainstream undergraduate provision and targeted reskilling and conversion courses.

Since 2012, under the ICT skills initiative, HEA has sought proposals for ICT conversion courses. This was incorporated into Springboard+ in 2014 and has provided for intensive, one-year NFQ Level 8 higher diploma courses delivered by higher education providers in partnership with industry. Two year part-time programmes were added in 2016. Under the 2017 Call we are inviting proposals for both one year and two-year programmes (see the 2017 Call for Proposals for further detail). Springboard+ (including ICT conversion courses) is co-funded under the European Social Fund Programme for Employability, Inclusion and Learning (PEIL) 2014-2020

Successful graduates of an ICT skills conversion course will acquire an NFQ level 8 Higher Diploma in Science in Computing which will enable them to apply the transferable skills that they have obtained as part of their original degree to specific computing / IT skills in their chosen area of specialisation. While there should be an emphasis on providing a broad overview of the ICT landscape, particular attention should be given to technologies that are used heavily in industry. Courses should focus on openly transferrable and industry relevant skills rather than vendor-specific frameworks and platforms. Successful graduates are expected to obtain an award which will contain the following stages:

a. *Immersion in computing knowledge*
Participants on ICT Conversion courses will initially undertake a broad immersive set of modules in the fundamentals of computing covering software development, systems analysis & testing, databases, architecture, OS & networking, web design / user-experience. These modules will have to be separately taught to the general provision for computing students for two key reasons:

- The participants will be graduates who have already obtained significant transferable skills by comparison with other undergraduate students,
- The pace of delivery will have to be significantly higher than for normal undergraduate programmes to bring participants to an appropriate level in the timescale available.

Please note that the structure of a Data Analytics programme can be different to other ICT Conversion programmes, with a particular focus on earlier specialisation on data analytics as opposed to broader IT modules. See page 11 onwards for more detail.

b. *Deepening and specialisation*
Following on from the immersive modules, participants are expected to take a specialisation which reflects their own strengths as demonstrated on the programme to date. This element is a focused set of 6 modules and project-work designed to bring candidates quickly to the industry entry standard for graduates in the chosen field of specialisation.

For the two-year part-time ICT Conversion course running across up to four semesters, the indicative schedule above may be altered to reflect the extended course duration.

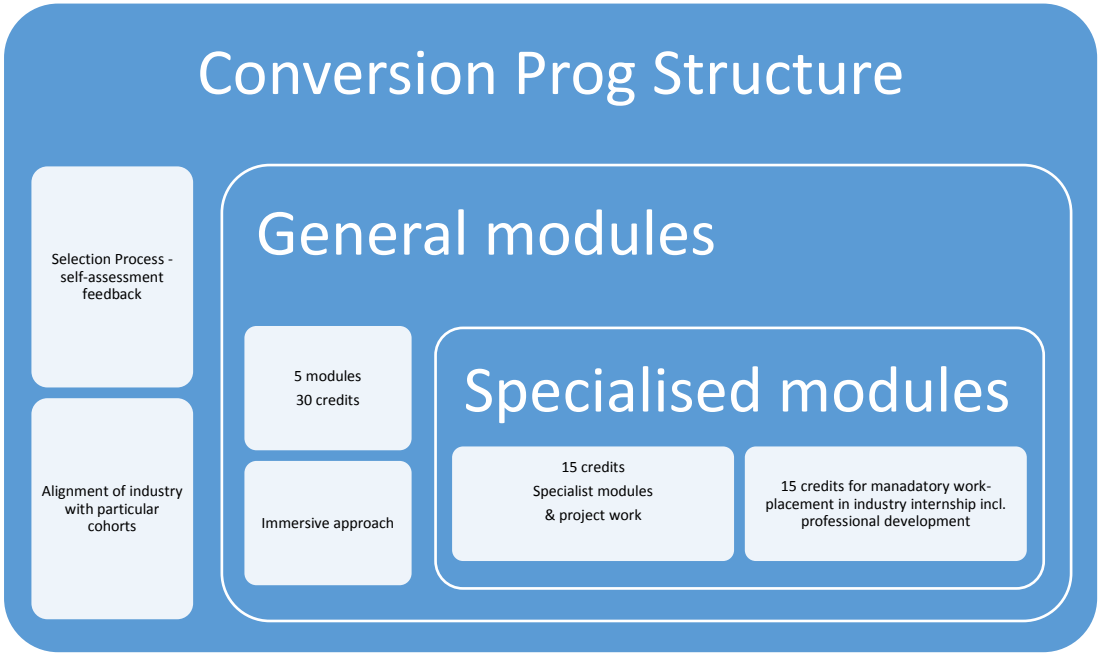
With appropriate resource-sharing this element of the programme can allow different specialisations to be delivered in different institutions and locations. Participants will be expected to select their specialisation based on their achievement in the immersive modules and their own ambitions, and so should be in a position to progress quickly in their specialisation of choice.

c. *Industry experience and professional development*
A work-placement or internship with the associated industrial partners for a three to six-month period following successful completion of the taught material is a mandatory requirement of the one-year full-time programme. Internships or work placements are seen as crucial to providing graduates with the context and confidence in their new knowledge. Outputs expected from the work placement would include a work placement report (e.g. a reflective journal), a project ideally conducted in the work placement organisation and/or a professional certification or equivalent. It is expected that academic and industry partners will cooperate in the provision of appropriate academic supervision resources for the duration of this work placement activity. Building towards these placement opportunities, programmes could also include regular (e.g. once a month) peer to peer sessions (e.g. hackathons; coder dojo for adults) with software developers in industry as part of the programme.

For the two-year part-time option, a mandatory credit-bearing project (preferably industry related) *or* work placement will form part of the course.

The course will provide graduates with technical skills, knowledge, and competences in the fundamentals of computing, as well as with expertise in a range of specialisations.

Figure 1: Draft outline structure for Higher Diploma in Science in Computing



Industry partnership

Course proposals are required to include the following input from industry partner/s:

- Articulation of the skills needs that will be addressed by the course
- Commitment to provide work-placements to participating students
- An indication of the employment opportunities in the field that are likely to be available to graduates of the programme.

Industry partners who engage with the initiative will also have an opportunity to put forward an in-house training programme for recognition. Employers could propose in-house training or professional certification preparation as a 5-credit 'professional development' element attached to the work-placement. Small and medium enterprises in particular may wish to support students to obtain professional accreditations. In this case it is expected that enterprise would support the participants on the programme towards obtaining the professional certification.

Specialisation

Specialisation, which will allow students to focus on their strong points, is a key element of the initiative. It is not expected that providers would provide all specialisations on one site. However, it is expected that providers should present solutions which encourage the efficient use of resources through co-operation in provision. Where possible course participants should be facilitated to access the specialisation for which they are best-suited even though this may not be available from the higher education provider with whom they initially enrolled

Progression

On successful completion of their course it is expected that graduates will be of a standard to be eligible for entry into specialist computing M.Sc. programmes which are available through both full and part-time modes of delivery.

Course duration

ICT Skills Conversion course proposals for full-time programmes to be delivered over one year, excluding the duration of the work placement component, must provide at least 60 European Credit Transfer System (ECTS) credits or equivalent. Proposals for programmes to be delivered on a part-time basis across up to two full academic years, excluding the duration of a work placement / project, must provide at least 60 ECTS credits or equivalent.

Sample structures and sample material for ICT and software development NFQ Level 8 skills conversion courses

1 Sample Structures

A Higher Diploma (NFQ level 8 conversion) in Science in Software Development might look as follows:

Sample Structure - Higher Diploma in Science in Software Development	
Semester 1 –Core Computing	
OO Software Development 1 (10) Information Systems (5) Architecture, Operating Systems and Networks (5)	Web & UI Design (5) Systems Analysis & Test (5)
Semester 2 – Software Development	
OO Software Development 2 (15)	Project (10) Company Specific Training/ Certification/ Additional Module (5)

A Higher Diploma (level 8 conversion) in Science in IT Infrastructure might look as follows:

Sample Structure - Higher Diploma in Science in IT Infrastructure	
Semester 1 –Core Computing	
OO Software Development 1 (10) Information Systems (5) Architecture, Operating Systems and Networks (5)	Web Design & Development (5) Systems Analysis & Test (5)
Semester 2 – IT Infrastructure	
IT Infrastructure (15)	Project (10) Company Specific Training/ Certification/ Additional Module (5)

A Higher Diploma (NFQ level 8 conversion) in Computing (Data Analytics) might look as follows:

Sample Structure - Higher Diploma in Science in Data Analytics	
Semester 1 – Introduction to Analytics	
Programming for Big Data (10) Information Systems (5) Probability and Statistics (5)	Project and Change Management (5) Data Analytics I (5)
Semester 2 – Analytics for Business Support	
Advanced Databases (5) Data Analytics II (5) Data Analytics Case Studies (5)	Project (10) Company Specific Training / Certification / Additional Module (5)

The above are indicative and other Higher Diploma (Level 8 conversion) courses which might help to address the skills needs as identified in Section 6 of this document would also be considered.

2 Sample Material - Core Computing

Sample Material for ICT Level 8 Conversion Programme – Core Computing

OO Software Development 1 (10 credits)
On successful completion of this module the learner will be able to:

1. Design, develop, test and debug software applications using an object-oriented programming language utilising core object-oriented programming concepts
2. Implement basic algorithms and data structures using an object-oriented programming language

Content outline
OO programming: types, variables and operators; control structures; objects and classes; methods; inheritance and polymorphism; exception handing; code style and quality
Data Structures and Algorithms: implement basic data structures and algorithms in an OO programming language e.g. stacks, queues, searching and sorting; analysis of algorithms

Information Systems (5 credits)
On successful completion of this module the learner will be able to:

1. Design and implement a relational database schema for a software application
2. Query a relational database using SQL
3. Evaluate and use non-relational data storage technologies

Content outline:
Relational Database design: ER diagrams and mapping to a relational schema, data normalisation, relational integrity, keys, indexes, database transactions
SQL: schema definition and data manipulation in SQL, SQL queries, an introduction to stored procedures
Non-relational storage: schema-less storage (no SQL); XML and XML Schema

Systems Analysis (5 credits)

On successful completion of this module the learner will be able to:

1. Complete an OO analysis and design using core UML features
2. Describe testing approaches for software applications
3. Apply project management principles to a software project

Content outline:
UML: user requirements capture; using core UML constructs to complete an OO analysis and an OO design e.g. user cases, classes diagrams, sequence diagrams etc.
Software Testing and Project Management

Web & UI Design (5 credits)

On successful completion of this module the learner will be able to:

1. Build an UI for a web application using appropriate UI design principles
2. Describe the architecture of the web and web applications
3. Introduction to client-side web applications

Content outline:
UI Design: HCI, UI design principles for web applications, event driven architectures (e.g. Node.js)
Web Architecture: HTTP and HTML, web servers and clients, security, web for mobile
Client-side web application development: intro to client-side scripting using Javascript, UI design, CSS

Architecture, Operating Systems and Networks (5 credits)

On successful completion of this module the learner will be able to:

1. Understand the basic architecture and operation (processing, storage and communication)of a micro-processor based system
2. Develop a conceptual understanding of the architecture of a typical operating system
3. Explain network models such as OSI and TCP/IP and the process of data encapsulation
4. Plan and test a network with the appropriate cables and device interconnections and develop an addressing & testing scheme.

Outline content
CPU Components. BIOS configuration. Assembling a computer; Logic Gate functions to adders. Machine Code, 8086 instruction set, registers. Memory & forms of memory. Discriminate and differentiate the processes by which operating system software manages resources, processes, I/0 and storage, Utilise Unix scripting to implement simple problem solving tasks
OSI and TCP/IP models. Network traffic analysis, real and simulated networks, peer-to-peer networks. The process of data encapsulation.
HTTP, DNS, DHCP, SMTP/POP, Telnet and FTP. TCP and UDP. Network addressing and routing, configuring hosts to access the local network and exploring routing tables.

Host configurations, ICMP (Internet Control Message Protocol)

3 Sample Material - Software Development Specialisation

Sample Material for ICT Level 8 skills conversion – proposed module content for Software Development Specialisation

OO Software Development 2
(15 Credits)
Student electing to take this stream will be equipped with the skills to become software developers/software engineers. In addition to the core material proposed below guest lectures from industry/academia on current topics (e.g. scalability & loading, the parallel paradigm, software process management, secure coding) will be encouraged.

On successful completion of this module the learner will be able to:

1. Concurrency:
    a. Implement advanced OO features in software applications
    b. Implement concurrency in software applications
2. Algorithms & Data Structures:
    a. Implement algorithms and data structures using an OO programming language
3. Platforms:
    a. Implement software applications and services on web, IaaS/PaaS cloud, and mobile platforms
    b. Implement a Service-Oriented Architecture using RESTful and to a lesser extent SOAP based web services
    c. Implement event driven server-side software systems and technologies such as Node.js
4. Code design:
    a. Apply well known style and design principles and patterns to a software application developed using an OO programming language
    b. Analyse source code using industry accepted code metrics
    c. Develop software using a test-driven development approach

Content outline:

Concurrency: *Advanced OO programming e.g. inner classes, anonymous methods and classes, interfaces, collections, attributes/annotations; threading and concurrency, parallel extensions and platforms*
Data Structures and Algorithms*: Implement structures and algorithms in an OO programming language e.g. queues, trees, heaps etc.*
Platforms*: Web, Cloud, and Mobile: architecture of web, cloud (IaaS/PaaS) and mobile applications; development of basic applications for such platforms; persistence frameworks, project module to allow student to specialise in development for any of these platforms* ***Service-Oriented Architectures****: SOAP, WSDL and the WS-* specifications; REST; web services; SOA design and implementation.*
Code design: *Code metrics, design patterns, style; test-driven development lifecycle, unit testing using a unit testing framework, code coverage, continuous integration,*

source code control systems

Software Development Project
(10 credits)
On successful completion of this module the learner will be able to:

1. Undertake a significant software development project using a test-driven development approach
2. Conduct research as part of the project
3. Complete an OO analysis and OO design as part of the project
4. Implement the project, test it, and demonstrate it to peers
5. Use state of the art software technologies in a software application

Content outline
Research, design and develop a significant software development project. Ideas will be taken from a list put together by and industry-academic steering committee.

The project must use state of the art technologies for leading enterprise platforms e.g. web, cloud, or mobile. Students will develop specialist skills for specific software platforms as part of this module.
Deliverables:

1. research, analysis and design documentation
2. software implementation

Sample Projects

1. Design and develop a novel web application using an industry standard web application development framework, encompassing a data source using a persistence engine, and an interactive web UI
2. Design and develop a web application or web service for an IaaS/PaaS cloud solution exploiting the storage and scalability features of such a platform
3. Design and develop a mobile app, test on a range of devices, release on an app store
4. Design and develop a computer game for a games console

Company Specific Training/ Certification/ Module (5)
This is intended to allow credit for specific company training and/or certification. It can be associated with placement. Should this not be available, provision should be made for an additional academic module.

4 Sample Material - IT Infrastructure Specialisation

Sample Material for ICT Level 8 skills conversion – Proposed Module Content for IT Infrastructure Specialisation
Student electing to take this stream will be equipped with the skills to become a Junior Network Engineer, LAN and IaaS (Infrastructure as a Service) Support Technician, Virtualisation Network Engineer, Junior Network Administrator and Network Support

Analyst. In addition to the core material proposed below guest lectures from industry/academia on current topics (e.g. scalability & loading, the economics of clouds, computer forensics,) will be encouraged.

Network and Virtualisation Infrastructure (15 Credits)

On successful completion of this module the learner will be able to:

Routing Configuration and Deployment:

1. Explain the characteristics, operations and limitations of dynamic link state and distance vector routing solutions.
2. Describe and apply the benefits of VLSM along with CIDR.
3. Configure Security Firewall partitions Optimised Secure LAN Design:
4. Design, build and troubleshoot a security switched VLAN network.
5. Evaluate link state concepts, operations, the Shortest Path First (SPF) algorithm and the operation of spanning tree protocols.
6. Configure advanced features of network routers and switches using the Cisco IOS command set.Network Security:
7. Design, Build and manage a campus network campus spread across many locations.
8. Effectively manage a network using diagnostic tools and SNMP

protocols. Infrastructure as a Service & Virtualisation

9. Describe the basic physical and virtual architecture of IaaS deployments and to evaluate the security implications of using Cloud-based services
10. Assess and implement the architectures, components, operation and tools of cloud computing

Content

Routing Configuration and Deployment

Classless Routing, VLSM, RIP v2, OSPF concepts and configuration. WAN Technologies PPP, Frame Relay.

Optimised Secure LAN Design

LAN Switching/ Segmentation. LAN Design methodology, Switch Configuration, Spanning-Tree Protocol, Redundant Topologies. Virtual LANs. Virtual Trunking Protocol. Trunking, VTP & Inter- VLAN Routing. Network Strategy: Planning and Design, Network performance & troubleshooting, SNMP

Network Security

Enterprise security policies, VPN technologies, IPSec security protocols, Layer 3 Access control lists, Device hardening, Securing routing protocols

IP Addressing Services: Adv IP addressing, NAT, Port Address Translation, DHCP, IPv6 migration

Infrastructure as a Service & Virtualisation deployments

Cloud benefits, deployment & data centre models, multi- tenancy security issues, cloud services delivery & service types SANs (Storage Area Networks) & Redundancy. Virtual Machines

(VMs) and Hypervisors. Virtual Failover

Clusters.

Network Infrastructure Project (10 credits)

On successful completion of this module the learner will be able to:

1. Undertake a state of the art network infrastructure design & implementation project
2. Conduct research as part of the project
3. Implement the solution, assess it, and make recommendations to peers
4. Deploy state of the art infrastructure technologies

Content outline
Research, deploy and critically assess a state-of-the art Network Infrastructure project. Ideas will be taken from a list put together by and industry-academic steering committee.

The project must use current network technologies in current key areas e.g. SAN, green energy savings, Virtualization overheads, Security assessments, Open source versus proprietary Cloud deployments. Students will develop specialist skills in specific network areas as part of this module.

Deliverables:

1. Research, analysis and conclusions documentation
2. Network test-bed implementation

Sample Projects:

1. Design and develop a virtualised failover-cluster infrastructure and test its capabilities.
2. QoS over LANs: investigate the QoS attributes of switches on real time voice, video and data transmissions. Areas of QoS that should be considered: Scheduling, Classification and Marking, Policing & Congestion Management.
3. Investigate dynamic routing protocols across wireless mesh networks.
4. Evaluate network management station applications that retrieve the hardware details of a selection of specifically configured network hardware via SNMP.

Company Specific Training/ Certification/ Module (5)
This is intended to allow credit for specific company training and/or certification. Can be associated with placement. Should same not be available provision should be made for an additional academic module.

5– Sample Material - Data Analytics

Sample Material for ICT Level 8 skills conversion – Data Analytics
In recent years the falling cost of digital storage, the increasing move towards online information processing and other related technological developments have made it possible for organisations to collect massive amounts of data about their customers, users and processes. Data analytics is the science of extracting actionable insight for large amounts of raw data in order to enable better decision making within an organisation. The following modules might be offered as part of a Level 8 Data Analytics conversion programme:

Programming for big data (10 credits)
Based on an assumption of no prior computing experience, students taking this module

will acquire the computer programming skills necessary to analyse and manipulate big data. This module will begin with an introduction to key programming concepts using programming languages designed specifically for data manipulation (e.g. Base SAS or R). Once students have developed a suitable grounding in these skills focus will turn to turn to tools and techniques for handling big data, which in this context refers to datasets that are too large to be handled by the software tools commonly used to analyse and manipulate data within a tolerable elapsed time.

On successful completion of this module the learner will be able to:

1. *Develop solutions for common data programming problems such as extracting, cleaning, merging, aggregating and integrating datasets.*
2. *Write programmes to analyse and report on the contents of datasets.*
3. *Clearly describe the characteristics of big data, and contrast the requirements for processing big data with conventional data.*
4. *Identify and illustrate the challenges of programming for big data, and evaluate contrasting methods for addressing these challenges.*
5. *Implement solutions to various big data programming problems using a range of state of the art tools and techniques, and evaluate the effectiveness of these solutions.*

Content outline

The following is indicative of the syllabus that would be covered in this module (suitable programming tools such as SAS, R or SQL will be used for each topic):

- *Introduction to programming for big manipulation and analysis*
- *Data access programming*
    - *Data structures for data analytics*
- *Data manipulation programming*
    - *Extracting, cleaning and aggregating datasets*
    - *Merging and integrating datasets*
- *Data analysis and reporting programming*
    - *Programming for descriptive statistics*
    - *Generating reports from data*
- *Introduction to programming for big data*
    - *What is big data?*
    - *How is programming for big data different?*
- *Performing data access, manipulation, analysis and reporting for big data*
    - *Approaches to handling big data* ○ *Big data programming patterns* ○ *Big data programming tools*
- *Distributed programming paradigms*
    - *Map, Reduce, and MapReduce*
    - *Distributed programming tools for data storage and data analysis (e.g. Hadoop, Mahoot, Pig)*

Information Systems (5 credits)

This module provides the learner with fundamental skills to design information systems, focussing on the design and implementation of database systems

On successful completion of this module the learner will be able to:

1. *Design and evaluate a relational database schema for a software application*
2. *Devise and implement a set of relational tables and develop the relational database.*
3. *Query a relational database using SQL*
4. *Evaluate the use of relational and non-relational data storage technologies*

Content outline

The following is indicative of the syllabus that would be covered in this module:

- *Relational Database Design*
  - *ER diagrams and mapping to a relational schema*
  - *Data normalisation*
  - *Relational integrity*
  - *Keys*
  - *Indexes*
  - *Database transactions*
  - *ACID properties*
- *SQL*
  - *Schema definition and data manipulation in SQL*
  - *SQL queries*
  - *Introduction to stored procedures*
- *Non-relational storage*
  - *Schema-less storage (no SQL)*
  - *XML and XML Scheme*

Probability and Statistics (5 credits)
This module will introduce students to the role of probability models and statistical inference in data analytics. Laboratory work will give the student experience in applying probability and statistical models to real data.

On successful completion of this module the learner will be able to:

1. *Formulate probability models for continuous and discrete data.*
2. *Perform and interpret statistical hypothesis tests in a number of situations including tests applied to contingency tables.*
3. *Fit the multiple and logistic regression model using software and interpret the output from such models. Use regression type models for classification.*
4. *Use a statistical analysis software package.*

Content outline
The following is indicative of the syllabus that would be covered in this module:

- *Introduction and orientation, motivation for formal statistical analysis.*
- *Data summary, measures of location and dispersion and their meaning, skew.*
- *Probability and probability models for data, calculating probabilities, discrete and continuous distributions, means and standard deviations of probability distributions*
    - *Bernoulli, binomial, hypergeometric, Poisson, Multinomial and Normal probability distributions.*
    - *Multivariate Distributions.*
- *Hypothesis tests*
    - *Statistical significance*
    - *p-values and their interpretation*
    - *Confidence intervals.*
    - *Tests applied to contingency tables.*
- *Multiple linear and logistic regression models*
    - *Predictions from regression models*
    - *Classification using regression type models.*

Data Analytics I (5 credits)
Data analytics is an area of increasing importance and interest to organisations. Data analytics techniques offer huge potential in the creation of new knowledge products and services and the enhancement of existing products and services. Rather than focus on the details of specific data analytics techniques, this module addresses the application of data analytics techniques to real business problems and the preparation of data for these applications.

On successful completion of this module the learner will be able to:

1. *Discuss the role of data analytics in an organisation*
2. *Develop appropriate data analytics solutions to business problems*
3. *Prepare data for data analytics projects*
4. *Discuss the role of data management in data analytics*

Content outline

The following is indicative of the syllabus that would be covered in this module:

- *Overview*
  - *Introduction to data mining and applications of data analytics*
  - *Data, Information, Knowledge*
  - *Modelling an activity*
  - *Framing a business model*
  - *Developing a model*
  - *Deploying a model*
- *Data Analytics Life Cycle*
  - *Stages of a data analytics project*
  - *Outputs of each stage*
  - *Roles and responsibilities of people involved in data analytics*
- *Data Management*
  - *Introduction to Data Management*
  - *Role of organisations and stakeholders*
  - *Data architecture management*
  - *Data governance and data security*
  - *Meta-data management*
- *Data Preparation*
  - *Extracting and loading data*
  - *Data exploration*
  - *Data issue investigation and data cleaning*
  - *Data sampling*
  - *Preparing data for data analytics (e.g. deriving variables, data representations, normalisation)*

Project and change management (5 credits)

To be effective data analytics practitioners require an understanding of basic project management and change management concepts, tools and techniques. Furthermore, practitioners need an understanding of the nature of data analytics projects, the inherent risk and change management needed, and the ability to apply good project management skills to data analytics specific problems.

On successful completion of this module the learner will be able to:

1. *Examine the fundamentals of the data analytics project and the factors involved in using a methodology in the context of project management.*
2. *Explain the risks, issues, and critical success factors associated with data analytics projects.*

3. *Create a project plan, including scope definition, risk assessment, task breakdown, team selection, estimates, communication mechanisms and progress evaluation and reporting using an appropriate project lifecycle.*
4. *Employ appropriate software for project planning, estimation, monitoring and control, communication and reporting.*
5. *Identify and analyse the causes of project success versus failure within data analytics projects.*
6. *Understand the importance of change management within data analytics projects.*

Content outline

The following is indicative of the syllabus that would be covered in this module:

- *Project Management overview:*
  - *Nature of data analytics projects, project lifecycles and project stages*
  - *Organisational influence on projects*
  - *Role and skills of project managers*
- *Managing people and organising teams*
  - *Roles and responsibilities*
  - *Team Work*
  - *Managing decision making and conflict*
- *Planning and Estimation*
  - *Work break down structures, milestone identification*
  - *Estimation techniques*
  - *Expressing plan using appropriate tools*
- *Monitoring and control*
  - *Responsibility for monitoring and control within team and project;*
  - *Appropriate tools for tracking and monitoring;*
  - *Risk monitoring and mitigation*
- *Change management*
  - *Types of change*
  - *Mapping change*
  - *Systems approach to change*
  - *Organisation development*
- *Project Communication*
  - *Communication with stakeholders*
  - *Communication within teams*
  - *Presenting project outcomes.*
- *Project Evaluation*
  - *Success criteria and metrics, evaluation, customer satisfaction measurement, transition to operations.*
- *Project Management tools*
  - *Selection and use of appropriate, industry relevant project management tools and software.*

Advanced databases (5 credits)

Building on the Information Systems module, this module presents a detailed study of the advanced usage and functionality of SQL in an enterprise database environment using a suitable relational database management system.

On successful completion of this module the learner will be able to:

1. *Write complex SQL using cursors, triggers, stored procedures and procedural SQL*
2. *Implement and use advanced data types in SQL*
3. *Incorporate and use XML in a relational database*
4. *Manage database security in a complex environment*

Content outline

The following is indicative of the syllabus that would be covered in this module:

- *Advanced data types – structured, arrays, objects*
- *Advanced database design*
- *Triggers*
- *Cursors*
- *Query optimisation and performance tuning, stored procedures*
- *Procedural SQL*
- *Advanced SQL functions*
- *XML / SQL*
- *Data security and data management*
- *Distributed databases - concurrent access, locking, fragmentation and replication*
- *Standards - SQL:2003, W3C (XPath and XQuery), and OMG*
- *Emerging database technologies and application areas.*

Data Analytics II (5 credits)

This module will build on the content covered in Data Analytics I focusing on analytics techniques and how these can be applied to specific business problems. The focus will be on breadth rather than depth - meaning that students will be introduced to, and made aware of, a wide range of data analytics techniques rather than covering a small number of techniques in great depth. The module will also cover the legal and ethical issues associated with data analytics. Finally, the module will review the most widely used data analytics tools on the market and equip students with the tools to evaluate and select from these tools for specific projects.

On successful completion of this module the learner will be able to:

1. *Understand the a range of different data analytics techniques and their data requirements*
2. *Analyse and evaluate the suitability of different data analytics techniques*
3. *Perform basic data analytics tasks using suitable data analytics tools (e.g. SAS Enterprise Miner)*
4. *Understand the legal and ethical issues associated with data analytics projects*
5. *Evaluate, asses and select analytics tools for different analytics tasks*

Content outline

The following is indicative of the syllabus that would be covered in this module:

- *Data Analytics Techniques*

    - *Predictive modelling techniques (e.g. regression, nearest neighbour, decision trees, neural networks, support vector machines)*
    - *Pattern discovery (e.g. association rule mining, clustering, heuristic algorithms)*
    - *Data visualisation & evaluation*
- *Legal & ethical issues in data analytics*
    - *Data protection issues*
- *Data analytics tools*
    - *Data preparation tools*
    - *Data analysis tools*
    - *Data modelling tools*
    - *Evaluating tools for data analytics*

Data Analytics Case Studies (5 credits)
The purpose of this module is to expand the student's understanding of techniques employed in data analytics by exposing them to real world case studies. These case studies may be of approaches that organisations have taken to implement solutions to real problems in the field or based on scenarios which have no a priori solutions to allow the students to create their own approach and compare it with other students. One of the main goals of this module will be to expose students to the varied uses of data analytics in different industries.

On successful completion of this module the learner will be able to:

1. *Read about, and intelligently discuss applications of data analytics within an organisation*
2. *Examine case studies of applications of data analytics and how they are implemented in the workplace*
3. *Identify issues in a range of disciplines that can be addressed by the application of data analytics*
4. *Explain the different contributions of people, organisational systems and technologies in organisations*
5. *Analyse and evaluate the ways in which data professionals contribute to an organisation*
6. *Critically assess data analytics solutions using a range of appropriate criteria.*

Content outline
The following is indicative of the syllabus that would be covered in this module:

- *Case study techniques:*
    - *Types of Case Studies*
    - *Collecting Data for Case Studies*
    - *Designing and Conducting Case Studies*
    - *Analysing Case Study Evidence*
    - *Reporting Case Studies*
- *Innovation in organisations*
- *Varied case study content that may include the following industries or topics:*
    - *Telecommunications*
    - *Pharmaceuticals*
    - *Finance*
    - *Customer relationship management*
    - *Marketing*

- *Digital media*
- *Open source software*
- *Ethical issues*
- *Geographical Information Systems*

Data Analytics Project (10 credits)
On successful completion of this module the learner will be able to:

1. *Undertake a significant data analytics project*
2. *Conduct research as part of a significant project*
3. *Complete all steps of the data analytics project life cycle (e.g. business understanding, data understanding, data preparation, data modelling, evaluation, and deployment)*
4. *Conduct the data analytics project and communicate the generated insights to peers*
5. *Use suitable state of the art data analytics tools.*

Content outline
Research, design and undertake a significant data analytics project. Ideas will be taken from a list put together by an industry-academic steering committee, or from an idea generated by the student. The project must use state of the art data analytics technologies and students will be expected to develop specialist skills for this project beyond those covered in the core modules.

Deliverables

1. *Research, analysis and design documentation*
2. *Analytics artefacts (e.g. databases, models etc.)*
3. *Documented insights extracted from data.*

Sample Projects
The following are examples of possible areas that students might address in their projects:

1. *Design, development and deployment of a predictive model for a specific business application.*
2. *Exploration of a specific social issue through the use of data analytics tools.*
3. *Undertaking a customer segmentation for a specific business (to include data analytics work as well as development of communication strategies and collateral)*
4. *The generation of a holistic data visualisation tool, for a set of disparate, but connected, data sources*
5. *The design and implementation of data collection and storage systems for novel data types.*

Company Specific Training/ Certification/ Module (5 credits)
This is intended to allow credit for specific company training and/or certification, and can be associated with placement. Should this not be available, provision should be made for an additional academic module.

6 ICT skills demand for specific ICT skill sets

In making a proposal for an ICT Skills Conversion course applicants should make specific reference to the skills needs identified in the 2016 *Guidance for higher education providers on current and future skills needs of enterprise.*

Software Engineers for the **design and development** of applications & systems: Specific skill-sets required are:

- **Programming languages** - Java, JavaScript, C#, C++, C+++, Visual Basic; .Net; SQL data base; Perl, Ruby, Python, Objective-C, Objective – Orientated Programming (OOP);
- Java knowledge combined with experience in Spring and Grails Frameworks; PHP knowledge;
- **Web Development** - understanding of Web 2.0 development technologies, XML, Microsoft ASP.Net (web application framework to build sites, applications and services),
  Personal Homepage Tools (PHP), Microsoft Sharepoint family of software products, other web page development skills (HTML, CSS, XHHTML, Ruby on rails);
- **Games developers** with skills (both entry and advanced level) in web based architecture and technologies, Java, and game state management (GSM), as well as high level skills in 3D animation;
- **Enhancing end user experience** and usability (UX, UI, Tibco, Messagebroker), which are becoming increasingly important as businesses migrate to online platforms; and
- Knowledge of **operating platforms** – Windows, UNIX / Linux processing environment.

Computing architects and administrators with skills and expertise in:

- Big data analytics infrastructure and technologies (for big data developers: NoSQL, Java, JavaScript, MySQL and Linux combined with TDD, CSS and Agile; for big data architects: Oracle, Java, SQL, Hadoop, SQL Server and Data Modelling ETL);
- Customer relationship management applications (Salesforce, Dynamics, Oracle, SAP, Advanced Excel); and
- SQL Server database administration

Cloud computing specialists

- Cloud infrastructure skills (e.g. Python and open source technologies)
- VMWare and other virtualisation technologies know-how
- Expert support engineers (Windows, Linux, Redhat, Debian, Ubuntu)

Network specialists and engineers: e.g. Server Message Block (SMB), wireless sensor testing, collaboration functions, process management, search modules and document management platform, router configuration and management, experience with scripting language Java, C, C+ and network configurations

Security experts: high level expertise in security, malware, digital forensics, web security, etc. Internet security and network security models and solutions - certified IT systems, architecture, engineering and management (e.g. Cisco information security systems), firewall configurations administration, authorisation mechanisms

Telecommunications: Mobile technology applications developers (e.g. Apple iOS; Android neycomb, Icecream, Sandwich); Windows Phone; Linux; Unix; open source tools; Software Development Life Cycle); the demand spans a range of levels but is particularly strong for high level skills.

IT Project managers with technical skills combined with program management, business analytics, or Agile/Scrum/Kanban and Prince II skill sets.

IT user support: Networking and PC maintenance experts with skills in Cisco CCNA and MS MCITP; there is also a demand for skills, even those with less experience, in Oracle, Comptia Linux+, Comptia A+, wireless networks and IP networking, especially, although not restricted to, the telecommunications and security industries.

IT testing and troubleshooting: performance testers; automation and manual testers (especially in the financial and telecommunications industries). 33

Personnel with **foreign languages skills and IT technical background**: To fill positions in IT technical support, accounting, marketing and business development; requirement for fluent oral and written French, German, Spanish, Dutch, Flemish and Swedish.

Sales and Marketing personnel with IT technical background and relevant industry knowledge: To support business development; Oracle and SAP business applications and services and other software solutions for specific business solutions.

Data analytics, skilled professionals with data analytics skills. Skills needs identified include supporting technology professionals, with the skills to develop, implement and maintain the hardware and software required to make use of Data Analytics including Big Data. Programme content to address such needs should include the following:

- Fundamentals of computing software development
- Building, implementing and managing Hadoop environments
- Mapreduce
- Database management and administration– SQL, MySQL, NoSQL
- Social media technologies
- Design/user experience skills
- Communications, problem solving, ethics and teamworking skills