ICON College of Technology and Management

BSc (Hons) Computing

Course Handbook 2021- 2022

Course Title: BSc (Hons) Computing with Integrated Foundation Year

Course Code: ICON xxxxx

1. Key Information

Award: BSc (Hons) Computing
Course Id: ICON
Location: ICON College of Technology and Management, London
Awarding Institution: Falmouth University
Credit Value: 360 Level 4-6 Credits
Course Structure: 16x20 credits; 1x40 Computing Project (Dissertation)
Duration: 3 Years
Academic year: 2021 -2022
Mode of Study: Full Time
Language of Study: English
Course Fees: £7500
Timetables: Day, Evening and Weekend

Introduction

ICON College of Technology and Management offers a BSc (Hons) Computing in partnership with Falmouth University, a TEF Gold Rated University.

The overall aim of the programme of awards is to develop students' intellectual, practical and interpersonal skills to the best of their ability at their selected level of study, and to prepare them for, or advance their prospects in, a career in the field of Computing. This will be achieved by providing a thorough educational basis in the fundamental theoretical, practical, sustainable and managerial aspects of Computing, together with other complementary topics appropriate to the award's level of study.

Entry Requirements

To meet the entry criteria for admission, a candidate must have:

A minimum of two completed A-Levels D grade and above, a BTEC Level 3 Diploma, Equivalent of A-Level Qualification based on NARIC, or 4 GCSEs at grade C and above and 3 Years' Experience;

Alternative entry to the course is through the Integrated Foundation Year Course;

IELTS 5.5 in Reading, Writing, Speaking and Listening or Equivalent.

Course Map – BSc (Hons) Computing

Stage 1 – Level 4

Study Block 1		Study Block 2	
Network Engineering Pathway	Software Engineering Pathway	Network Engineering Pathway	Software Engineering Pathway
COMP 410 Procedural Programming Compulsory (20 credits)		COMP 440 Database Design and Implementation Compulsory (20 credits)	
COMP 420 Mathematics for Computing Compulsory (20 credits)		COMP 450 Project management & Professional Development Compulsory (20 credits)	
COMP 430 Software Engineering Principles Compulsory (20 credits)		COMP 460 Computer Networks and Operating Systems Compulsory (20 credits)	

Stage 2 – Level 5

Study Block 1		Study Block 2	
Network Engineering Pathway	Software Engineering Pathway	Network Engineering Pathway	Software Engineering Pathway
COMP 500 Data Communication & Networks Compulsory (20 credits)	COMP 530 Object Oriented Analysis, Design and Implementation Compulsory (20 credits)	COMP 550 Computer & Digital Forensics Compulsory (20 credits)	COMP 580 Test-Driven Development (TDD) Compulsory (20 credits)
COMP 510 Web Application development Compulsory (20 credits)	COMP 510 Web Application development Compulsory (20 credits)	COMP 560 Wireless Network Compulsory (20 credits)	COMP 590 Data Science Principles & Statistics Compulsory (20 credits)
COMP 520 Computer Systems and Security Compulsory (20 credits)	COMP 540 Data Structures and Algorithms Compulsory (20 credits)	COMP 570 Cloud Computing Compulsory (20 credits)	

Stage 3 – Level 6

Study Block 1		Study Block 2	
Network Engineering	Software Engineering	Network Engineering	Software Engineering
COMP 610 Computing Project Compulsory (40 credits)		COMP 610 Computing Project Compulsory (40 credits)	
COMP 620 Network Infrastructure & Design Compulsory (20 credits)	COMP 640 Big Data Analytics Compulsory (20 credits)	COMP 660 Internet of Things (IoT) Compulsory (20 credits)	
COMP 630 Network Security Compulsory (20 credits)	COMP 650 Mobile Applications Development Compulsory (20 credits)	COMP 670 Machine Learning and Artificial Intelligence Compulsory (20 credits)	

Course specific employability skills

The course tailors the development of student's technical skills towards the development and application of computer engineering relevant to the computing disciplines. These include:

Knowledge & Understanding

- Explain and apply essential facts, concepts, principles and theories relating to computing and computer applications as appropriate to the programme of study;
- Discuss scientific and engineering practice and theory in computing and extend knowledge through self-led study;
- Discuss management issues concerning the planning, design and delivery of computer-based systems;
- Identify and model requirements for specialised computing systems and propose and evaluate solutions to fulfil them;
- Demonstrate knowledge of systems architecture;
- Use appropriate theories, practices and tools for the specification, design, implementation and evaluation of computer-based systems;
- Explain security issues in relation to the design and use of computer systems;
- Explain the concepts of computer programming and critically evaluate and predict their utility in models, tools and applications;
- Demonstrate advanced, specialist theoretical and practical knowledge in a range of computer science sub-fields;
- Explain the legal, social, ethical and professional issues involved in the exploitation of computer technology with respect to good professional practice.

Cognitive and Intellectual Thinking Skills

- Develop and critically evaluate specifications for specialist computer systems;
- Analyse and solve problems based on theoretical considerations;
- Analyse and abstract problems and propose and apply effective solutions;
- Synthesise information from disparate sources to compose systems and

Documents;
- Design and construct computer systems from given specifications;
- Identify the risks and beneficiaries involved in a practical computing project;
- Apply controlled compromise in meeting requirements;
- Apply techniques and tools for modelling and managing information;
- Understand the commercial context in which content are developed and consumed.

Practical, Professional or Subject-specific Skills

- Understanding of and ability to use relevant materials, equipment, tools, processes, or products;
- Knowledge and understanding of workshop and laboratory practice;
- Ability to use and apply information from technical literature;
- Ability to use appropriate codes of practice and industry standards;
- Awareness of quality issues and their application to continuous improvement;
- Version control and continuous integration;
- Legal, social, ethical and professional issues and codes of practice;
- Professional standards and bodies in the computing sector;
- Materials and technologies appropriate to professional practice;
- Explain the issues of professionalism in computing including the need for continuing professional development;
- Plan and manage a large-scale problem-solving computing project.

Transferable Key or Personal Skills

- Industry-relevant business practices and how to align them to future aspirations;
- The principles of communication design as it relates to personal branding;
- Adapting fundamental computing skills and knowledge to work in a diverse range of application domains;
- Communicating across technical specialisms and application domains;
- Assessing any risks or safety aspects that may be involved in the operation of computing and information systems within a given context;
- Understanding of the principles of managing engineering processes;
- Communicating requirements and proposals for computer systems to other computing professionals;
- Working as a member of a development team, recognising the different roles within a team;
- Designing and execute methodologically sound scientific and engineering studies;
- Planning work;
- Managing personal time;
- Presenting and communicating complex ideas;
- Applying sound research methods
- Understanding, evaluating, synthesising and applying complex ideas.

Career/Future Study Opportunities

The skills offered as part of the BSc (Hons) in Computing can provide graduates with the opportunity to work in many different areas of the Computing sector. Below are some

examples of job roles to which each qualification could lead:

- Systems Analyst/Data Scientist
- Network Engineer
- Software Engineer
- Consultant
- System Administrator
- IT Project Manager
- Software developer
- Business analyst
- Web developer
- Technical architect
- Technical Manager
- Technologist
- User experience designer
- Helpdesk Engineer
- Lead Programmer/Chief Technical Officer
- Programmer
- Network Programmer
- Trainer/ Educator
- Platform to continue further higher studies at postgraduate level and research

Structure of Course Delivery

The programme is delivered and assessed via a coordinated combination of: lectures (including programmed student activity); supervised tutorials; supervised laboratory work; independent coursework; group project work; and individual project work and dissertation.

The teaching and assessment methods used are largely consistent throughout the programme, although the level of each module determines the level at which assessment is carried out; i.e. it is the nature of the problems encountered and the solutions required which determines the level of the modules, not the activities performed. The intention is to require increasingly greater levels of analysis, autonomy, etc. as students progress through the programme.

This is reflected in the programme structure: fundamental concepts and skills are addressed first, followed by core knowledge that builds on this, which in turn prepares students for advanced modules and a large individual or group project in the final Programme Stage.

The College will accommodate a variety of methods for the delivery of modules throughout the course as appropriate to meet the module expectations at different levels. The delivery will therefore be flexible, based on the learning styles of the students as well as diversity of the contents.

Project work plays an important Programme Stage in computing programme. The Group Project provides students with experience of the issues involved in network/software development projects as well as enhancing team-working and related transferrable skills.

In the Individual Project, students are expected to undertake an independent investigation of a significant computing problem, allowing them to apply what they have learned throughout the

programme. This activity is carried out under the supervision of academic staff, offered through a series of supervision sessions.

Lectures are normally used to: (a) present and explain the theoretical concepts underpinning a particular subject; (b) highlight the most significant aspects of a module's syllabus; and (c) indicate additional topics and resources for private study. Tutorials are used to help students to develop skills in applying the concepts covered in the lectures of the relevant module, normally in practical problem-solving contexts.

Laboratory sessions serve a similar purpose to tutorials, but their emphasis will be to demonstrate application of concepts and techniques through the use of software development tools, network design tools and environments.

The ICON Virtual Learning Environment (ICON VLE) tools will be used to supplement face-to-face delivery through pre-recorded video, discussion fora, breakout sessions and so on, in order to support learners in different modules. The ICON VLE will continue to be used for submitting coursework for summative and formative assessments.

Throughout the module delivery tutors will be urged, through formative assessment, to keep track of learners' achievement in gaining specific employability skills outlined as relevant to specific module. In addition, guest lectures from relevant industries will share their experience of employability skills required in the field of computing. Special workshop sessions in formative assessment will be used to assess the learners' level of achievement in employability skills, including critical thinking, creativity, research and analysis, team working and self-management.

Project supervision sessions will be used to indicate theories, methods, techniques and concepts which are relevant to the issues investigated by the particular project as well as ways of applying these instruments in specific problem-solving contexts.

The Teaching and Learning

Through our teaching and learning, we aim to develop course-related employability skills along with knowledge and understanding of academic content, models and theories. *(See details of ICON College* Teaching, Learning and Assessment Strategy in the ICON *Quality Manual pp 80).*

To achieve these learners:

- Experience a range of delivery/teaching styles that address a diverse range of learning styles
- Become independent learners through taking responsibility for own learning
- Have access to resources on the ICON VLE that will help them
- Receive support that enhances learning.

To support the above, staff will:

- Provide a curriculum that is current, relevant and underpinned by up-to-date research and professional practice
- Provide a varied diet of teaching and learning methods.

Teaching Methods

A variety of teaching methods will be utilised as individual learners learn in different ways.

Lecturers will base their teaching on the Five Steps Model developed and indicated in the weekly plan:

i) **Introduction (**information of the objectives of the session: introduce concept, theories and models)

ii) **Lectures and delivery method (**session lecturer on specific topic, with learners participating answering questions: task-based learning will be used to develop problem solving skills and to relate theory to practice)

iii) **Activity** (Group work during breakout sessions based on a case study, reading an article, blog, etc. This will encourage learners to communicate, share ideas and experiences and learn from each other)

iv) **Reflection and feedback (**from group work: reflection and discussion will encourage application and analysis. This will also enable learners to develop higher level of learning skills of synthesis and evaluation)

v) **Consolidation and integration (**learners will share their experience and share the summaries of Topic or case study. This will enable the learners to engage in the pursuit of life-long learning

In addition, Feedback and Tutorial support classes for either groups or individuals will be provided regularly and also by appointment.

Learners will be expected to work independently both at home using the resources available on the ICON VLE and in the College library.

Course Assessment Strategy

A broad range of skills and knowledge are in demand in the computing profession and assessments are tailored to the particular activity being undertaken and to students' learning needs. Assessed activities include the development of working software, the design of computer network systems, the application of theory to practical problems, teamwork, project work and the communication of problem analysis and solutions through reports and presentations. The assessment of these activities is guided by assessment criteria.

The assessment strategy aims to measure the skill and competence of the individual student by means of a structured and integrated approach to a defined coursework schedule. The assessment strategy has been devised to reflect the diverse nature of the module content with a balance between those modules assessed through assignments, coursework and class tests, and others that are examined during or at the end of the session. A coursework descriptor will be issued with each element of assessment, which will provide details of and guidance notes on the specified requirements.

Oral presentations aimed at developing the student's communication and oratory skills are used at all levels, especially in design and project modules, where the ability to express ideas, concepts and thoughts are required. This addresses modern industry requirements for graduates to be able to present information confidently. Elements of self- and peer-assessment are used, especially in group design and project activities.

Further details of assessments, including types of assessment, word counts for reports, tests and presentation duration will be given in assessment briefs for each of the Levels 4, 5 and 6 respectively.

Summative Feedback

Feedback on assessments is given in a variety of ways in order to maximise student learning opportunities. For written reports or problem-solving tasks, the feedback may be written, while feedback on lab work, presentations and some group work will be given face-to-face. In all cases, feedback is provided such that students can learn the most they can from the work that they have done and apply that learning to future activities.

Feedback will be provided in line with the College Assessment Policy. In particular, students will normally be provided with feedback within two to three weeks of the submission deadline or assessment date. This would normally include a provisional grade or mark.

Formative Feedback

Non-mark bearing (formative) assessment also constitutes an important part of the assessment process. Formative assessment includes all the feedback received from tutors and in peer-review sessions. It allows for the opportunity to receive constructive feedback on work at various stages of each module. Students can use this feedback to shape the work submitted for summative assessment. For Level 4 to Level 6, assessments will provide progressively less scaffolding and more space to explore individual interests in ways that individuals determine will be most effective. This is to ensure that students will be confident in independently developing and pitching their own solutions by the time they graduate.

Assessment Methods: Modular assessment methods reflect the specific Aims and Learning Outcomes. Assignments remain the major method of assessment and are designed to facilitate learning and how students develop knowledge, along with critical and reflective thinking. Some assignments may have more than one method used for assessment purposes. The Module Guide provides an explanation on how each module will be assessed. The following are typical assessment methods used in this course:

- CT: Class Test
- TH: Thesis and Dissertation
- PO: Portfolio
- PP: Presentation of work
- CA: Coursework Assessment
- OT: Other type of assessment
- EX: Exam
- CR: Critical Review

Course Learning Outcomes

Students who have successfully completed the BSc Computing degree would be expected to demonstrate the following Learning Outcomes:

LO name Level	Level 4	Level 5	Level 6
1. Code	Translate technical notation into executable code.	Implement working and maintainable software components.	Construct reusable and deployable Software systems, with appropriately verified functional coherence.
2. Architect	Translate requirements into suitable technical notation.	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	Refactor software systems in correspondence with relevant theories, practice, and discourse in the computing sector.
3. Solve	Demonstrate computational thinking and numeracy skills.	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Synthesise knowledge of computing to address complex technical challenges.
4. Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.
5. Research	Report on an issue using appropriate Research sources and academic conventions.	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.
6. Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.
7. Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.
8 Application	Apply existing artefacts, facts, concepts and ideas in a similar situation	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.
9. Deliver	Describe how to create and test prototypes in order to deliver an interesting experience.	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.

TPA Table

Module Code	Level	Module Name	Credits	Study Block	Compulsory (C) or Option (O)	Assessment Methods*	Contributing towards the Learning Outcomes* (Taught (T), Practised (P) and/or Assessed (A))								
							1	2	3	4	5	6	7	8	9
Level 4															
COMP 410	4	Procedural Programming	20	1	C	CA, CT, OT	TPA	TPA	TPA					TPA	
COMP 420	4	Mathematics for computing	20	1	C	CA, CT, OT	TPA		TPA		TPA		TPA		
COMP 430	4	Software Engineering Principles	20	1	C	CA, CT, PP		TPA		TPA		TPA	TPA		
COMP 440	4	Database Design and Implementation	20	2	C	CA, CT, OT	TPA	TPA		TPA				TPA	TPA
COMP 450	4	Project management & Professional Development	20	2	C	CA, CT, PP			TPA		TPA	TPA	TPA		
COMP 460	4	Computer Networks and Operating Systems	20	2	C	CA, CT, PP		TPA	TPA						TPA
Level 5															
COMP 500	5	Data Communication & Networks	20	1	C	CA, CT, PP			TPA	TPA			TPA	TPA	
COMP 510	5	Web Application development	20	1	C	CA, CT, OT	TPA	TPA		TPA					TPA
COMP 520	5	Computer Systems & Security	20	1	C	CA, CT, PP			TPA	TPA	TPA			TPA	
COMP 530	5	Object Oriented Analysis, Design and Implementation	20	1	C	CA, CT, OT	TPA		TPA			TPA			TPA
COMP 540	5	Data Structures and Algorithms	20	1	C	CA, CT, OT	TPA	TPA	TPA					TPA	
COMP 550	5	Computer & Digital Forensics	20	2	C	CA, CT, PP			TPA	TPA	TPA		TPA		TPA
COMP 560	5	Wireless Network	20	2	C	CA, PP			TPA	TPA		TPA		TPA	
COMP 570	5	Cloud Computing	20	2	C	CA, PP	TPA	TPA				TPA			TPA
COMP 580	5	Test-Driven Development (TDD)	20	2	C	CA, CT, OT	TPA	TPA			TPA		TPA		
COMP 590	5	Data Science Principles & Statistics	20	2	C	CA, CT, OT	TPA	TPA	TPA		TPA				
Level 6															
COMP 610	6	Computing Project	40	1,2	C	TH, PP	TPA		TPA	TPA	TPA			TPA	TPA
COMP 620	6	Network Infrastructure & Design	20	1	C	CA, OT	TPA		TPA		TPA	TPA			TPA
COMP 630	6	Network Security	20	1	C	CA, OT			TPA		TPA	TPA		TPA	TPA

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Module Code	Level	Module Name	Credits	Study Block	Compulsory (C) or Option (O)	Assessment Methods*	Contributing towards the Learning Outcomes* (Taught (T), Practised (P) and/or Assessed (A))								
							1	2	3	4	5	6	7	8	9
COMP 640	6	Big Data Analytics	20	1	C	CA, CT, PP			TPA	TPA	TPA			TPA	
COMP 650	6	Mobile Applications Development	20	1	C	CA, CT, OT	TPA	TPA	TPA				TPA		
COMP 660	6	Internet of Things (IoT)	20	2	C	CA, CT, PP	TPA	TPA					TPA		TPA
COMP 670	6	Machine Learning and Artificial Intelligence	20	2	C	CA, CT, PP	TPA		TPA			TPA			TPA

Assessment Method	
CT	Class Test
TH	Thesis and Dissertation
PP	Presentation
OT	Other type of assessment
CA	Coursework Assessment
EX	Exam
PO	Portfolio
CR	Critical review

Learning Outcomes
1. Code
2. Architect
3. Solve
4. Advocate
5. Research
6. Reflect

7. Collaborate
8. Application
9. Deliver

Degree classification

The classification of the degree shall be determined in accordance to the following criteria:

First Class (1):

- Students achieving an overall mean score of 70% or above.
- Students achieving an overall mean score of between 68% and 70% with at least 60 Level 6 credits at above 70% with the approval of the Assessment Board.

Upper Second Class (2:1):

- Students achieving an overall mean score of between 60% and 69%.
- Students achieving an overall mean score of between 58% and 60% with at least 80 Level 6 credits at above 60% with the approval of the Assessment Board.

Lower Second Class (2:2):

- Students achieving an overall mean score of between 50% and 59%.
- Students achieving an overall mean score of between 48% and 50% with at least 80 Level 6 credits at above 50% with the approval of the Assessment Board.

Third Class (3):

- Students achieving an overall mean score of between 40% and 49%.

Assessment Regulations

Students submit assignments through the ICON VLE where a check for plagiarism is made and feedback from the tutor is provided. A student will not be able to submit their assignments if their attendance is too low and not in line with College attendance policy.

Assignments submitted after the final submission deadline, and within one week of the deadline, will be capped at 40% (Pass) unless extenuating circumstances apply. Any assignment submitted later than two weeks after the deadline (week one being final submission and week two, the following week, being the late submission window) will not be accepted. A student should then follow the relevant submission and resubmission process.

Where circumstances beyond a student's control impact negatively on an assessment opportunity, a student may submit a claim for exceptional extenuating circumstances and their work will be not be capped at Pass if it is accepted.

A student who, for the first assessment opportunity and resubmission opportunity, still fails to pass the module will be allowed to repeat the module. The module will be capped at Pass and can be repeated only once.

For further information on Assessment regulations, please refer to the Student Handbook. For further information on Assessment regulations regarding submission, resubmission and repetition of the module, please refer to the Student Handbook.

Student Support

The College assigns every student a designated Personal Tutor who is available by appointment throughout the academic year. The Personal Tutor is the first contact point at the College who will act as a mentor, and guide students who encounter non-academic problems, e.g. financial hardship, accommodation matters, learning disabilities and so on. All Personal Tutors will be expected to have online meetings with each of their tutees at least once a semester.

The aims of the Personal Tutoring System are:

- To ensure a student has someone who provides general advice and can point him/her in the direction of other resources in place to support the student;
- To ensure a student has someone who will support their academic progression and identify any problems;
- To ensure that a student has a named person to whom they can go for support.

The College has a Hardship Fund intended to provide support to all students who are experiencing exceptional financial difficulty during their studies.

The College provides pastoral care and counselling through a Private Therapy Clinic (an external healthcare company). A Student Career and Welfare Officer is available for published hours each week (including Saturdays) to provide counselling and welfare advice to ensure equality of access to provision.

The College has two members of staff, including the College Student Career and Welfare Officer, to provide advice regarding academic transition and progression following Course completion. The members of staff publish their availability on a noticeboard outside their office detailing the times each week they are available to provide this advice, including in the evening.

The College is committed to providing equality of access to education to all students through disability support services. The Student Career and Welfare Officer is responsible for liaising with the student and the relevant staff to implement all reasonable measures.

Evaluation and Revision

- The Assessment Board receives and evaluates the external examiner's reports every year and evaluates the standard achieved by the students and the quality of the provision of their work. They then produce a report for submission to the Academic Board.

- The College also gives formative feedback on assignments to students through an online Formative Feedback Forum.

- The internal moderator checks a range of assessment decisions for all assessors and modules by sampling some of the assignments. In the event of unexpected assessment decisions, e.g. a preponderance of First Class grades in the assignment, additional sampling will be conducted on individual modules/assessors.

The Academic Board has the responsibility to oversee the management of academic standards and quality of teaching and learning for all Courses and to ensure that the requirements of the College are fulfilled.

Further Information

See the ICON College website https://www.iconcollege.ac.uk for more information about the BSc (Hons) Computing .

Course Handbook in PDF

Download Course Handbook in PDF

General Module Information

Status	Draft
Module Name	Procedural Programming
Module Code	COMP 410
Credit Value	20
Level and Study block	Level 4, Study Block 1
Pre-requisites	None
Named Module Leader	Amjad Alam

Module Aim

On successful completion of this unit learners will benefit from being encouraged to exercise autonomy and judgement to produce a solution to a programming problem, adapt their thinking and reach considered conclusions when analysing the requirements and producing the solution to a programming problem for a client. Learners will also benefit from getting knowledge and skills with the core elements of programming including control statements, primitive data elements and structures, program structure using functions, basic input and output, and the software development process. Emphasis will be made on supporting learners to acquire the necessary ability to write well-formed and structured programs using well defined data structures, methods, and filing.

Summary Module Description

This unit enables learners to become familiar with the underpinning concepts of procedural programming and subsequently to develop skills in a procedural programming language. The unit starts by looking at the features of procedural programming, explores the tools and techniques used in their development and takes learners through design and program development. Learners will use a structured approach to the design and development of applications, ensuring the solution is well documented and thoroughly tested against the original user requirement.

This unit will introduce learners with the core concepts of programming with an introduction to algorithms/ pseudocodes and the characteristics of programming paradigms. In relation with different programming paradigms, procedural, object-orientated, and event-driven programming will be compared. The unit then puts theory into practice and learners will design and develop procedural programs to meet specified needs. There are many concepts to be learned and practised to enable learners to design and implement programs confidently. As with all programming, the focus is on developing solutions to meet identified needs is made along with emphasis on the importance of testing and reviewing. Good practice in testing and documenting programs will be emphasised and learners will develop techniques for ensure their program code is understandable and able to be maintained by others.

On successful completion of this unit learners will benefit from being encouraged to exercise autonomy and judgement to produce a solution to a programming problem, adapt their thinking

and reach considered conclusions when analysing the requirements and producing the solution to a programming problem for a client.

Module-Specific Employability Skills

- Logical thinking
- Problem-solving
- Programming
- Decision making
- Research and Analysis
- Collaborative working
- Communication

Learning Outcomes

LO	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Translate technical notation into executable code.	Process
2	Architect	Translate requirements into suitable technical notation.	Knowledge
3	Solve.	Demonstrate computational thinking and numeracy skills.	Analysis
4	Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	None
5	Research	Report on an issue using appropriate Research sources and academic conventions.	None
6	Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	None
7	Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	None.
8	Application	Apply existing artefacts, facts, concepts, and ideas in a similar situation.	Application
9	Deliver	Describe how to create and test prototypes in order to deliver an interesting experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework Assessment	60	1,8	Compulsory
CT	Class Test(s)	20	2, 3	Compulsory
OT	Demonstration of work	20	1	

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
OT	Other type of Assessment

Assessment Criteria

COMMON ASSESSMENT CRITERIA

Assessment Criteria	OUTRIGHT FAIL 0-29%	UNSATISFACTORY 30-39%*	SATISFACTORY 40-49%	GOOD 50-59%	VERY GOOD 60-69%	EXCELLENT 70-84%	EXCEPTIONAL 85-100%
1. Research Extent of research and/or own reading, selection of credible sources, application of appropriate referencing conventions	Little or no evidence of reading. Views and findings unsupported and non-authoritative. Referencing conventions largely ignored.	Poor evidence of reading and/or of reliance on inappropriate sources, and/or indiscriminate use of sources. Referencing conventions used inconsistently.	References to a limited range of mostly relevant sources. Some omissions and minor errors. Referencing conventions evident though not always applied consistently.	Inclusion of a range of research-informed literature, including sources retrieved independently. Referencing conventions mostly consistently applied.	Inclusion of a wide range of research-informed literature, including sources retrieved independently. Selection of relevant and credible sources. Very good use of referencing conventions, consistently applied.	A comprehensive range of research informed literature embedded in the work. Excellent selection of relevant and credible sources. High-level referencing skills, consistently applied.	Outstanding knowledge of research-informed literature embedded in the work. Outstanding selection of relevant and credible sources. High-level referencing skills consistently and professionally applied.
2. Knowledge Extent of knowledge and understanding of concepts and underlying principles associated with the discipline.	Major gaps in knowledge and understanding of material at this level. Substantial inaccuracies.	Gaps in knowledge, with only superficial understanding. Some significant inaccuracies.	Evidence of basic knowledge and understanding of the relevant concepts and underlying principles.	Knowledge is accurate with a good understanding of the field of study.	Knowledge is extensive. Exhibits understanding of the breadth and depth of established views.	Excellent knowledge and understanding of the main concepts and key theories. Clear awareness of challenges to established views and the limitations of the knowledge base.	Highly detailed knowledge and understanding of the main theories/concepts, and a critical awareness of the ambiguities and limitations of knowledge.
3. Analysis Extent of summarising the key findings of internal and external analysis in relation to the marketing of a product or service	Little or no ability to critically engage with and analyse information and formulate reasoned arguments.	Some ability to critically engage with and analyse information and formulate reasoned arguments	Adequate ability to critically engage with and analyse information and formulate reasoned arguments.	A competent ability to critically engage with and analyse information and formulate reasoned arguments.	A very good ability to critically engage with and analyse information and formulate reasoned arguments	An excellent ability to critically engage with and analyse information and formulate reasoned arguments	An outstanding ability to critically engage with and analyse information and formulate reasoned arguments.

4. Application Effective deployment of appropriate methods, materials, tools and techniques; extent of skill demonstrated in the application of concepts to a variety of processes and evidence of innovative ideas.	Limited or no use of methods, materials, tools and/or techniques. Little or no appreciation of the context of the application. Limited innovative and creative ideas	Rudimentary application of methods, materials, tools and/or techniques but without consideration and competence. Flawed appreciation of the context of the application flawed innovative ideas.	An adequate awareness and mostly appropriate application of well established methods, materials, tools and/or techniques. Basic appreciation of the context of the application and basic innovative ideas.	A good and appropriate application of standard methods, materials, tools and/or techniques. Good appreciation of the context of the application, with some use of examples, where relevant and evidence of innovative ideas.	A very good application of a range of methods, materials, tools and/or techniques. Very good consideration of the context of the application, with perceptive use of examples, where relevant. Evidence of some innovation ideas.	An advanced application of a range of methods, materials, tools and/or techniques. The context of the application is well considered, with extensive use of relevant examples. Application and deployment extend beyond established conventions. Innovation evident throughout.	Outstanding levels of application and deployment skills. Assimilation and development of cutting edge processes and techniques and evidence of outstanding innovative ideas
5. Professional Practice Demonstrates attributes expected in professional practice including: individual initiative and collaborative working; deployment of appropriate media to communicate (including written and oral); clarity and effectiveness in presentation and organisation.	Communication media is inappropriate or misapplied. Little or no evidence of autonomy in the completion of tasks. Work is poorly structured and/or largely incoherent.	Media is poorly designed and/or not suitable for the audience. Poor independent or collaborative initiative. Work lacks structure, organisation, and/or coherence	Can communicate in a suitable format but with some room for improvement. Can work as part of a team, but with limited involvement in group activities. Work lacks coherence in places and could be better structured.	Can communicate effectively in a suitable format, but may have minor errors. Can work effectively as part of a team, with clear contribution to group activities. Mostly coherent work and is in a suitable structure.	Can communicate well, confidently and consistently in a suitable format. Can work very well as part of a team, with very good contribution to group activities. Work is coherent and fluent and is well structured and organised.	Can communicate professionally and, confidently in a suitable format. Can work professionally within a team, showing leadership skills as appropriate, managing conflict and meeting obligations. Work is coherent, very fluent and is presented professionally.	Can communicate with an exceptionally high level of professionalism. Can work exceptionally well and professionally within a team, showing advanced leadership skills. Work is exceptionally coherent, very fluent and is presented professionally.
6. Process Recognise the key academic and professional concepts and express relevant technical processes in response set briefs and/or problem-solving context	Little or no ability to generate ideas, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity	Some ability to generate ideas, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity.	An adequate ability to generate ideas, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity	Competent ability to generate ideas, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity.	Very good ideas generation, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity	Excellent ideas generation, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity	Outstanding ideas generation, problem solving, concepts, technical competency and proposals in response to set briefs and/or self-initiated activity
7. Industry Identify concepts relating to ethically informed industry practices and their real-world application(s)	Little or no ethically informed real-world experience of industry/business	Some ethically informed, real-world experience of industry/business	An adequate, ethically informed, real-world experience of	A competent, ethically informed, real-world experience of	A very good, ethically informed, real-world experience of industry/business	An excellent, ethically informed, real-world experience of industry/business	An outstanding, ethically informed, real-world experience of industry/business

	environments and markets.	environments and markets.	industry/business environments and markets.	industry/business environments and markets.	environments and markets.	environments and markets.	environments and markets.
8. Evaluation Extent of evaluation and synthesis of issues and material	Little or no evaluation and synthesis of issues and material	Some evaluation and synthesis of issues and material	Some critical evaluation and synthesis of key issues and material	Critical evaluation and synthesis of complex issues which does not include an original approach	Critical evaluation and synthesis of complex issues and material which includes an original approach	Critical evaluation and synthesis of complex issues and material which includes an original and reflective approach	Critical insightful evaluation and synthesis of complex high level of originality and reflection.

Modes of delivery

Module Target Learner Hours: 200	
Activity	**Hours**
Lecture	36
Practical classes and workshops	24
Seminar	6
Tutorial	10
Independent Learning Hours: 124	

Indicative list of resources

Key Text:

BOURAS, Aristides S. (2019), *Python and Algorithmic Thinking for the Complete Beginner*: Learn to Think Like a Programmer, 2nd edition, **ISBN-13:** 978-1099184871

BARRY, Paul. (2016) *Head-first Python, 2nd edition*, **ISBN-13:** 978-1491919538

GRIES, Paul; CAMPBELL, Jennifer; MONTOJO, Jason, (2013) *Practical Programming: An Introduction to Computer Science Using Python 3, The Pragmatic Programmers*, ISBN 9781937785451

DAWSON, Michael., (2010) *Python Programming for the Absolute Beginner*, Delmar Cengage Learning, ISBN 9781435455009.

Websites:

https://www.w3schools.com/python/python_intro.asp

https://pythonprogramming.net/game-development-tutorials/

https://www.tutorialspoint.com/software_testing_dictionary/debugging.htm

https://www.minigranth.com/software-testing/debugging/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Mathematics for Computing
Module Code	COMP 420
Credit Value	20
Level and Study block	Level 4, Study Block 1
Pre-requisites	Basic Algebra, Trigonometry and Co-ordinate geometry
Named Module Leader	Amjad Alam

Module Aim

To enable learners with the core areas of discrete mathematics knowledge needed for successful study of undergraduate computing topics, including data analytics, game designing and Artificial Intelligence (AI).

Summary Module Description

This module will provide learners with an introduction to the core areas of mathematics that form the foundation of computer science. The unit introduces students to the mathematical principles and theory that underpin the computing curriculum. Through a series of real-life application scenarios and task-based assessments, learners will explore number theory within a variety of scenarios; use applicable probability theory; apply geometrical and vector methodology; and finally evaluate problems concerning differential and integral calculus.

The main areas of discrete mathematics are covered including logic, numbers, set theory, relations, matrices, probability, statistics, and calculus. The use of discrete mathematics within different areas of computing is introduced.

On successful completion of this unit learners will be able to gain confidence with the relevant mathematics needed within other computing units. As a result, they will develop skills such as communication literacy, critical thinking, analysis, reasoning, and interpretation, which are crucial for developing competence in game designing, data analytics, AI, and other related areas.

Module-Specific Employability Skills

- Logical thinking
- Problem-solving
- Research and Analysis
- Communication
- Programming.
- Decision making.

Course Learning Outcomes

LO	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Translate technical notation into executable code.	Process
2	Architect	Translate requirements into suitable technical notation.	None
3	Solve.	Demonstrate computational thinking and numeracy skills.	Knowledge
4	Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	None
5	Research	Report on an issue using appropriate Research sources and academic conventions.	Research
6	Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	None
7	Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	Application
8	Application	Apply existing artefacts, facts, concepts, and ideas in a similar situation.	None
9	Deliver	Describe how to create and test prototypes to deliver an interesting experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	5, 7	Compulsory
CT	Class Test(s)	20	3	Compulsory
OT	Demonstration of Work	20	1	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
OT	Other Type of assessment

Assessment Criteria

Indicative list of resources

<u>**Key Text:**</u>

MAKINSON, David. (2012), *Sets, Logic and Maths for Computing*, 2nd edition, Springer.

VINCE, John., 2015. *Foundation Mathematics for Computer Science*.

GERAND, O'Regan, (2016), *Guide to Discrete Mathematics*, Springer.

WALLIS, W.D. (2011), *A Beginner's Guide to Discrete Mathematics*, 2nd edition, Springer.

STROUD, K.A. (2009) *Foundation Mathematics*. Basingstoke: Palgrave Macmillan.

Websites:

https://www.tutorialspoint.com/discrete_mathematics/index.htm

https://www.javatpoint.com/discrete-mathematics-tutorial

https://www.geeksforgeeks.org/engineering-mathematics-tutorials/

http://www-math.mit.edu/~djk/calculus_beginners/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Software Engineering Principles
Module Code	COMP 430
Credit Value	20
Level and Study block	Level 4, Study Block 1
Pre-requisites	None
Named Module Leader	Ifeoluwa Agboola

Module Aim

The aim of the module is to ensure students are well equipped with practical and transferrable skills in the application of existing tools and techniques for the design and development of usable and user-friendly software. This include substantial experience of applying a systematic approach to software development and evaluation individually or as members of a software team.

Summary Module Description

The module enables students to understand programming techniques and implement them in the development of adequate solutions to medium-scale real-life problems. It enhances student's ability to adapt and apply fundamental principles and concepts of software engineering, such as programming languages, tools, techniques, methodologies, standards, quality assurance systems, testing, organisation and management methods.

The focus of the module also teaches students software development stages in the Software Development Life Cycle (SDLC), processes and methodologies including a comparison between predictive models such as waterfall type and adaptive models such as Agile. The roles and responsibilities of how developers work in a team across the full software development lifecycle are also looked into.

The use of case studies will be implemented to enable the application of the theoretical understanding of real-world issues. In this way, abstract concepts are brought to life through practical activities.

This module provides the support for students in the form of lectures, labs and tutorials that will enable students develop personal portfolio of skills and knowledge. Concepts, principles and theories are generally explored in formal lectures, practiced in associated tutorials and seminars and demonstrated and experimented in laboratory classes. Practical skills are developed in laboratory sessions.

Students completing the course will have sufficient expertise to enter the highly dynamic and rapidly developing software industry productively based on the software engineering practice; will be able to produce ideas and solutions to make existing technologies more efficient; or to

develop new technologies in total awareness of the professional, ethical and legal issues that might arise in a software development environment.

Typical career opportunities include: Software Engineer, Web Application Programmer, Software Designer/Analyst, Web Site Designer/Programmer.

Module-Specific Employability Skills

- Project management
- Programming
- Critical thinking
- Problem solving
- Teamwork
- Verbal and written communication
- Research
- Logical thinking

Learning Outcomes

LO	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Translate technical notation into executable code.	None
2	Architect	Translate requirements into suitable technical notation.	Application
3	Solve	Demonstrate computational thinking and numeracy skills.	None
4	Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	Industry
5	Research	Report on an issue using appropriate Research sources and academic conventions.	None
6	Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	Knowledge
7	Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	Process
8	Application	Apply existing artefacts, facts, concepts and Ideas in a similar situation.	None
9	Deliver	Describe how to create and test prototypes in order to deliver an interesting experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	2	Compulsory
CT	Class Test(s)	20	4, 6	Compulsory

PP	Presentation	20	7	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	**Hours**
Lecture	30
Practical classes and workshops	12
Seminar	6
Tutorial	6
Independent Learning Hours: 140	

Indicative list of resources

Essential texts:

BECK K. (2000), *Extreme Programming Explained: Embrace Change*. Addison Wesley. Upper Saddle River, NJ, USA

BOOCH G, RUMBAUGH J, JACOBSON I (1999) *The Unified Modelling Language Users Guide.* Addison Wesley.

COAD P, LEFEBVRE E, DE LUCA J. (1999). *JAVA Modelling in Colour with UML: Enterprise Components and Process.* Prentice Hall.

COCKBURN (2001). *Writing Effective Use Cases.* Addison-Wesley. Boston, Ma, USA.

HALL E. A., (1998). *Managing Risk: Methods for Software Systems Development*. Addison-Wesley. Reading, MA, USA.

ERIC Freeman, BERT Bates, KATHY Sierra, and ELISABETH Robson. 2004. *Head First Design Patterns: A Brain-Friendly Guide,* O'Reilly Media. ISBN-10: 9780596007126

FOSTER, Elvis 2014. *Software Engineering: A Methodical Approach*. ISBN 978-1-4842-0847-2
JOHNSON G, NISSENBAUM H, (1995). Computers, Ethics and Social Values. Prentice-Hall.

KULAK D, GUINEY E, (2000). *Use Cases: Requirements in Context.* Addison-Wesley. Boston, Ma, USA.

NEWKIRK J, MARTIN R C, (2001). *Extreme Programming in Practice.* Addison Wesley. Upper Saddle River, NJ, USA.

HANS van Vliet 2008. *Software Engineering: Principles and Practice.* Available online at http://160592857366.free.fr/joe/ebooks/ShareData/Software%20Engineering%20-%20Principles%20and%20Practice%20By%20Hans%20van%20Vliet%20-%20Wiley%202007.pdf.

HEATHER Adkins, BETSY Beyer, BLANKINSHIP Paul, LEWANDOWSKI Piotr, ANA Oprea, STUBBLEFIELD Adam (2020). *Building Secure and Reliable Systems*, O'Reilly Media, Inc.ISBN: 9781492083122

MARK Richards and NEIL Ford (2020). *Fundamentals of Software Architecture: An Engineering Approach*, O'Reilly. ISBN-10: 1492043451

Journals

- Communications of the ACM

- Decision Sciences

- Information Systems Research

- ACM Trans. on Database Systems

Databases

- Science Direct

- Wiley

Indicative Web Sites

Tutorials Ride
https://www.tutorialride.com/software-engineering/software-engineering-tutorial.htm

JavaTPoint
https://www.javatpoint.com/software-engineering-tutorial

Tutorials Point
https://www.tutorialspoint.com/software_engineering/index.htm

W3Schools
https://www.w3schools.in/sdlc-tutorial/software-development-life-cycle-sdlc/
https://www.w3schools.in/category/software-testing/

Named Awards

Course	Compulsory
BSc (Hons) Computing	Compulsory

General Module Information

Status	Draft
Module Name	Database Design and Implementation
Module Code	COMP 440
Credit Value	20
Level and Study Block	Level 4, Study Block 1
Pre-requisites	None
Named Module Leader	Ifeoluwa Agboola

Module Aim

The aim of this module is to give students opportunities to develop an understanding of the concepts and issues relating to database design and development, as well as to provide the practical skills to translate that understanding into the design, creation, testing and deployment of relational database systems.

Summary Module Description

Database systems continue to demand more complex data structures and interfaces, as applications get increasingly sophisticated. Databases stand as the backend of most systems. Database design and development is a fundamental and highly beneficial skill for computing students either in relational or non-relational concepts.

The focus of the module is to ensure students learn and understand the concept of designing database queries that solve specific application-level problems and write them in Structured Query Language (SQL), which involves implementing a database schema using a relational Database Management System (DBMS) that supports standard SQL and No-SQL for non-relational database systems.
This module provides an insight into database systems concepts and architecture, database designs, data modeling using the Entity Relationship (ER) model.Topics included in this unit are: examination of different design tools and techniques; examination of different development software options; considering the development features of a fully functional robust solution covering no-SQL data, data integrity, data validation, data consistency, data security and advanced database querying facilities across multiple tables; verifying the accuracy and completeness of a conceptual schema to the user and system requirements; and elements of complete database system documentation.

Students will develop extensive soft skills such as communication literacy, critical thinking, reasoning and interpretation alongside with the technical skills crucial for gaining employment in the database domain such as Database Administrator, Database Developer, Database Tester.

Module-Specific Employability Skills

- Critical thinking
- Analytical
- Written and verbal communication
- Problem solving
- Research and analysis
- Project management
- Time Management
- Assessing processes

Learning Outcomes

LO	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Translate technical notation into executable code.	Process
2	Architect	Translate requirements into suitable technical notation.	Knowledge
3	Solve.	Demonstrate computational thinking and numeracy skills.	Industry
4	Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	None
5	Research	Report on an issue using appropriate Research sources and academic conventions.	None
6	Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	None
7	Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	None
8	Application	Apply existing artefacts, facts, concepts and ideas in a similar situation.	Application
9	Deliver	Describe how to create and test prototypes in order to deliver an interesting experience.	Evaluation

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	1,2	Compulsory
CT	Class Test(s)	20	8	Compulsory
OT	Demonstration of work	20	4, 9	Compulsory

The following codes for assessment methods apply	
CA	Individual Report
CT	Computer Based
OT	Other type of Assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	**Hours**
Lecture	30
Practical classes and workshops	12
Seminar	6
Tutorial	6
Independent Learning Hours: 140	

Indicative list of resources

Essential Texts

AVISON D and FITZGERALD G, (2006). *Information Systems Development: Methodologies, Techniques and Tools*, McGraw Hill Higher Publishing Company. ISBN 0077114175

BASIT A. Masood-Al-Farooq (2014) SQL Server 2014 Development Essentials

CHAO L. (2006). *Database Development and Management*, CRC Press, ISBN 0849392381

CONNOLLY T and BEGG C (2004). *Database Systems: A Practical Approach to Design, Implementation and Management*, Addison Wesley. ISBN 0321210255

DEWSON, Robin, (2015. *Beginning SQL Server for Developers*, 4th Edition

JEFFREY D ULLMAN, JENNIFER Widom, (2008). *First Course in Database Systems*, A: Pearson New International Edition, 3/E. ISBN-10: 1292025824 • ISBN-13: 9781292025827

PONNIAH P (2006) Database Design and Development: An Essential Guide for IT Professionals: Visible Analyst Set. John Wiley & Sons Inc, ISBN 0471760943

RAMEZ Elmasri, SHAMKANt B. Navathe, (2017). Fundamentals of Database Systems, Global Edition, 7/E, Pearson, UK. ISBN-10: 1292097612 • ISBN-13: 9781292097619

Journals
- Communications of the ACM
- Decision Sciences
- Information Systems Research
- Decision Support Systems
- ACM Trans. on Database Systems
- Computing

Databases
- Business Source Premier
- Science Direct
- Wiley

Indicative Web Sites:

Lynda
https://www.lynda.com/search?q=database

Deep Training
www.deeptraining.com/litwin/dbdesign/FundamentalsOfRelationalDatabaseDesign.aspx

Tutorials Point
https://www.tutorialspoint.com/dbms/index.htm
https://www.tutorialspoint.com/database_tutorials.htm
https://www.tutorialspoint.com/dbms/sql_overview.htm
https://www.tutorialspoint.com/dbms/er_diagram_representation.htm
https://www.tutorialspoint.com/software_testing_dictionary/database_testing.htm

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Project Management & Professional Development
Module Code	COMP 450
Credit Value	20
Level and Study block	4 , Study Block 1
Pre-requisites	None
Named Module Leader	M. J. Hasan

Module Aim

The aim of this module is to present modern project management core principles and equip learners with the techniques, skills and understanding of practical project management as a means to help deliver successful software, hardware and IT related project. Including the implications of systems development trends, project/product life cycle, introduce the technical management activities, which pervade information systems development, give understanding of the techniques and procedures for the planning and control a project in information systems development environment.

Summary Module Description

Project planning and management are essential skills for the (IT/IS) practitioner, and so relevant to all types of projects, be they individual or large commercial projects. The project manager should then be able to co-ordinate teams and resources in a diverse socio-cultural context and be equipped with leadership skills, coupled with an ability to manage diverse and ever-changing requirements and scopes of IT/IS projects.

By completion of this module, students will be able to gain knowledge in problem-solving in relation to project management with the following overall attributes.

- Project Management in an Information Technology Context
  - Background
  - The Project Management Body of Knowledge
  - Core processes and facilitating processes
  - Project lifecycle models
  - Project initiation; planning and project execution

- Core Functions
  - Estimation and metrics
  - Quality management.
  - Time, resources and cost management.

- Facilitating Functions
  - Human resource management
  - Teams and motivation

- o Project tracking and control
- o Risk management and recovery
- o Project closure
- o professional responsibility
- o Agile Developments implications for Project Management

Module-Specific Employability Skills

- Legal, social, ethical and professional issues and codes of practice.
- Professional standards and bodies in the computing sector.
- Business planning, financial modelling, enterprise, and risk management.
- The socio-cultural context in which artefacts and experiences are situated.
- The commercial context in which content are developed and consumed.
- Materials and technologies appropriate to professional practice.
- Varied modes of design practice and the implications of different ways of working.
- Version control and continuous integration.
- The principles of communication design as it relates to personal branding.
- Communicating across technical specialisms and application domains.

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Translate technical notation into executable code.	None
2	Architect	Translate requirements into suitable technical notation.	None
3	Solve	Demonstrate computational thinking and numeracy skills.	Knowledge
4	Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	None
5	Research	Report on an issue using appropriate Research sources and academic conventions.	Research
6	Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	Professional Practice
7	Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	Application
8	Application	Apply existing artefacts, facts, concepts and ideas in a similar situation	None
9	Deliver	Describe how to create and test prototypes in order to deliver an interesting experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	3, 5, 6 & 7	Compulsory
CT	Class Test	20	3	Compulsory
PP	Presentation of work	20	7	Compulsory

The following codes for assessment methods apply	
CT	Class Test
PP	Presentation of Work
CA	Coursework Assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	1
Lecture	18
Practical classes and workshops	7
Seminar	18
Tutorial	4
Independent study	152

Indicative list of resources

Larson, E.W., Gray, C.F. (2018). *Project management: the managerial process.* McGraw-Hill.

Kerzner, H. (2017). *Project management: a systems approach to planning, scheduling, and controlling.* John Wiley & Sons.

ISO (2012), *Guidance on project management: ISO 2150,* International Organisation for Standardisation.

Hinde, D. (2018). *PRINCE2 Study Guide: 2017 Update*. John Wiley & Sons.

Schwalbe, K., 2010, 6th edition, Information Technology Project Management, Thomson

AL-Ashmori, A., Bashari, B. (2017), Hybrid SPI Framework Based on Agile and CMMI for SMEs

Francis, D. & Horine, G., 2009, PMP (Project Management Professional) Exam Cram 2, Que Publishing

Galin, D., 2004, Software Quality Assurance, Pearson

Jones, C., 2000, Software Assessments, Benchmarks, and Best Practices, Addison-Wesley

Meredith, J. & Mantel, S., 2003, Project Management, a managerial approach, Wiley

McManus, J. & Wood-Harper, T., 2003, Information Systems Project Management, Pearson

Bustard, D.W., Wilkie, G., Greer, D., Agile Software Development Diffusion: Insights from a

IEEE & ACM Joint Task Force, "Computer Society and ACM Approve Software Engineering Code of Ethics", IEEE Computer, Oct 1999, pp84- 88. https://www.computer.org/education/code-of-ethics

IEEE, 2020. IEEE Code of Ethics. [Online] Available at: https://www.ieee.org/about/corporate/governance/p7-8.html [Accessed 01 August 2020].

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Computer Network and operating systems
Module Code	COMP 460
Credit Value	20
Level and Study block	4, Study Block 1
Pre-requisites	None
Named Module Leader	K. Ali

Module Aim

The aim of this module to develop an understanding of fundamental concepts of modern computer networks and operating systems investigating different operating system and applying theoretical understanding of operating systems and computer network in a real-world implementation.

Summary Module Description

This module introduces students to different types of operating systems focussing on modern operating systems and computer networks, the relationship between computer networks and the affective use of OS, include, but are not limited to:

(i) historical background of operating system, to gain a contextual understanding of operating system development, operating systems in practice and background of different operating system;
(ii) the role of operating systems in managing resources and computer components including memory management, processor management, device management, file management, network management, user interface;
(iii) Concepts, purpose, benefits, and resource implications of computer networks including conceptual models and standards, Logical and physical topologies;
(iv) explore the interaction of protocols, services and applications with a focus on operating system interaction with networks including physical/logical addressing;
(v) introduction to switched networks, simulating real world computer network and monitoring, practicing simple device configuration, and maintenance and Network monitoring.

Module-Specific Employability Skills

- Creative thinking skills
- Analysing facts and figures
- Creating and implementing solutions
- Research & Analysis
- Problem solving
- Analytical

- Risk and safety assessment

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Translate technical notation into executable code.	None
2	Architect	Translate requirements into suitable technical notation.	Analysis
3	Solve	Demonstrate computational thinking and numeracy skills.	Knowledge
4	Advocate	Recognise the legal, social, ethical, Advocate and professional issues that affect creative projects.	None
5	Research	Report on an issue using appropriate Research sources and academic conventions.	None
6	Reflect	Identify professional attributes and illustrate how they are relevant to your practice.	None
7	Collaborate	Define the suitable development practices, project management approaches, and version control tools in the execution of a collaborative project.	None
8	Application	Apply existing artefacts, facts, concepts and Ideas in a similar situation	None
9	Deliver	Describe how to create and test prototypes in order to deliver an interesting experience.	Professional Practice

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	2,3,9	Compulsory
CT	Class Test	20	3	Compulsory
PP	Presentation	20	9	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	1
Lecture	16
Practical classes and workshops	22
Seminar	10
Tutorial	8
Guided independent study	143

Indicative list of resources

Burgess, M. (2003) *Principles of Network and System Administration*. 2nd Ed. John Wiley and Sons Ltd.

Hallberg, B. (2005) *Networking: A Beginner's Guide*. 4th Ed. Osborne/McGraw-Hill US.

McHoes, A. M. & Flynn, I. M., (2011). *Understanding Operating Systems*. 6th Ed ed. Boston: Cengage Learning.

Philip Irving (2010). *Computer Networks*. Colchester: Lexden.

Subramanian, M. (2000) *Network Management: An Introduction to Principles and Practice*. Addison-Wesley.

William Stallings (2013). *Data and Computer Communications*. 10th ed. New York: Prentice Hall.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Data Communication & Networks
Module Code	COMP 500
Credit Value	20
Level and Study block	Level 5, Study Block 1
Pre-requisites	
Named Module Leader	K. Ali

Module Aim

This module considers the fundamental principles of communications, particularly as applied to digital data. The main aim of the module is to provide students with a good understanding of how communications systems work, and specifically how we can communicate information almost effortlessly, over long and short distances, with great accuracy and reliability.

The unit will introduce students to fundamentals of data and computer communications methods and techniques. It covers: ISO and TCP/IP layered protocols; physical layer concepts: data transmission methods, signal encoding and digital data communication techniques; data link control protocol, multiplexing methods; WAN and LAN networking fundamentals; internetworking and transport protocols; and basic concepts of network security.

Summary Module Description

- The overall introduction of data and communication. Communications media types and applications of communications technology, guided and unguided communications, broadcast and private communications;
- Data encoding, transmission modes, error detection and correction, flow control, multiplexing, switching techniques, network routing;
- Network topologies, protocols, layering, standardisation, LANs, WANs & MANs, internetworking, management, multicast, continuous media;
- Purpose of modulation (channel bandwidth and source bandwidth) Types of modulation amplitude, frequency, phase, code;
- Analogue and digital communications, analogue to digital conversion, sampling errors in sampling and their effects. Why we use digital transmission for analogue signals;
- Study of particular networks and protocols: FDDI, Ethernet, ISDN, SNMP, TCP/IP, X25, ATM.

Module-Specific Employability Skills

- Creative thinking skills
- Analysing facts and figures
- Assessing processes
- Creating and implementing solutions

- Research & Analysis

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	None
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	None
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Knowledge
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	Research
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	None
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	Application
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	Professional Practice
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	70	4, 7 & 8	Compulsory
CT	Class Test(s)	15	3	Compulsory
PP	Presentation (team work)	15	4	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test

PP	Presentation of work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	1
Lecture	30
Practical classes and workshops	12
Seminar	14
Tutorial	8
Guided independent study	135

Indicative list of resources

Core Text

Curt M White, Fundamentals of networking and data communications, Seventh Edition, Cengage Learning, ISBN 9781-133-62648-0 or International Edition.

Additional Texts

- William Stallings, *Business Data Communications*, Fourth Edition, Prentice Hall, ISBN 0-13-088263-1.
- Shelly, Cashman & Serwatka, *Business Data Communications*, Fourth Edition, Thomson, ISBN 0-7895-6806-3
- Behrouz A Forouzan, *Data Communications and Networking*, Second Edition, McGraw-Hill, ISBN 0- 07-118160-1
- William Stallings, *Data and Computer Communications*, Seventh Edition, Prentice Hall, ISBN 0-13-183311-1
- Fred Halsall, *Multimedia Communications*, Addison-Wesley, 0-201-39818-4
- Michael Duck and Richard Read, *Data Communications and Computer Networks*, 2nd Edn, Pearson, ISBN 0-130-93047-4

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Web Application Development
Module Code	COMP 510
Credit Value	20
Level and Study block	Level 5, Study Block 1
Pre-requisites	Object oriented analysis, design and implementation.
Named Module Leader	Y Meressi

Module Aim

To enable learners to gain the knowledge and the skills required to design, implement, test and deploy secure modern web applications using advanced client-side and server-side technologies.

Summary Module Description

This module enables you to understand, learn and gain the skills required to develop n-tier web applications utilising one or more modern client-side and server-side technologies. You will learn and apply appropriate design patters (e.g. MVC) for developing interactive web applications using latest tools and technologies that are used in industry while applying emerging standards and frameworks in design and development.

Although the emphasis of this module is on server-side technologies, we will also explore modern client-side technologies, understand and apply usability and accessibility principles in the design and build of interactive web applications. Nearly all websites are data driven, to this end, students will also gain the skills to connect code to databases and implement various CRUD operations on the data with appropriate security policies and ethical considerations.

Through lectures and seminars, the key concepts and technologies are introduced and illustrated. In lab sessions and workshops, students will work across all the stages of the software development lifecycle to solve real-world business problems by applying the techniques learned from the lectures and seminars. In the workshops, students will have the opportunity to collaborate as well as work independently while developing non−trivial web applications. Tutorials will provide students with opportunities to review what they have learned and discuss the material through group tasks and exercises.

By completion of this module, students will gain the knowledge and the practical skills required to become a full-stack web developer. Students will have a broad understanding of web application development, its terminology, the tools and technologies required to implement interactive data-driven web applications.

Module-Specific Employability Skills

- Logical thinking
- Problem-solving

- Collaborative working
- Research and Analysis
- Communication
- Self-management
- Project management

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	Process
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	Application
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	None
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	Analysis
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	None
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	None
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	Professional Practice

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	1,4	Compulsory
CT	Class Test(s)	20	2	Compulsory
OT	Demonstration of work	20	1, 9	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
OT	Other type of Assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	2
Lecture	10
Practical classes and workshops	32
Seminar	20
Tutorial	3
Guided independent study	133

Indicative list of resources

Key Texts:

NORTHWOOD, Chris. 2018. *The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer*.

PERES, Ricardo. 2020. Modern Web Development with ASP.NET Core 3: An end to end guide covering the
latest features of Visual Studio 2019, Blazor and Entity Framework.

JOSHI, Bipin, 2020. Beginning Database Programming Using ASP.NET Core 3: With MVC, Razor Pages, Web API, jQuery, Angular, SQL Server, and NoSQL.

SMITH, Lynn. 2020. Software Architecture with ASP.NET Core 3.1 MVC.

LOCK, Andrew. 2018. ASP.NET Core in Action.

OMOLE, Olayinka. 2018. Server-Side development with Node.js and Koa.js Quick Start Guide: Build robust and scalable web applications with modern JavaScript techniques.

SULLIVAN, Bryan, LIU, Vincent. 2012. Web Application Security, A Beginner's Guide.

LOVE, Chris. 2018. Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web.

ZAMMETTI, Frank. Modern Full-Stack Development: Using TypeScript, React, Node.js, Webpack, and Docker.

MELONI Julie C., KYRNIN, Jennifer. 2018. HTML, CSS, and JavaScript All in One: Covering HTML5, CSS3, and ES6, Sams Teach Yourself.

Websites:

https://www.w3schools.com/

https://developer.mozilla.org/en-US/docs/Learn

https://docs.microsoft.com/en-us/dotnet/architecture/modern-web-apps-azure/develop-asp-net-core-mvc-apps

https://docs.microsoft.com/en-us/dotnet/architecture/modern-web-apps-azure/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Computer Systems & Security
Module Code	COMP 520
Credit Value	20
Level and Study block	5 , Study Block 1
Pre-requisites	
Named Module Leader	M. J. Hasan

Module Aim

This module will equip and engage students with knowledge of the ever-challenging areas of the computing environment, looking at the background, concepts and application of security systems covering vulnerability, threats, attacks, risks, risk assessment and mitigation, considering business continuity and disaster recovery.

Summary Module Description

The ubiquitous nature of computer systems and ever-increasing computer crimes and cyber security alerts increases the need to educate professionals of the fundamentals of computer systems hardware and software adding to the challenges in modern computing in protecting and securing assets, data network and communication infrastructure in view of security triad (Confidentiality, Integrity, and Availability).

The basic element of digital technologies starts with understanding and the ability to comprehend the digital logic and logic gates, Number systems, ASCII, binary, hex, binary-hexadecimal. Memory hierarchy, cache, virtual memory, ROM, PROM, EPROM, RAM, Memory Management Storage, Networks, and Other Peripherals.

This module will cover and introduce operations and operands of the computer hardware, basic assembly language instruction representation, and understanding of the fundamentals of computer hardware and of the principles of operation of computers and peripheral devices such as disk storage and buses, I/O devices; interfacing I/O devices to the processor, disk and file systems.

The building block to security is to understand the concept of security; introducing computer security, security triad (Confidentiality, Integrity, and Availability), authenticity, accountability, types of risks and preventions, vulnerabilities, user authentication, malicious software, human resources security, external/ internal attacks, social engineering

The ability to secure assets, Hardware including computer systems and software including the operating system, adding to communication facilities and networks: Local and wide area network communication links,

Managing security, use of security tools, security policies, procedures, standards, and guidelines, risk assessments, legal and ethics, business continuity and disaster recovery.

Module-Specific Employability Skills

- Applying essential facts, concepts, principles and theories relating to computing, computer architectures, and computer applications as appropriate to the programme of study;
- Using mathematical principles, with particular emphasis on the application of computational thinking, numeracy, and discrete mathematics;
- Utilising tools for the construction and documentation of computer applications, with particular attention to understanding the whole process involved in the effective deployment of computers and to solve practical problems;
- Preparing professional technical documentation using appropriate tools;
- Interpreting notations used in technical communication and the documentation of computing systems;
- Referencing scholarly sources found using library resources such as online databases of academic research;
- Maintaining a standard of academic conduct.

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	None
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	None
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Analysis
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	Knowledge
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	Evaluation
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	Professional Practice

9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	4,5	Compulsory
CT	Class Test(s)	20	3	Compulsory
PP	Presentation	20	8	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	1
Lecture	14
Practical classes and workshops	14
Seminar	9
Tutorial	10
Guided independent study	152

Indicative list of resources

Cheswick, W.R., Bellovin, S.M. and Rubin, A.D. (2003). *Firewall and Internet Security*, 2nd ed., Addison-Wesley.

Kaufman, C., Perlman, R. and Speciner, N., *Network Security: Private Communication in a Public World*, 2nd Prentice Hall.

Yuan, R. and Strayer, W.T., *Virtual Private Networks: Technologies & Solutions*, Addison-Wesley.

Stallings, W., *Network Security Essentials: Applications and Standards*, Prentice Hall.

Alexander, D. et al. (2008) *Information Security Management Principles*. BSC.

James F. Kurose, Keith W. Ross.(2012) *Computer Networking: A Top-down Approach*, 6th edition, Prentice Hall.

Stallings, W. and Brown, L. (2015), *Computer Security Principles and Practice*, 3rd Edition, Pearson

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Object Oriented Analysis, Design and Implementation
Module Code	COMP 530
Credit Value	20
Level and Study Block	Level 5, Study Block 1
Pre-requisites	Basic knowledge of any programming language.
Names Module Leader	Sanjib Raj Pandey

Module Aim

To enable learners with Object-Oriented Analysis and Design (OOAD) skills required to develop object-oriented software systems using Unified Modelling Language (UML) notation in the analysis and design and an object-oriented language for the implementation.

Summary Module Description

This module covers advanced Object-Oriented design techniques and UML notation in the process of software development. Students will develop the skills and understanding required to analyse, design and implement robust OO software systems. UML structure diagram such as class diagram, object diagram, package diagram, component diagram, deployment diagram and behaviour diagram such as use case diagram, sequence diagram, activity diagram etc. will be used to model the dynamic and static behaviours of software systems. The module will expose the student to the full software development lifecycle stages from inception to implementation with strong emphasis on analysis, design and implementation stages. In this journey, students will learn various activities for example requirements analysis using object-oriented approach and identify the software components. They will learn how to analyse and design classes, their relationship to each other in order to develop an object model of the problem domain. Students will learn to take reusability, extensibility and maintainability into account when designing software systems.

Code object-oriented concepts (abstraction, encapsulation, inheritance, polymorphism, Interfaces etc) will be illustrated with practical code implementation examples.

On successful completion of this module, learners will be able to design, implement and test real-world software systems by following an object-oriented design and programming paradigm. Learners will have an opportunity to understand the difference between writing code and doing analysis and design.

Module-Specific Employability Skills

- Critical and logical thinking
- Research and analysis
- Problem – solving
- Decision making
- Programming
- Communication
- Able to prioritise task and time management

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	Process
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	None
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Knowledge
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	None
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	None
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	Professional Practice None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	None
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	Application

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcome Assessed	Compulsory or Compensable
CA	Coursework	60	1,3	Compulsory
CT	Class Test(s)	20	3	Compulsory
OT	Demonstration of work	20	1,6 & 9	Compulsory

The following codes for assessment methods apply.	
CT	Class Test
RE	Coursework Assessment
OT	Other type of assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Lecturer	36
Tutorial	14
Supervised lab based work	20
Project supervision	10
Independent Learning Hours: **120**	

Indicative list of resources

Key-Text:

DATHAM Brahma, RAMNATH Sarnath.2015. *Object-Oriented Analysis, Design and Implementation: An Integrated Approach.* Springer.

SKELTON, Bennet & Lunn. 2015. *Schaum's Outlines - UML*, 2nd Ed, McGraw-Hill,ISBN 0-07-710741-1.

FOWLER Martin.2006. *UML Distilled: A Brief Guide To The Standard Object Modelling Language*, 3rd Ed, Addison Wesley,ISBN 0-321-19368-7.

WIXOM Dennis, and TEGARDEN. 2005. *Systems Analysis And Design With UML Version 2.0 An Object-Oriented Approach*, 2nd Ed, Addison Wesley, ISBN 90-471-65920-7.

GAMMA, E. et al. 1995. *Design Patterns: Elements of Reusable Object-Oriented Software*.1st Ed. New Jersey: Addison-Wesley.

MCLAUGHLIN, B.D. et al. 2007. *Head First Object-Oriented Analysis and Design*.

1st Ed. United States of America: O'Reilly Media.

Websites (Online Resources):

https://www.tutorialspoint.com/object_oriented_analysis_design/index.htm : TutorialsPoint – OOAD

https://modeling-languages.com/ : Modelling language - UML

https://www.tutorialspoint.com/uml/index.htm : TutorialsPoint - UML

https://www.lucidchart.com/pages/ : Lucidchart –UML

https://app.diagrams.net/ : Draw IO

https://www.visual-paradigm.com/ : Visual Paradigm - UML

https://www.minigranth.com/software-testing/debugging/

https://www.tutorialspoint.com/software_testing_dictionary/debugging.htm

https://www.w3schools.com/java/java_oop.asp : Java OOP – W3School

https://www.w3schools.com/cs/cs_oop.asp : C# OOP – W3School

https://www.w3schools.com/cpp/cpp_oop.asp : C++ OOP – W3School

https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm : C++ OOP – TutorialPoints

https://www.tutorialspoint.com/python/python_classes_objects.htm : Python OOP-TutorialPoints

Academic Journals:

Journal of Systems and Software, ISSN: 01641212, Elsevier.

IEEE Transactions on Software Engineering, ISSN: 0098-5589, Institute of Electrical and Electronics Engineers Inc.

Journal of Object-Oriented Programming, ISSN: 0896-8438, SIGS Publications.

The Journal of Object Technology, ISSN 1660-1769,AITO publication.

Advances in Engineering Software, 18735339, 09659978, Elsevier.

Science of Computer Programming, ISSN: 01676423, Elsevier.

Software Testing Verification and Reliability, ISSN: 10991689, 09600833, John Wiley and Sons Ltd.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Data Structures and Algorithms
Module Code	COMP 540
Credit Value	20
Level and Study block	Level 5, Study Block1
Pre-requisites	Knowledge in any programming language. Basic concepts of OOP.
Named Module Leader	Amjad Alam

Module Aim

To introduce the learners with the design, analysis, and implementation of data structures and algorithms to solve wide range of problems in computer science. Learners will be able to apply elementary data structures, (including arrays, stacks, queues, and lists) and advanced data structures (including trees and graphs in building complex application.

Summary Module Description

This module will provide learners with the knowledge to implement algorithms and data structures in solving real problems. This module will also help learners in understanding the purpose, complexity, and use of algorithms as an essential toolkit for software engineers. The unit introduces the specification of abstract data types and explores their use in concrete data structures. Based on these knowledges, students should be able to develop solutions by specifying, designing, and implementing data structures and algorithms in a variety of programming paradigms for an identified need.

This module will go through linear data structures such as arrays, lists, stack, queue, and tree. This unit will extends further, to learn other data structures (such as trees and hash tables) for collections, sorting algorithms (e.g. heapsort, merge sort and quicksort), graphs and graph algorithms (e.g. for searching, topological sorting, critical path analysis, shortest paths, minimum spanning trees, network flow), pattern finding (for substrings and regular expressions), algorithmic problem solving and algorithm design techniques (e.g. greed, divide and conquer, dynamic programming, backtracking). Finally, the module will cover with the study of trade-off between aspects of implementation, such as the Time/Space dichotomy and an understanding of time complexity notation, such as the 'Big O' notation to compare algorithms regarding their correctness and regarding their efficiency.

On completion of this unit the learner should be able to identify program data requirements, specify abstract data types using a formal notation, translate into concrete data structures and be able to develop, using a programming paradigm, different sorting, searching and navigational algorithms that implement complex data structures and evaluate their effectiveness.

Module-Specific Employability Skills

- Logical thinking
- Problem-solving
- Reasoning
- Interpretation
- Numerical Literacy
- Programming.
- Decision making.

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	Process
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	Analysis
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Knowledge
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	None
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	None
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	Application
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	1, 3 & 8	Compulsory
CT	Class Test(s)	20	2, 3	Compulsory
OT	Demonstration of work	20	1	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CB	Class Test
OT	Other type of assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Lecture	30
Practical classes and workshops	24
Seminar	16
Tutorial	10
Independent Learning Hours: 120	

Indicative list of resources

Key Text:

CAREY, John; DOSHI, Shreyans and PAYAS, Rajan, 2019, *C++ Data Structures and Algorithm Design Principles: Leverage the power of modern C++ to build robust and scalable applications*, ISBN-13: 978-1838828844

CORMEN, Thomas H. 2009, *Introduction to Algorithms.* MIT Labs, ISBN: 9780262033848.

HEMANT, Jain. 2016. *Problem Solving in Data Structures & Algorithms Using C#: Programming Interview Guide,* Taran technologies publisher, ISBN 13: 9789352655915

KENT, D. Lee and HUBBARD, Steve, 2015, *Data structures and algorithms with Python*, ISBN-13: 9783319130712

LAFORE, Robert., 2017. *Data Structures & Algorithms in Java.* Indianapolis, Indiana: Sams, ISBN: 9780134847993

MCMILLAN, Michael., 2007. *Data Structures and Algorithms In C♯.* Cambridge: Cambridge University Press.

WOOD, Emma L., ANAND, Shivana and BECK, Emily J. 2019, *Data structures and advanced algorithms*, ISBN-13: 978-1691728824

Websites:

https://www.tutorialspoint.com/data_structures_algorithms/index.htm

https://www.csharpstar.com/csharp-algorithms/

https://www.studytonight.com/data-structures/

https://www.includehelp.com/data-structure-tutorial/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Computer & Digital Forensics
Module Code	COMP 550
Credit Value	20
Level and Study block	Level 5, Study Block 2
Pre-requisites	
Named Module Leader	M. J. Hasan

Module Aim

The aim of this module is to introduce students in the field of computer forensics to concepts, processes, tools and activities, and to develop an understanding and equip learners with the necessary skills to undertake and contribute to forensic investigation using current forensic tools.

Summary Module Description

Computers including smart phones and networks have become ubiquitous and embedded in our society, business and daily life; there are growing civil disputes such are countries updating their legal guidelines to address the ever-changing and challenging aspects of digital evidence. Professionals will undoubtedly deal with growing numbers of digital investigation and/or legal dispute such as such as computer fraud, insider threat, industrial espionage, or phishing, this will involve some form of digital evidence and hence a knowledge and understanding of the concept, process and technical in-depth knowledge of different

Professionals therefore need to be introduced to basic computer forensic principles: What is computer forensics and identifying the processes and procedures for carrying out digital forensic investigation. Real-life examples of computer crime, digital forensics and evidence will be used. Legal and ethical considerations: Legal and ethical considerations when conducting a Forensic Investigation; Data Protection Act; Computer Misuse Act and the Freedom of Information Act will also be covered.

- Study of different storage and file format, Cluster tips or slack, free space, the swap file, History files, registry files, Storage forensics, Understanding disk architecture and disk-based Investigations. Disk Drive Overview, Disk structures, file systems (FAT and NTFS). Deleted files and the artefacts left by the Windows OS. Advanced Windows registry. Digital Forensic Investigation Tools: Hardware and software tools, Introduction to computer forensic tools (EnCase, FTK, Hex editors, etc.). Methods of information hiding techniques: Steganography as an example.
- Introduction to Windows, Linux, and Macintosh Boot Processes, Boot Loader, Boot Sector, Basic System Boot Process. Basic programming method to accessing sectors. Basic OS forensics, Default Password Databases and Password-Cracking Tools, Conducting a simple computer forensic investigation. Mobile device forensics Basic Network forensic: Network sniffing and extracting basic information. The Incident life cycle.

Module-Specific Employability Skills

- Creative thinking skills
- Assessing processes
- Creating and implementing solutions
- Research & Analysis
- Problem solving
- Critical thinking
- Preparing technical documents

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	None
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	None
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Knowledge
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	Professional Practice
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	Evaluation
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	Analysis
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	None
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	Application

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	70	3, 5, 7 & 9	Compulsory

CT	Class Test(s)	10	3	Compulsory
PP	Presentation	20	4	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
PP	Presentation of work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	1
Lecture	12
Practical classes and workshops	24
Seminar	8
Tutorial	3
Guided independent study	152

Indicative list of resources

Altheide, C. & Carvey, H., (2011). *Digital Forensics with Open Source Tools.* London: Syngress .

Carrier, B.(2005), *File system Forensic Analysis,* Addison Wesley.

Carvery, H. (2011) *Windows Registry Forensics: Advanced Digital Forensic Analysis of the Windows Registry*, Syngress.

Carvey, H. (2009) *Windows Forensic Analysis*, Syngress

Casey (2011) *Digital Evidence and Computer Crime Forensic Science, Computers, and the Internet*, 3rd Edition. Elsevier.

Casey, E. (2009), *Handbook of Digital Forensics and Investigation*, Academic Press

Farmer, D & Venema, W. (2004) *Forensic Discovery*, Addison Wesley.

Malin, Casey, Aquilina (2012) *Malware Forensics Field Guide for Windows Systems*, Syngress

Russinovich, M.E. and Solomonm, D.A. (2009) *Windows Internals*, Microsoft Press

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Wireless Network
Module Code	COMP 560
Credit Value	20
Level and Study block	5, Study Block 2
Pre-requisites	
Named Module Leader	K. Ali

Module Aim

The module aims to provide the students with a comprehensive technical foundation of the wireless communication systems and wireless network architectures. Wireless network system and their applications are today regarded as a prerequisite for any business success story. It is therefore of paramount importance that networking professionals can cope with the demands imposed on them.

This module deals with a complex and rapidly evolving field in which it is essential to keep up to date with material drawn from a variety of sources. Material from several of these areas is used to enrich the hands-on practical work. It prepares student for the use, positioning, planning, implementation, and operation of wireless networks. The module also provides you with information and practice activities to design, install, configure, monitor, and conduct basic troubleshooting tasks of a WLAN in small-business and enterprise level.

The module is divided into four parts, such that: Part I deals with the fundamental aspects of signals; Part II is concerned with the concept of cellular systems and the evolution towards next generation networks. Part III covers other wireless technology systems and networks while Part IV discusses the mobility aspects in wireless communications and recent advancements

Summary Module Description

- The overall introduction of basics of wireless communications (e.g., technical challenges, spectrum and frequencies, antennas, beamforming, etc.);
- Random access protocols (e.g., fixed and random-access techniques);
- The Cellular Concept;
- Cellular Systems Evolution (e.g., from 2G to 5G);
- Wireless Systems Evolution (e.g., IEEE 802.11 family);
- Wireless Ad-Hoc Networks (e.g., routing algorithms);
- Introduction to Vehicular Wireless Networks;
- Introduction to Internet of Things;
- Basic Satellite Systems (e.g., LEO, GEO, MEO);
- Mobility in Wireless Communications (e.g., Mobile IPv4/IPv6, Hierarchical Mobile IPv6, Mobile DCCP, Mobile SIP, etc.);
- TCP in Wireless Communications (e.g., Indirect TCP, Snooping TCP, Mobile TCP, Selective retransmission, Transaction oriented TCP).

Module-Specific Employability Skills

- Creative thinking skills
- Analysing facts and figures
- Creating and implementing solutions
- Research & Analysis
- Problem solving
- Team working skills
- System analysts

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	None
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	None
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Application
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	Knowledge
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	None
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	Analysis
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	Professional Practice
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	75	3,4,6 & 8	Compulsory

PP	Presentation (team work)	25	6	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
PP	Presentation of work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	6
Lecture	20
Practical classes and workshops	10
Seminar	10
Tutorial	10
Guided independent study	144

Indicative list of resources

Core Texts

- W. Stallings, 'Wireless Communications & Networks: Pearson New International Edition, 2/E', Pearson, 2014, ISBN-10: 129202738X, ISBN-13: 9781292027388.

Additional Texts

- B. A. Black, P. S. DiPiazza, B. A. Ferguson, D. R. Voltmer, F.C. Berry, 'Introduction to Wireless Systems', Prentice Hall, 2008, ISBN-10: 0132782243, ISBN-13: 9780132782241.

- J. H. Schiller, Mobile communications. London; Boston: Addison-Wesley, 2003, ISBN-10: 0321123816 ISBN-13: 9780321123817

- R. Trestian and G.-M. Muntean, "Paving the Way for 5G Through the Convergence of Wireless Systems", IGI Global, 2019, ISBN13: 9781522575702.

- - I.-S. Comşa and R. Trestian, "Next-Generation Wireless Networks Meet Advanced Machine Learning Applications", IGI Global, 2019, ISBN13: 9781522574583

- Michael Duck and Richard Read, Data Communications and Computer Networks, 2nd Edn, Pearson, ISBN 0-130-93047-4

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Cloud Computing
Module Code	COMP 570
Credit Value	20
Level and Study block	Level 5, Study Block 2
Pre-requisites	
Named Module Leader	K. Ali

Module Aim

The module introduces the concepts of distributed computing systems, scalable infrastructures and development and configuration of complex large-scale systems. Students learn how to develop and deploy modern applications on cloud platforms. Cloud computing describes a new supplement, consumption, and delivery model for IT services based on the Internet, and it typically involves over-the-Internet provision of dynamically scalable and often virtualized resources. The need for computational power and data storage continues to drive demand for more highly capable systems. Highly data-intensive applications demand fast access to terabytes, petabytes, even exabytes of storage, processor intensive applications demand access to various types of processors in various configurations. Such applications are increasingly being developed in both scientific and industrial contexts and need to be variously scalable and supportable for large numbers of geographically distributed users. This module will provide insights into how Cloud Computing attempts to meet the varying needs of such applications.

On successful completion of this unit, students will understand the concept, architecture, and services of Cloud Computing and will gain hands-on experience of configuring a cloud service from major providers such as ECM, Google, Amazon, Microsoft, IBM etc., and implementing a simple cloud platform using open source software with an appropriate networking platform. As a result, students will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation, which are crucial for gaining employment and developing academic competence.

Summary Module Description

- Networking Concept:
  Peer-to-peer Computing, Client-Server Computing, Distributed Computing, Cluster Computing, Parallel Computing, Grid Computing.

- Cloud Computing:
  High Performance Computing (HPC) & High Throughput Computing (HTC).
  Cloud structure: SaaS, PaaS and IaaS, types, deployment methods, characteristics, technological trends .

- Virtualisation:

Why and how is virtualisation used to implement cloud platforms?
Virtualisation techniques
System Models for Distributed and Cloud Computing – Cluster Architecture
What are Internet Clouds?

- Data Centres
  Virtual Machines and Virtualisation of Clusters and Data Centres
  Different types of Hardware Virtualisation Techniques

- Effectively use quantitative and qualitative techniques to professionally design and implement scalable applications and services that execute in a distrusted computing environment.

Module-Specific Employability Skills

- Data Analyst
- Systems Analyst
- Cloud engineer
- IT Project Manager
- Infrastructure Network engineer

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	Knowledge
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	Analysis
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	None
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	None
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	None
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	Evaluation
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None

8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	None
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	Professional Practice

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework & Lab work	60	1, 2, 6 & 9	Compulsory
PP	Presentation	25	9	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	2
Lecture	20
Practical classes and workshops	15
Seminar	15
Tutorial	10
Guided independent study	138

Indicative list of resources

Das, Prashanta Kumar, Deka, Ganesh Chandra, *Design and Use of Virtualization Technology in Cloud Computing*, 2018, published by Hershey: IGI Global. ISBN: 9781522527862: (ebk: Dawson). Dawsonera ebook.

Jamsa, Kris A, *Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security, and More*, 2013. ISBN: 979-1-4496-4739-1. Burlington, Mass: Jones & Bartlett Learning.

Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, *Distributed and Cloud Computing: From Parallel Computing to the Internet of Things*, 2012, published by Morgan Kaufmann. ISBN : 9780123858801

Venkata Josyula, Malcolm Orr, Greg Page, *Cloud Computing: Automating the Virtualised Data Center*, 3rd Ed., 2012, ISBN: 13:978-1-58720-434-0, CISCO systems, Inc.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Test Driven Development
Module Code	COMP 580
Credit Value	20
Level and Study block	Level 5, Study Block 2
Pre-requisites	Object oriented analysis design and implementation
Named Module Leader	Y Meressi

Module Aim

To enable learners to gain the knowledge and the skills required to build complex real-world applications with less bugs, higher quality software using Test-Driven-Development.

Summary Module Description

Traditional software development process leaves testing to last, i.e. the application code is written before it is tested. Test-Driven Development (TDD) aims to invert this practice where developers write tests for the application code they have not yet written. In this test first approach, the tests are a description of the intended behaviour of the application being implemented and will fail until the code that satisfies the behaviour described is written. This practice helps the developer to write as little code as possible in order to satisfy the requirements. In addition, having automated testing for the code gives the developer the confidence to refactor freely without changing the intended behaviour of the code or introducing errors.

Through the medium of lectures and seminars you will learn the objectives of TDD and unit testing and write unit tests in a test first development approach through the use of some of the popular unit testing frameworks (e.g. MSTest, xUnit, NUnit),

TDD requires a complete change of developer's mindset. In order to address this challenge, the lab sessions and workshops will provide hands-on practical guidance on implementing unit testing in a TDD approach. Students will solve real-world business problems by applying the techniques learned from the lectures and seminars. In the workshops, students will have the opportunity to collaborate as well as work independently while developing non−trivial business applications. Tutorials will provide learners with opportunities to review what they have learned and discuss the material through group tasks and exercises.

By completion of this module, students will learn the core concepts of TDD and gain the practical skills required to write unit tests and testable code. Your development practice will shift from a conventional approach to a modern and efficient software development and testing approach.

Module-Specific Employability Skills

- Logical thinking
- Problem-solving

- Collaborative working
- Research and Analysis
- Communication
- Self-management
- Project management

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	Process
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	Knowledge
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	None
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	None
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	Research
6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	Application
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	None
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	1, 5	Compulsory
CT	Class Test(s)	20	2	Compulsory
OT	Demonstration of work	20	1, 7	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
OT	Other type of Assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	2
Lecture	15
Practical classes and workshops	32
Seminar	20
Tutorial	10
Guided independent study	121

Indicative list of resources

Key Text:

ADEWOLE, Ayobami, 2020. C# and .NET Core Test-Driven Development: Dive into TDD to create flexible, maintainable, and production-ready .NET Core applications.

BECK, Kent, 2002.Test Driven Development: By Example (The Addison-Wesley Signature Series)

FARCIC, Viktor 2015 Test-Driven Java Development.

ALLS, Jason, 2020. Clean Code in C#: Refactor your legacy C# code base and improve application performance by applying best practices.

ALEXEI, Vorontsov and JAMES W, Newkirk, 2004. Test-Driven Development in Microsoft .NET.

SMART, John Ferguson 2014. BDD in Action: Behavior-driven development for the whole software lifecycle.

J.W PERCIVAL, Harry, 2017. Test-Driven Development with Python 2e.

Websites:

http://www.testdriven.com/

https://www.pluralsight.com/guides/introduction-to-test-driven-development-in-javascript

https://docs.microsoft.com/en-us/archive/msdn-magazine/2008/launch/unit-testing-apply-test-driven-development-to-your-database-projects

https://docs.microsoft.com/en-us/visualstudio/test/quick-start-test-driven-development-with-test-explorer?view=vs-2019

https://www.tutorialspoint.com/software_testing_dictionary/test_driven_development.htm

https://www.guru99.com/test-driven-development.html

http://www.infoq.com/tdd

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Data Science Principles & Statistics
Module Code	COMP 590
Credit Value	20
Level and Study Block	Level 5, Study Block 2
Pre-requisites	Programming skills in Python or R, Knowledge in Statistics
Names Module Leader	Sanjib Raj Pandey

Module Aim

To educate learners in statistics, data analysis and computer science to solve real-word problems by extracting knowledge from complex large mixed data sets. This will enable them to build predictive model, discover new knowledge, discover patterns and create data visualization tools which will also support for data-driven decision making.

Summary Module Description

This subject is a multidisciplinary domain that requires skills in statistics, data analysis, and computer science to solve real-world industry problems. This subject will teach you to apply machine learning algorithms including deep learning to develop predictive models and predictive analysis to solve a wide variety of problems, enable you to create data visualization tools that will also support for data-driven decision making. Learners will also be able to communicate and give critical arguments on the result.

Learners will have the opportunity to understand a wide variety of real-world applications such as customer analytics, credit scoring, business forecasting; Health and social care eg automatic diagnosis, prediction, genetic data mining, bioinformatics and unstructured data analysis, extraction information from semi-structure data, etc.

Topics included in this subject are: data analytic terminologies, types of data analytics, data exploration and visualisation, understanding data with descriptive, predictive and prescriptive analytics; machine learning algorithms including deep learning, various problems such as classification, linear and non-linear regression and clustering.

On successful completion of the subject the learner will be competent of the collection, analysis, interpretation, presentation and organization of mixed data. And learners will understand the theoretical underpinnings of Statistics and Probability, Statistical Modelling and Inferences, Multivariable Calculus, Linear Algebra, Optimization Methods, Data Analytics Methods and Techniques. Likewise, they will gain experience of investigating the ranges of predictive analytic techniques, models and algorithms and deploy appropriate models for analysis and prediction.

They will have experience in experimenting and evaluating the performance and accuracy of predictive models. In addition, they will also have the opportunity to implementing the visualization of data in various ways such as graphs, charts, dashboard and more. Eventually, learners will understand and recognise the importance of safety and security plus privacy and ethical issues in any applications or models, for example medical & healthcare data science etc.

As a result, learners will develop skills such as communication literacy, critical thinking, analysis, reasoning and interpretation which are crucial for gaining employment and developing academic competence. This subject will support learners to become a dynamic problem solver.

The subject will use a mixture of lecturers, tutorials, laboratorial works, learners require to reading related journal, conference papers, to participate on associated seminars, and workshops.

Module-Specific Employability Skills

- Critical Thinking

- Reasoning and Interpretation

- Problem-Solving

- Research & Analysis

- Team Working

- Decision Making

- Data Visualisation

- Communication

- Programming

- Ability to prioritise tasks and time management

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Implement working and maintainable software components.	Process
2	Architect	Integrate appropriate data structures and interoperating components into software, with reference to their merits and flaws.	Analysis
3	Solve	Apply knowledge of algorithms, data structures, and mathematics to solve well-defined problems.	Knowledge
4	Advocate	Analyse the legal, social, ethical, and professional issues that affect creative projects, with a focus on the role of professional bodies.	None
5	Research	Develop an argument on a topic using appropriate research methods, primary and secondary sources, and academic conventions.	Research

6	Reflect	Analyse your strengths and weaknesses in relation to knowledge, skills, experience, and outcomes associated with your professional attributes.	None
7	Collaborate	Use appropriate development practices, project tracking approaches, and tools to support development pipelines in a multidisciplinary team.	None
8	Application	Analyse existing artefacts to identify opportunities, highlight unique features that would fill a gap, and define routes to audiences.	None
9	Deliver	Apply divergent thinking and creativity to prototyping in order to deliver an engaging experience.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcome Assessed	Compulsory or Compensable
CA	Coursework	60	1, 2, 3	Compulsory
CT	Class Test(s)	20	3	Compulsory
OT	Demonstration of work	20	5	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
OT	Demonstration of work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Lectures	30
Supervised tutorials	16
Supervised laboratory work	20
Workshop and seminar	10
Independent Learning Hours : 124	

Indicative list of resources

Key-text

KRZANOWSKI W.J. 1998. *An Introduction to Statistical Modelling* Arnold, 000-0-340-69185-9.

DRAPER N.R. & SMITH H. 1998. *Applied Regression Analysis* 3rd edition John Wiley & Sons 9780471170822.

JAMES, G., WITTEN, D., HASTIE, T., & TIBSHIRANI, R. 2013. *An Introduction to Statistical Learning* (Vol. 112). New York: Springer.

FRIEDMAN Jerome, HASTIE Trevor, and TIBSHIRANI, Robert. 2001. *The Elements of Statistical Learning.* Springer.

FLACH, P. 2012. *Machine Learning: The Art and Science of Algorithms that Make Sense of Data.* 1st Ed. Cambridge: Cambridge University Press.

RUNKLER, T. 2016. *Data Analytics: Models and Algorithms for Intelligent Data Analysis.* 2nd Ed. Vieweg +Teubner Verlag.

CRAN.R-PROJECT.ORG : The R Project for Statistical Computing "R Archive Network" (Development Tool).

GOODFELLOW et al. 2017. "Deep learning". MIT Press.
LAROSE, D. T., & LAROSE, C. D. 2015. Data Mining and Predictive Analysis. (Second, Ed.) New Jersey: Wiley.

SMITH, J. Q. 2010. *Bayesian Decision Analysis: Principles and Practice.* Cambridge University Press.

Websites (Online Resources)

www.thearling.com : Kurt Thearling "Information about analytics and data science" (General Reference).

https://matplotlib.org/ : Visualization with Python.

https://www.microsoft.com/en-us/microsoft-365/excel : MS Excel.

https://www.knime.com/ : KNIME.

https://www.tableau.com/ : Tableau.

https://www.datacamp.com/onboarding : Learn Data Science DataCamp.

https://julialang.org/ : Programming Language (Development Tool).

https://powerbi.microsoft.com/en-us/ : Microsoft Power BI "Power BI Desktop" (Development Tool).

https://spark.apache.org/ : Apache Spark.

https://rapidminer.com/ : Rapid Miner.

https://www.tensorflow.org/ : End to end open source ML platform.

https://www.scipy.org/ : Python-based ecosystem of open-source software.

https://github.com/accord-net/framework/

https://scikit-learn.org/stable/ : Scikit-Learn.

https://keras.io/ : the Python deep learning API.

www.fujitsu.com : Fujitsu "The White Book of Big Data" (E-Book).

Python Dash with Ploty.

W3School for Python & Data Science

https://www.w3schools.in/category/python-data-science/
https://www.w3schools.in/

Tutorial Point – Data Science with Python
https://www.tutorialspoint.com/python_data_science/index.htm

Academic Journals

International Journal of Data Science and Analytics, Springer.

Computational Statistics and Data Analysis, ISSN:0167-9473, Elsevier.

Statistics and Computing, ISSN:0960-3174, Springer.

Machine Learning, ISSN:0885-6125, Springer.

Journal of Statistical Software, ISBN: 1548-7660; CODEN JSSOBK.

IEEE Transactions on Pattern Analysis and Machine Intelligence, ISSN:0162-8828, IEEE Computer Society.

Statistics and its Interface, ISSN Print 1938-7989 ISSN Online 1938-7997.

Data Mining and Knowledge Discover, ISSN:1384-5810, Springer.

Intelligent Data Analysis, ISSN: 1088467X, 15714128, IOS Press.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Computing Project
Module Code	COMP 610
Credit Value	40
Level and Study Block	Level 6, Study Block 1 & 2
Pre-requisites	
Names Module Leader	Y Meressi

Module Aim

To produce a market-viable IT solution/IT product individually.

Summary Module Description

This module is the culmination of the theoretical knowledge, research and practical skills gained throughout the undergraduate study. It encourages independent and self-directed learning where the student is required to identify, evaluate, synthesise and apply effectively the knowledge and skills gained from the other modules into creating IT products and solutions.

Under a supervision of experts, students will work on a major computing project focussing on delivering a realistic product or a technical solution with appropriate delivery milestones and by following relevant development methodologies. The project topic areas will vary but at the heart of this module is academic creativity and an opportunity to specialise in a topic area or technology though the exploration of individual intellectual interests. Through this experience, the student will emerge with expert knowledge of the subject areas and technologies engaged.

By the end of this module, the project deliverable should be a market-viable and complete solution that demonstrates creativity, individual contribution and academic professionalism.

Module-Specific Employability Skills

- Innovation
- Creativity
- Research and analysis
- Project management
- Logical thinking
- Critical thinking
- Problem-solving

- Communication
- Self-management
- Evaluation and reflection

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable software systems, with appropriately verified functional coherence.	Process
2	Architect	Refactor software systems in correspondence with relevant theories, practice, and discourse in the computing sector.	None
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	Analysis
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	Professional Practice
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	Research
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	None
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	None
8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	Evaluate
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.	Industry

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
TH	Dissertation	70	1, 3, 5, 8 & 9	Compulsory
PP	Presentation of work	30	1, 3, 4	Compulsory

The following codes for assessment methods apply	
TH	Thesis & Dissertation
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 400	
Activity	Hours
Lecture	2
Project supervision	10
Practical classes and workshops	20
Tutorial	8
Supervised time in workshop	80
Guided independent study	280

Indicative list of resources

Key Text:

Tahir Ahmed, Julian Cox, Lynda Girvan, Alan Paul, Debra Paul, Peter Thompson, James Cadle, 2014. *Developing Information Systems: Practical Guidance for IT Professionals.*

Steve Skidmore, Malcom Eva, 2003. *Introducing Systems Development.*

Jeremy Savell, 2019. *Agile Project Management: A Beginner's Guide to Agile Implementation and Leadership.*

Joshua Boyde, 2014. *A Down-To-Earth Guide To SDLC Project Management: Getting your system /software development life cycle project successfully across the line using PMBOK adaptively.*

Costley, C., Elliot, G. and Gibbs, P. 2010. *Doing Work Based Research: Approaches to Enquiry for Insider-researchers. London:* SAGE Publications Ltd.

Gray, D. 2009. *Doing Research in the Real World. 2nd Ed. London:* SAGE Publications Ltd.

Dawson, C. 2016. *Projects in Computing and Information Systems: A Student's Guide. 2nd ed. London:* Pearson Education.

Dow, C., 2018. *Internet of Things Programming Projects: Build Modern IoT Solutions with the Raspberry Pi 3 and Python,* Birmingham: Packt Publishing.

Shovic, J. C., 2016. *Raspberry Pi IoT Projects: Prototyping Experiments for Makers,* Washington: Liberty Lake.

Kurniawan, A., 2019. *Internet of Things Projects with ESP32.* Birmingham: Packt Publishing.

Websites:

https://www.scrum.org/resources/what-is-scrum
https://www.projectsmart.co.uk/9-steps-to-a-hassle-free-and-effective-software-development-project.php
https://plan.io/blog/software-development-process/
https://relevant.software/blog/7-steps-for-effective-software-product-development-2018/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Network Infrastructure and Design
Module Code	COMP 620
Credit Value	20
Level and Study block	6, Study Block 1
Pre-requisites	
Named Module Leader	M. J. Hasan

Module Aim

This module introduces students to enterprise network modelling and design principles. Students will analyse business and technical requirements and evaluate alternative network design methods and techniques in order to plan, design and test a local or wide area network. The students are expected to apply network design principles in the design and implementation of redundant networks. The students are also expected to evaluate Wide Area Network (WAN) technologies and make choices based on specific enterprise requirements. In addition, they will also solve network-related issues using network monitoring and troubleshooting methods and techniques.

Summary Module Description

- Introduction to the network design, network design module, IP addressing, three-layer design model, enterprise architecture design model, features of hierarchical networks (redundancy, hierarchy, scalability, availability, reliability), analyse and evaluate business technical requirements, the importance of Wireless Network.
- Network features: bandwidth, delay, load balancing, redundancy, spanning tree concepts, Spanning Tree Protocols, link aggregation concepts and operations, bandwidth aggregation.
- Network Technology: Selecting network devices, modularity, multi-layer switching and router, IP telephony, IPTV, Internet of Thing (IoT), network simulation, Wireless devices. VLAN.
- Network Protocol and configuration: Allocation of IP addresses subnetting, DHCP, NAT/PAT, IPv4/IPv6., and protocol suited to enhance the performance and scalability of network, VTP, ieee802,1q etc.
- Site Networks: Network Planning: Peer to peer, client-server, intranets, extranets; Network resilience
- Network device selection: NICs, switches, routers, firewalls. Selecting network devices, use of modularity, stackability, port density.
- Network implementation and configuration: configuring VLAN, device configuration. Layer 2 LAN redundancy: Configuration of different Spanning Tree Protocols, First Hop Redundancy Protocols (FHRP), Hot Standby Routing Protocol (HSRP), EtherChannel technology.

- WAN technologies including PPP, ATM, Frame-Relay, VPN, configuring WAN network based on specific enterprise requirements. Analyse and evaluate suitability of use based on given enterprise requirements different WAN technologies
- Network troubleshooting: Network baselines, troubleshooting methods, information gathering, network support and documentation.

Module-Specific Employability Skills

- Creative thinking skills
- Analysing facts and figures
- Assessing processes
- Creating and implementing solutions
- Research & Analysis
- Problem solving
- Advanced Engineering
- Applying appropriate tools in preparing technical documents

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable Software systems, with appropriately verified functional coherence.	Knowledge
2	Architect	Refactor software systems in correspondence with relevant theories, practice, and discourse in the computing sector.	None
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	Application
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	None
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	Evaluate
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	Industry
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	None
8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	None
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.	Professional Practice

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	80	1,3,5, 6 & 9	Compulsory
OT	Demonstration of work	20	9	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
OT	Other type of assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	2
Lecture	20
Practical classes and workshops	18
Seminar	10
Tutorial	10
Guided independent study	140

Indicative list of resources

Meyers, M. (2015) *CompTIA Network+ Guide to Managing and Troubleshooting Networks*, Fourth Edition. London: McGraw Hill Professional.

Subramanian, M. (2012) *Network Management: Principles and Practices.* A: Prentice Hall.

Thomatis, M. (2015) *Network Design Cookbook: Architecting Cisco Networks*. UA: Lulu Press, Inc.

White, R. and Donohue, D. (2014). *The Art of Network Architecture: Business-Driven Design*. UA: Cisco Press.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Network Security
Module Code	COMP 630
Credit Value	20
Level and Study block	Level 6 , Study Block 1
Pre-requisites	
Named Module Leader	M. J. Hasan

Module Aim

Network security is maintained by the ability to secure the confidentiality, integrity and availability of network infrastructure. This module introduces students to enterprise network security modelling and design principles. Students will be expected to build on experience in configuring routers, switches, and firewalls including network monitoring devices and the ability to evaluate alternative network security design methods and techniques in order to plan, design and test a local or wide area network.

Summary Module Description

- Introductory Network Concepts, Introductory Network Security Concepts, principles of network security.
- Network security threats, operations, physical and environmental security, network infrastructure and devices, threats and type of threats, identify risks, threats, vulnerabilities and countermeasures, differentiate between security policies, standards and guidelines.
- Network Security considerations: Network Security issues, their impacts and solutions, physical security, servers and servers placements, hardware, environmental electrical and maintenance threats, issues with different unsecured protocol, DHCP, SMTP.
- Physical security and devices related: Biometric Technologies, CCTV, IoT. Sensors etc..
- Network security devices and protocols: Secure Protocols and VPNs: IPSec, Firewalls : Packet Filters (ACLs), Stateful, Stateless, Bastion Host, Application Gateway, DMZ, Host-Based Firewall, Network Address Translation (NAT). Routers, Switches, Port security, security policy. Designing Demilitarised Zone (DMZ)
- Security and hardening devices: configuration of secure router, the importance of AAA, standard and extended ACLs, functions and operations of IDS and IPS systems
- Confidentiality: Cryptography encryption algorithms, DES, 3DES, AES, PKI standards
- Network security implementation and configuration: configuring VLAN, device configuration. Layer 2 LAN redundancy: Configuration of different Spanning Tree Protocols, First Hop Redundancy Protocols (FHRP), Hot Standby Routing Protocol (HSRP), EtherChannel technology. Demilitarised zone

- Managing and monitoring secured network: The use of System Development Life Cycle (SDLC), Intrusion Detection Systems, Internet of things as a helper.
- Network troubleshooting: Network baselines, troubleshooting methods, information gathering, network support and documentation, network traffic filtering and monitoring.

Module-Specific Employability Skills

- Creative thinking skills
- Analysing facts and figures
- Assessing processes
- Creating and implementing solutions
- Research & Analysis
- Problem solving
- Advanced Engineering
- Critical thinking

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable Software systems, with appropriately verified functional coherence.	None
2	Architect	Refactor software systems in correspondence with relevant theories, practice, and discourse in the computing sector.	None
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	Application
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	None
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	Evaluate
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	Industry
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	None
8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	Analysis
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying	Professional Practice

		how and why it could engage, immerse an audience, and/or lead to innovation.	

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	80	3,5,6,8 & 9	Compulsory
OT	Demonstration of work	20	8	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
OT	Other type of assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	2
Lecture	30
Practical classes and workshops	24
Seminar	10
Tutorial	10
Guided independent study	124

Indicative list of resources

Bhaiji Y. (2008). *Network Security Technologies and Solutions: CCIE Professional Development*. UA: Cisco Press

Clem A., (2006). *Network Management Fundamentals*. Cisco Press

Meyers, M. (2015). *CompTIA Network+ Guide to Managing and Troubleshooting Networks*, Fourth Edition. London: McGraw Hill Professional.

Stallings W. (2008). *Network Security Essentials: Applications and Standards*. Pearson

Subramanian, M. (2012). *Network Management: Principles and Practices*. UA: Prentice Hall.

Thomatis, M. (2015). *Network Design Cookbook: Architecting Cisco Networks.* UA: Lulu Press, Inc.

White G et al (2009) *CompTIA Security+ All-in-One Exam Guide*, Second Edition. McGraw Hill

White, R. and Donohue, D. (2014). *The Art of Network Architecture: Business-Driven Design*. UA: Cisco Press.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Big Data Analytics
Module Code	COMP 640
Credit Value	20
Level and Study Block	Level 6, Study Block 1
Pre-requisites	Microsoft Excel and Programming
Named Module Leader	Ifeoluwa Agboola

Module Aim

The aim of the module is to demonstrate an extensive, detailed knowledge and understanding of big data management principles and technological practices. This is to enable students understand how to create, extend models and trends to support decision making with a view to explaining, interpreting and synthesising knowledge from big data.

Summary Module Description

This module is designed for students to learn how to analyse large data sets and identify patterns that will improve any company's and organization's decision-making process. Students will learn the use data analytical programming language, common algorithms, data mining frameworks and software to make sense of large amounts of data, which are applicable to most business and management problems will be focused on.

The module offers extensive training in big data technology and methods, providing extensive insights in areas such as Data Mining, NoSQL Databases, Text Analytics techniques and leveraging Cloud Computing platforms for Big Data Analytics through the medium of lectures and seminars. The key concepts and technologies are introduced and illustrated.

Real-world business data sets are analysed in the seminar sessions by applying the techniques learned from the lectures. In the workshops, students will have the opportunity to collaborate as well as work independently analysing big data sets. Tutorials will provide students with opportunities to review what they have learned and discuss the material through group tasks and exercises.

The possible career progression roles on completion of this module include Data Analyst, Business Analyst. Students will have a broad knowledge and practical skills on big data, big data technologies, platforms and tools to visualize and interpret complex data sets.

Module-Specific Employability Skills

- Analytical and Logical thinking
- Team working
- Problem solving
- Project management
- Written and verbal communication
- Data visualization

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable software/hardware systems, with appropriately verified functional coherence.	None
2	Architect	Refactor software/hardware systems in correspondence with relevant theories, practice, and discourse in the computing sector.	None
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	Knowledge
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	Industry
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	Research
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	None
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	None
8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	Analysis
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	3, 5	Compulsory
CT	Class Test(s)	20	8	Compulsory
PP	Presentation of work	20	4	Compulsory

The following codes for assessment methods apply	
CA	Coursework Assessment
CT	Class Test
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Lecture	30
Practical classes and workshops	18
Seminar	12
Tutorial	10
Independent Learning Hours:	130

Indicative list of resources

Key Texts:

ANAND Rajaraman and JEFFREY D. Ullman 2011. *Mining of Massive Datasets*. 12th Edition. Cambridge University Press. ISBN: 1107015359 (ISBN13: 9781107015357)

ALEXANDER Loth. 2019. *Visual Analytics with Tableau*. John Wiley & Sons. ISBN-10: 1119560209

DONALD Miner and ADAM Shook 2012. *MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems*. 4th Edition. ISBN:1449327176 (ISBN13: 9781449327170)

HOLDEN Karau, ANDY Konwinski, WENDELL Patrick and ZAHARIA Matei 2015. *Learning Spark: Lightning-Fast Big Data Analysis*. 10th Edition. ISBN: 1449359051.

JOSHUA N. Milligan. 2016. *Learning Tableau 10: Business Intelligence and data visualization that brings your business into focus*, 2nd Edition. Packt Publishing. ISBN-13: 978-1786466358.

KONNOR Cluster 2019. *Machine Learning for Beginners: A Math Free Introduction for Business and Individuals to Machine Learning, Big Data, Data Science, and Neural Networks*. ISBN: 978-1691462902

PRABHU C.S.R., ANEESH Sreevallabh Chivukula, ADITYA Mogadala, ROHIT Ghosh 2019.

Big Data Analytics. Systems, Algorithms, Applications.

TABLEAU 2019: *Tools for Business Intelligence*, Packt Publishing. ISBN-10: 1788839528.

LIAM Damien 2019. Data Analytics. *A Comprehensive Beginner's Guide to Learn the Realms of Data Analytics.*

NATHAN Marz and JAMES Warren. 2015. *Big data: principles and best practices of scalable real-time data systems* ISBN-10: 1292097612

PETER Ghavami 2019. *Big Data Analytics Methods. Analytics Techniques in Data Mining, Deep Learning and Natural Language Processing.*

RYAN Sleeper. 2018. *Practical Tableau*. 1st Edition. O'Reilly. ISBN-10: 1491977310

THOMAS H. Davenport 2014. *Big Data at Work: Dispelling the Myths, Uncovering the Opportunities*. Harvard Business Review Press.

VIGNESH Prajapati. 2013. *Big Data Analytics with R and Hadoop*. ISBN-10: 1292025824 • ISBN-13: 9781292025827

Journals

- Communications of the ACM
- Decision Sciences
- Information Systems Research
- Decision Support Systems
- ACM Trans. on Database Systems
- Computing

Databases

- Business Source Premier
- Science Direct
- Wiley

Indicative Web Sites:

Lynda

https://www.lynda.com/Hadoop-tutorials/Big-Data-Analytics-Hadoop-Apache-Spark/2813260-2.html

https://www.lynda.com/Data-Science-tutorials/Data-Visualization-Storytelling-Information-Design/664825-2.html

https://www.lynda.com/course-tutorials/Data-Visualization-Data-Analysis-Analytics/2825746-2.html

Tutorials Point

https://www.tutorialspoint.com/big_data_analytics/introduction_to_sql.htm

https://www.tutorialspoint.com/hadoop/hadoop_big_data_overview.htm

https://www.tutorialspoint.com/big_data_analytics/big_data_analytics_pdf_version.htm

https://www.tutorialspoint.com/big_data_analytics/index.htm

W3Schools

https://w3points.com/what-is-big-data/

https://www.w3schools.in/hadoop-tutorial/what-is-big-data/

https://www.w3schools.in/category/hadoop-tutorial/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Mobile Application Development
Module Code	COMP 650
Credit Value	20
Level and Study block	Level 6, Study Block 1
Pre-requisites	Object oriented analysis, design and implementation.
Named Module Leader	Y Meressi

Module Aim

To enable learners to gain the knowledge and the skills required to design, implement, test and deploy cross-platform mobile applications.

Summary Module Description

This module enables students to understand, learn and gain the skills required to develop cross-platform mobile applications utilising modern development tools and technologies. Students will learn and apply appropriate design patters (e.g. MVVM) for developing native and web-based mobile applications while considering the user experience and device capabilities.

The module will address the current trends in mobile application development: native, web-based and the hybrid approaches. This will equip students with the skills and understanding required to make informed decisions on mobile development techniques, tools and technologies in order to meet specific business requirements.

Through lectures and seminars, key concepts and technologies are introduced and illustrated. In lab sessions and workshops, students will work across all the stages of the software development lifecycle to solve real-world business problems by applying the techniques learned from the lectures and seminars. In the workshops, the students will have the opportunity to collaborate as well as work independently while developing non−trivial mobile applications. Tutorials will provide students with opportunities to review what they have learned and discuss the material through group tasks and exercises.

Upon completion of this module, students will gain the knowledge and the practical skills required to develop cross-platform mobile applications. Students will have a broad understanding of mobile application development, its terminology, the tools and technologies required to design, implement, test and deploy mobile applications.

Module-Specific Employability Skills

- Logical thinking
- Problem-solving
- Collaborative working
- Research and Analysis

- Communication
- Self-management
- Project management

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable software systems, with appropriately verified functional coherence.	Process
2	Architect	Refactor software systems in correspondence with relevant theories, practice, and discourse in the computing sector.	Analysis
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	Knowledge
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	None
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	None
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	None
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	Application
8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	None
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.	None

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	1, 2	Compulsory
CT	Class Test(s)	20	3	Compulsory
OT	Demonstration of work	20	1, 7	Compulsory

The following codes for assessment methods apply	
CA	Individual Report
CT	Computer Based
OR	Other type of assessment

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Demonstration	2
Lecture	20
Practical classes and workshops	30
Seminar	15
Tutorial	8
Guided independent study	125

Indicative list of resources

Key Text:

Burton, Michael, 2015. Android App Development FD 3e (For Dummies).

FEILER, Jesse, 2014. iOS App Development For Dummies Paperback.

HORTON, John, 2018. Android Programming for Beginners: Build in-depth, full-featured Android 9 Pie apps starting from zero programming experience, 2nd Edition.

HORTON, John, 2019. Android Programming with Kotlin for Beginners: Build Android apps starting from zero programming experience with the new Kotlin programming language.

SNIDER, Ed, 2019. Mastering Xamarin.Forms: App architecture techniques for building multi-platform, native mobile apps with Xamarin.Forms 4, 3rd Edition Paperback.

KARLSSON, Johan, HINDRIKES, Daniel, 2018. Xamarin.Forms Projects: Build seven real-world cross-platform mobile apps with C# and Xamarin.Forms.

BIESSEK, Alessandro, 2019. Flutter for Beginners: An introductory guide to building cross-platform mobile applications with Flutter and Dart 2.

Websites:

https://kotlinlang.org/docs/reference/

https://dotnet.microsoft.com/apps/xamarin

https://phonegap.com/

https://cordova.apache.org/

https://flutter.dev/

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory

General Module Information

Status	Draft
Module Name	Internet of Things
Module Code	COMP 660
Credit Value	20
Level and Study Block	Level 6, Study Block 2
Pre-requisites	Engineering and Hardware Basics
Named Module Leader	Ifeoluwa Agboola

Module Aim

The aim of the module is to enhance students' understanding of the design and development of the Internet of Things (IoT) systems, including its architecture, applications, technologies on each layer, and IoT-specific data processing and analytics frameworks including cloud technologies.

The module teaches the students the ability to engineer interconnected, range of physical devices or things and the ability to communicate with each other, embedding these things into larger diverse systems and architectures and intelligently analyse the data generated through the use of the IoT applications for enhanced business decision making.

Summary Module Description

The module provides an insight into technological advances involving embedding uniquely identifiable computing devices within an existing internet structure focussing on key technologies to develop an IoT system.

The module also empowers students to implement and develop embedding of smart objects (generally involving microcontrollers, other transmitting sensors) into smart applications devices manually as well as the use of the simulation software and cloud technology platforms.

The IoT module will cover ranges of topics including IoT components and architecture; Sensors and Sensing technology; Data transmission and connectivity; IoT cloud platforms; IoT specific data processing and analytics; Data models and semantics; Applications of IoT including smart cities, Smart homes; Ongoing and future IoT challenges.

The module will be taught through lectures, problem-solving coursework and practical sessions. Lectures are used to introduce principles and methods and also to illustrate how they can be applied in practice. Practical sessions and lab sessions will provide students with guidance and

help while developing real case scenario IoT applications allowing students to convert what have been learnt in the lecture and seminar sessions into hands-on-practical.

By completion of this module, students will be able to gain skills in problem solving and to gain practical experience needed for career enhancement to become an IoT Engineer, Product Designer, Industrial Engineer, IoT Product Manager and Developer.

Module-Specific Employability Skills

- Problem solving
- Research
- Analytical
- Advanced Engineering
- Project management
- Time Management
- Critical thinking
- Programming
- Creativity
- Teamworking skills.

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable software/hardware systems, with appropriately verified functional coherence.	Application
2	Architect	Refactor software/hardware systems in correspondence with relevant theories, practice, and discourse in the computing sector.	Knowledge
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	None
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	None
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	None
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	None
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	Industry

8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	None
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.	Professional Practice

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcomes Assessed	Compulsory or Compensable
CA	Coursework	60	1, 2	Compulsory
CT	Class Test(s)	20	2	Compulsory
PP	Presentation	20	7, 9	Compulsory

The following codes for assessment methods apply	
RE	Coursework Assessment
CB	Class Test
PP	Presentation of Work

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Lecture	30
Practical classes and workshops	18
Seminar	12
Tutorial	10

Independent Learning Hours: 130

Indicative list of resources

Essential Texts

ARSHDEEP Bahga and VIJAY Madisetti, (2015). *Internet of Everything: A Hands-on Approach*.

ALESSANDRO Bassi, MARTIN Bauer, FIEDLER Martin, THORSTEN Kramp, ROB-VAN Kranenburg, SEBASTIAN Lange, MEISSNER Stefan (2013). *Enabling Things to Talk - Designing IoE solutions with the IoE Architectural Reference Model* (open access springer)

MILENKOVIC Milan 2020. *Internet of Things: Concepts and System Design*. Springer. ISBN 978-3-030-41346-0

NEERAJ Kumar, AAISHA Makkar. 2020. *Machine Learning in Cognitive IoT*. 1st Edition. CRC Press. ISBN 9780367359164.

OVIDIU Vermesan and FRIESS Peter 2013. *Internet of Everything: Converging Technologies for Smart Environments and Integrated Ecosystems* (River Publishers' Series in Information Science and Technology).

POSLAD S. 2009. *Ubiquitous Computing: Smart Devices, Environments and Interactions*. Wiley, ISBN: 978-0-470-03560-3, pp. 26.

RAJKUMAR Buyya, AMIR Vahid Dastjerdi 2016. *Internet of Things*. ISBN 9780128053959

SOUVIK Pal, VICENTE García Díaz and DAC-NHUONG Le. (Eds.) 2020. *IoT Security and Privacy Paradigm*. CRC Press, ISBN 9780367253844

VLASIOS Tsiatsis, STAMATIS Karnouskos, JAN Holler, DAVID Boyle, MULLIGAN Catherine 2018. *Internet of Things: Technologies and Applications for a New Age of Intelligence*. 2nd Edition. Academic Press, ISBN: 9780128144350.

Journals

- Communications of the ACM
- Information Systems Research
- Decision Support Systems
- Computer Engineering
- ACM Trans. on Database Systems
- Computing

Indicative Websites

http://www.buildinginternetofthings.com/

http://postscapes.com/internet-of-things-books

http://www.internet-of-things-book.com/

Named Awards

Course	Compulsory
BSc (Hons) Computing	Compulsory

General Module Information

Status	Draft
Module Name	Machine Learning and Artificial Intelligence
Module Code	COMP 670
Credit Value	20
Level and Study Block	Level 6, Study Block 2
Pre-requisites	Programming skill, knowledge in data structured with related mathematics, intermediate knowledge in Python or R, statistics.
Names Module Leader	Sanjib Raj Pandey

Module Aim

To provide learners with an introduction and basic theoretical understanding of Artificial Intelligence (AI), its applications, techniques, ethics in AI and main areas of Machine Learning (ML) theory and practice, especially in concepts of supervised, unsupervised and reinforcement learning algorithm. To enable learners to identify and implement appropriate ML algorithm to solve complex real-world business problems.

Summary Module Description

The extraordinary successes and development of Artificial Intelligence (AI) tools and methods are proof that AI has the capabilities to understand and build intelligent systems. This subject, AI and ML, will equip learners with both the computing and scientific skills to solve various real-world problems. AI and ML is one of the current most popular topics in Computer Science. It has been used to solve problems for almost every business today. This subject explores the concepts of AI and ML and understands how they are transforming the digital world. This subject provides an overview of AI concepts, workflows, ML algorithms, and performance metrics. It introduces Python or R, supervised, unsupervised and reinforcement learning algorithms, and various business cases and view to learners interested in starting careers and portfolio in AI and ML. Learners will understand how AI and ML are being used in various domains for instances Health and Social Care, Banking & Finance, Marketing, Agriculture, Engineering, Environment, Automobile, Gaming, Space, Academic etc.

In AI learners will familiar with the fundamental background of AI able to distinguish about Weak AI, Strong AI and Supper Intelligences. They will also learn the importance of ethics, and social value; and safety and security issues in AI-based application. Learners will cover AI areas such as robotics, computer vision, ML, NLP, Game, self-driving car, smart home, speech recognition, auto pilot, translate, Q&A / Chatbots etc. Learners will study AI techniques - top-down approach such as fuzzy logic, knowledge-based system, natural language processing etc, bottom-up

approach such as neural networks, evolutionary computing, swarm intelligence etc. Learners will also become familiar with propositional logic, first order predictive logic and descriptive logic. This subject also covers the basic concept of "reasoning with uncertainty" by using probabilistic reasoning (Bayesian networks) and fuzzy logic.

In ML learners will understand the theory and practice of ML algorithms (supervised, unsupervised and reinforcement learning) and practical implementation of some ML algorithms. Learners will learn about elementary classification problem (binary classification, multiclass classification) and regression problems (linear and logistics), training and loss (square loss function, mean square error), reducing loss using iterative approach, gradient decent.

Unsupervised learning: clustering approach such as Hidden Marko Models, K-Means, Fuzzy C-Means algorithm etc.

Supervised learning: (a) regression problems such as linear regression, random forest algorithms etc. (b) classification problems such as logistic regression, support vector machine, decision tree algorithms, Bayes classifier etc.

Reinforcement learning: such as Artificial Neural Network algorithm, Q learning, etc.

Students will also learn the ML model evaluation metrics such as confusion matrix, true positive, false positive, true negative, false negative, accuracy, precision, F1 score, ROC curve, root mean square etc.

On successful completion of this subject, learners will be able to understand the basic concept of machine learning algorithms, obtain hands-on experience in implementing some machine learning algorithms using programming language such as C#, Java, R or Python, machine learning tools such as Scikit-learn, PyTorch, TensorFlow, Numpy, Pandas, Keras, matplotlib, Jypyter Notebook, Azure Machine Learning studio, Google cloud ML engine, Java - Weka, KNIME, Accros.Net for C#.

Learners will also become capable in reasoning under uncertainty using probability theory and the fuzzy logic. As a consequence, learners will have the opportunity to improve their critical thinking; analysis problems and solving skills; reasoning and interpretation and be able to selects appropriate algorithms to solve problems, which are essential for gaining employment and evolving academic competence.

The subject will use a mixture of lecturers, tutorials, laboratorial works. Learners are also required to read related journal and conference papers, to participate in associated seminars, and workshops. In the tutorial and lab sessions learners will practise and research the taught topic and are individually required to complete the laboratorial task and log book.

Module-Specific Employability Skills

- Specialist knowledge and application
- Critical and Logical Thinking
- Complex Problem solving
- Research and Analysis
- Programming and Decision Making
- Independent working
- Communication
- Ability to prioritise tasks and time management

Learning Outcomes

LO #	Learning Outcome Name	Learning Outcome Description	Assessment Criteria Category
1	Code	Construct reusable and deployable Software systems, with appropriately verified functional coherence.	Application
2	Architect	Refactor software systems in correspondence with relevant theories, practice, and discourse in the computing sector.	None
3	Solve	Synthesise knowledge of computing to address complex technical challenges.	Knowledge
4	Advocate	Assess the legal, social, ethical, and professional issues in research and development contexts in correspondence with the relevant law, codes of conduct, and theory.	None
5	Research	Defend an argument that addresses a research question(s), using appropriate primary and secondary sources and academic conventions.	None
6	Reflect	Plan your post-graduation pathway, with reference to how you will overcome obstacles, and how you will build a personal brand that highlights your professional attributes.	Professional Practice
7	Collaborate	Produce work as part of a multidisciplinary team critically appraising practices, approaches, and tools; applying them to enhance development pipelines.	None
8	Application	Evaluate existing artefacts to identify opportunities, emphasise unique features that would fill a gap, and suggest optimal routes to audiences.	None
9	Deliver	Produce prototypes based on your own intellectual property that deliver distinguished experiences, justifying how and why it could engage, immerse an audience, and/or lead to innovation.	Analysis

Assessment Methods

Assessment Method	Description of Assessment Method	%	Learning Outcome Assessed	Compulsory or Compensable
CA	Coursework	60	1, 3	Compulsory
CT	Class Test(s)	20	3	Compulsory
PP	Presentation of work	20	1, 6 & 9	Compulsory

The following codes for assessment methods apply.	
CB	Computer Based
RE	Individual Report
PP	Presentation

Assessment Criteria

Modes of delivery

Module Target Learner Hours: 200	
Activity	Hours
Lecturer	30
Supervised tutorial / practical class	14
Supervised lab based work	20
Seminar or Workshop	10
Project supervision	10
Independent Learning Hours : 126	

Indicative list of resources

Key-Text

SOLOMON, Justin. 2015. *Numerical Algorithms*. AK Peters/CRC Press.

FRANKISH, K. and RAMSEY, W. 2014. *The Cambridge Handbook of Artificial Intelligence*. Cambridge: Cambridge University Press.

ERTEL Wolfgang. Introduction to AI Second Edition, ISSN 1863-7310 ISSN 2197-1781 (electronic), *Undergraduate Topics in Computer Science*, ISBN 978-3-319-58486-7 ISBN 978-3-319-58487-4 (eBook),DOI 10.1007/978-3-319-58487-4.

BELL, J. 2014. *Machine Learning: Hands-On for Developers and Technical Professionals*. 1st Ed. Wiley.

ENGELBRECHT, A. 2007. *Computational Intelligence: An Introduction*. Wiley-Blackwell.

MOHRI, Mehryar, ROSTAMIZADEH .Afshin and TALWALKAR, Ameet. 2018. *Foundations of Machine Learning.* MIT Press.

SHAI SHALEV-SHWARTZ and SHAI BEN-DAVID. 2014. *Understanding Machine Learning: From Theory to Algorithms.* Cambridge University Press.

ROGERS S and GIROLAMI M.2011. *A First Course in Machine Learning,* CRC Press.

MITCHELL T. 1997. *Machine Learning*, McGraw-Hill.

BARBER D.2012. *Bayesian Reasoning and Machine Learning.*

FLACH, P. 2012. *Machine Learning: The Art and Science of Algorithms that Make Sense of Data.* 1st Ed. Cambridge: Cambridge University Press.

KIRK, M. 2014. *Thoughtful Machine Learning: A Test-Driven Approach*. O'Reilly Media.

KLETTE, R. 2014. *Concise Computer Vision: An Introduction into Theory and Algorithms*. Springer.

FANKHAUSER, W. 2015. *Artificial Intelligence Applications: Natural Language Processing. Create Space Independent Publishing Platform*.

LOTFI A Zadeh & RAFIK A Aliev. 2018. Fuzzy Logic Theory and Applications, Part I and Part II, https://doi.org/10.1142/10936,   Pages: 612, By (author): LOTFI A Zadeh (University of California, Berkeley, USA), and RAFIK A Aliev (Azerbaijan State Oil and Industry University, Azerbaijan), Publisher: WSPC, eText ISBN: 789813238190, 9813238194.

BUCKLEY, JAMES J., ESLAMI, Esfandiar. 2002. "An Introduction to Fuzzy Logic and Fuzzy Sets", Springer.

Websites (Online Resources)

https://plato.stanford.edu/entries/artificial-intelligence/ : Stanford Encyclopedia of Philosophy.

http://archive.ics.uci.edu/ml/index.php : University of California, Irvine "Machine Learning Repository" (Data sets).

https://www.lfd.uci.edu/ : University of California, Irvine – Laboratory for Fluorescence. Dynamics "Binaries for Python Extension Packages" (Development Tool).

http://accord-framework.net/ : Accord.NET Framework (Development Tool).

https://cran.r-project.org/ : The R Project for Statistical Computing "R Archive Network" (Development Tool).

https://www.codechef.com/ : CodeChef educational initiative "List of Compilers" (Wiki).

https://www.knime.com/: Konstanz Information Miner "KNIME" (Development Tool).

www.nltk.org : Natural Language Toolkit "NLTK" (Development Tool).

https://julialang.org/ : Programming Language (Development Tool).

www.microsoft.com : Microsoft "Robotics Developer Studio" (Development Tool).

www.alicebot.org : ALICE A.I. Foundation "AIML: Artificial Intelligence Markup Language" (Development Tool).

http://www.aforgenet.com/: Open source C# framework "AForge.NET" (Development Tool).

https://www.openml.org/ : Open Machine Learning.

https://scikit-learn.org/stable/ : Scikit-Learn.

https://www.tensorflow.org/ : End to end open source ML platform.

https://www.scipy.org/ : Python-based open-source software.

https://www.datacamp.com/community : Data camp community.

https://keras.io/ : Keras.

W3School for Python and Machine learning:

https://www.w3schools.com/python/python_ml_getting_started.asp.

Tutorial Point - Artificial Intelligence & Machine Learning with Python:

https://www.tutorialspoint.com/artificial_intelligence/index.htm

https://www.tutorialspoint.com/machine_learning_with_python/index.htm

Academic Journals

IEEE Transactions on Pattern Analysis and Machine Intelligence, ISSN : 01628828 IEEE Computer Society.

Foundations and Trends® in Machine Learning, Now Publishers Inc, Print ISSN: 1935-8237, Online ISSN: 1935-8245.

Journal of Machine Learning Research, ISSN: 15337928, 15324435, Microtome Publishing.

IEEE Transactions on Fuzzy Systems, ISSN: 10636706, Institute of Electrical and Electronics Engineers Inc.

Engineering Applications of Artificial Intelligence, Elsevier, ISSN: 0952-1976.

Artificial Intelligence, ISSN: 00043702, Evsevier.

Machine learning, ISSN: 15730565, 08856125, Springer.

Swarm Intelligence, ISSN: 19353820, 19353812, Springer.

International Journal of Fuzzy Systems, ISSN: 15622479, 21993211, Springer.

AI and Society, ISSN: 09515666, 14355655, Springer.

Intelligent Data Analysis, ISSN: 1088467X, 15714128, IOS Press.

Natural Language Processing, ISSN: 14698110, 13513249, Cambridge University Press.

Conferences

https://www.aaai.org/ : The AAAI Conference on Artificial Intelligence.

https://icml.cc/ : International Conference on Machine Learning.

Named Awards

Course	Compulsory
BSc (Hons) in Computing	Compulsory