This prevalence of IT and IDM have created a level playing field encouraging new businesses and revenue models to sprout. It has become a critical enabler for big corporations to differentiate themselves from their competitors.

Ngee Ann Polytechnic’s School of InfoComm Technology (ICT) is a leader in providing quality IT and IDM education. Established in 1982, it has since nurtured more than 14,000 IT professionals, many of whom have assumed influential positions in various organisations. Some have even founded their own IT ventures.

ICT has a reputation for delivering a broad-based and holistic IT education that is industry-ready, solution-focused and university-relevant. Our courses also undergo stringent review and endorsement by an independent Advisory Committee comprising of high-standing industry players and university representatives.

Students enjoy a total learning experience in a collegial atmosphere, with the flexibility to specialise in niche areas of IT or business management, while broadening their perspectives with a selection of Interdisciplinary Studies electives. Students who are technology-savvy can further sharpen their knowledge and skills to become creators and developers. Business-savvy students can further hone their expertise in business-related areas and are able to analyse and address business needs through IT and IDM.

Upon graduation, students will find that their diplomas are internationally-recognised, making it easy for them to secure advanced standing at many good local and overseas universities.

Information Technology (IT) and Interactive Digital Media (IDM) pervade many aspects of our lives today. In most parts of the world, search engines such as Google and Yahoo, and social media tools such as YouTube, Facebook, Twitter, Wikipedia and Instagram have become a part of everyday vocabulary.

COURSES OFFERED
ICT offers the following courses to meet industry demand for specialist IT manpower:
• Diploma in Animation & 3D Arts (A3DA)
• Diploma in Financial Informatics (FI)
• Diploma in Information Security & Forensics (ISF) 
• Diploma in Information Technology (IT)
• Diploma in Multimedia & Animation (MMA)

MAJOR ACHIEVEMENTS
IT Award Winners
ICT students and alumni have proven their prowess in both national and international IT competitions and awards.
• Alumnus Kelly Choo was awarded the SCS National Young IT Professional 2012 Award. He is the third NP graduate to win this prestigious award. Douglas Gan, co-founder of ShowNearby.com, was the 2011 winner and Rakesh Gupta, CEO of Guptasoft Technologies, took home the award in 2009.

• Alumnus Nicholas Ooi Hsien Loong was awarded the SCS National IT Youth 2012 Award.

• Alumnus Hang Zhi Cheng won the Lee Kuan Yew Award and Ngee Ann Polytechnic Outstanding Award 2013.

• IT student Luo Wenhan emerged champion in the Microsoft Office Academic Skills Challenge 2012 (MSWord category) and secured the second runner-up position in the Certiport Worldwide Competition 2012.

• IT student Lewis Koh emerged champion in the Microsoft Office Academic Skills Challenge 2012 (MSExcel category) and was fourth in the Certiport Worldwide Competition 2012.
IT student Elliot Tan clinched the National Championship in Microsoft Word 2010 (Open Category) and the second place in Microsoft Excel 2010 (Tertiary Category) at the 2013 Singapore Microsoft Office Academic Skills Challenge.

Three IT students Jeremy Choo Wun Ka, Ong Pang Yi and Sim Tong Gerald received the 2013 A*STAR Science Award from the A*STAR Graduate Academy. Another two IT students Isaac Hong An Jie and Terence Yap Wen Jie received the A*STAR Science Award in 2014.

IT student Benjamin Tan emerged champion in the Singapore Microsoft Office Academic Skills Challenge 2014 (Word category).

Scholarships for Academic Progression

2012 IT Gold Medallist Sam Yong Shan Xian was awarded the DSTA Scholarship (local) and IDA's National Infocomm Scholarship (NIS) Scholarship (overseas) to pursue his Computer Science degree in 2015.

2012 MBS Gold Medallist Low Jia Wen Gabriel was awarded the SMU Lee Kong Chian Scholarship to pursue a Bachelor of Science in Information Systems Management in August 2012.

2009 IT Gold Medallist Koh Wei Jie was awarded the Yale-NUS Merit Scholarship to pursue a Bachelor in Liberal Arts with a major in Computer Science in Yale-NUS College in September 2013.

2012 IT graduates Goh Xue Li and Wang Poh Peng were offered the Integrated Infocomm Scholarship (IIS)-NIS scholarship to pursue their Bachelor of Computing degrees in NUS in August 2012.

2012 FI graduate Reynard Lee Jia Jin received the MINDEF/SAF Scholarship to do his degree in Computer Science in NTU in November 2013.

2013 IT graduate Muhammad Hatib B. Abdul Aziz was awarded the IDA IIS-NIS scholarship to pursue his Bachelor of Engineering (major in Information Systems Technology and Design) degree in SUTD in August 2013.

2013 MMA graduate Ng Soo Sian Amanda received the IDA IIS-NIS scholarship to pursue her Bachelor of Computer Science degree in NUS in August 2013.

ICT staff are armed with extensive infocomm and digital media qualifications and industry experience. Some of them have also created IT ventures and managed IT-related businesses, which put them in a good position to impart entrepreneurship skills to students.

ICT is well-equipped with extensive, state-of-the-art computing resources, supported by high-speed wired and wireless networks in an open systems environment. The latest industry-standard software is used for teaching and learning. Specialised labs are available for the development of skills in niche areas.

ICT enjoys strong strategic links with the industry by engaging in applied research and consultancy projects, and playing a proactive role in mutually beneficial partnerships and collaborations.

ICT diplomas are developed with industry inputs. For example, Microsoft Singapore played an advisory role in the design, development and delivery of the curriculum for the Diploma in Information Technology’s Infocomm Sales and Marketing specialisation.

Collaborations with industry partners have led to the establishment of ICT’s technology hubs, such as the eGarage®, The DOT® and RHyMeS Centre. These hubs nurture the students’ spirit of innovation and enterprise by allowing them to work with emerging technologies, in collaboration with industry experts.

The eGarage® houses a state-of-the-art infocomm showcase and development labs that are open to students and industry partners. These niche development labs are equipped with high-end hardware and software for teaching and project developments. The DOT® has a state-of-the-art sound recording studio, a drawing room, a blue room, as well as specialised multimedia labs equipped with advanced workstations capable of running resource intensive multimedia applications. The RHyMeS Centre, an infocomm incubation centre, focuses on IDM and mobile developments.

Diploma Plus Programmes


Certificate in Advanced Computing Mathematics (CACM)
Helps students build a mathematics foundation needed for pursuing degrees in computing at both local and overseas universities. Students with this certificate will be able to read all modules carrying ‘A’ Level Mathematics as prerequisite upon admission to National University of Singapore and Nanyang Technological University.

Certificate in Business Solutions Development (CBSD)
Equips students with the expertise needed to develop customised and integrated business office applications.

Certificate in Web Design & Development (CWDD)
Provides students with in-depth understanding of the concepts and techniques needed to develop web-based applications, Content Management Systems (CMS) and social networking websites.
The Diploma in Animation & 3D Arts (A3DA) is a practice-oriented course that gives students a strong foundation in animation, art, design and storytelling. From their second year onwards, students will get to specialise in either Character Animation or 3D Arts.

The Character Animation specialisation develops students’ pre-production and production skills in concept art design, storyboarding, 2D and 3D character animation and the production pipeline. This specialisation prepares students for a career in Character Design, Props & Environment Design, Storyboarding, 2D Animation, and 3D Animation.

The 3D Arts specialisation develops students’ pre-production and production skills in concept art design, storyboarding, 3D modelling, rigging, texturing and lighting. It prepares students for a career in Character Design, Props & Environment Design, Storyboarding, 3D Modelling, Lighting, Texturing and Rigging.

In the final year, students undertake a year-long production in the School's Amphibi Studio™ to further develop their expertise and nurture their business skills. Students from both specialisations will graduate with their own industry-standard portfolio.

Students also take several Interdisciplinary Studies (IS) modules that aim to broaden their minds and help them develop the spirit of innovation and enterprise. This is important for A3DA professionals working in a complex business environment, where problems are multi-faceted in nature and require knowledge and skills in different disciplines.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
</tr>
</thead>
<tbody>
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<td>1-7</td>
</tr>
<tr>
<td>Any two other subjects</td>
<td>1-6</td>
</tr>
</tbody>
</table>

You must have also sat for a Science or Art / Higher Art or Design & Technology or Food & Nutrition or a relevant OSIE / Applied Subject and fulfil the aggregate computation requirements.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to passing an in-house test.

Students are required to own a MacBook and purchase art materials.

CAREER PROSPECTS

A3DA graduates can join the fast-growing digital entertainment industry and be involved in the various stages of animation production; from concept, story development, storyboard art, character design, props and environment design, to 3D modelling and texturing, lighting, 3D character rigging and character animation!

ACCREDITATION FOR FURTHER STUDIES

The Diploma in Animation & 3D Arts is recognised by both local and overseas universities, which offer advanced standing to our graduates.
Graduates can pursue further studies in the creative field with universities such as:

- Nanyang Technological University: Bachelor of Fine Arts in Art, Design and Media
- Digipen Institute of Technology (Singapore): Bachelor of Fine Arts in Production Animation and Bachelor of Arts in Game Design
- Sheridan College (Canada): Bachelor of Applied Arts in Animation
- Queensland University of Technology (Australia): Bachelor of Fine Arts in Animation
- Royal Melbourne Institute of Technology (Australia): Bachelor of Arts in Animation & Interactive Media
- Savannah College of Art & Design (USA): Bachelor of Fine Arts in Animation

**INDUSTRY ENDORSEMENT**

Toon Boom Animation helped to design, develop and deliver the digital paperless 2D animation production portion of A3DA's curriculum. Toon Boom, the worldwide leader in animation software solutions, proudly supports ICT's commitment to jump-starting the process of creating a pool of highly-skilled and well sought-after 2D animation professionals.
Notes:
^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/
** The elective modules offered are reviewed regularly and subject to updates to ensure relevance to the industry needs and the sequence of module offering may change as deemed fit.

**IS Modules**
The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students’ competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.

COURSE MODULES

**LEVEL 1.1**

**Drawing & Perspective**
This module introduces drawing from observation. The emphasis is on developing the student’s understanding of the formal elements of drawing, perspective, composition, and other perceptual concepts. It introduces line, value, composition, linear and atmospheric perspectives, expressive mark making, and also explores the basic professional habits in drawing practice.

**Fundamentals for Creative Professionals**
This module aims to provide students with a broad introduction to the interactive and digital media industry. Students gain a good understanding of the critical success factors, professional roles and career development paths within the industry, professional practices and ethical expectations.

**History of Film & Animation**
This module surveys the development of film and animation over the past century. Students explore the evolution of the medium and how technology, economics, artistic trends, individual artists and national cultures have affected its development.

**Light, Colour & Design**
This module explores the fundamental elements and processes of organising, displaying, and communicating ideas and information creatively to the minds of the intended audience through two-dimensional form, colour structure, and composition. It introduces the elements and principles of design, visual organisation, visual perception and communication theory. Emphasis is on concept development, problem solving, and creative process relevant to visual communication.

**Principles of Animation**
This module introduces the language and principles of classical animation through analysis and decomposition of movement frame-by-frame. Students will explore the importance of effective timing and spacing, and how their manipulation can affect the feel of an action.

**Storytelling & Scriptwriting**
This module explores the nature of storytelling and exposes students to the historical traditions of storytelling in all forms. It introduces the essential components in a compelling story, techniques to create a story that will hook the audience and keep them emotionally involved, and explores at the more subtle elements of a story. This module also introduces practices in screenwriting such as characterisation, narration, dialogue, script forms, and alternatives.

**LEVEL 1.2**

**Figure Drawing**
This module introduces the concepts and techniques of figure drawing. It provides students a thorough understanding of the structure and anatomy of the human figure, and how the underlying skeletal structure can affect the surface appearance of the body. It aims to develop students’ ability to create drawings that communicate the dynamics of the body structure and movement.

**Principles of Body Mechanics**
This module further develops students’ classical animation skills on various biped/human characters. It continues to develop students’ understanding of the concepts of motion and body mechanics, and aims to develop students’ ability to create convincing movement, expression of mood, thought, attitude, and personality in the characters with a goal to bring the characters to life.

**Storyboarding**
This module explores the pre-production skills of storyboard art. It introduces the concepts of storyboard drawings, which map out camera angles, continuity, and lighting. Students learn about the basics of film grammar through the analysis of scripts, character, and set design, and translate these through drawings to create story flow, character development, mood, time, and place. Students will create both production and presentation storyboards.

**3D Form & Space**
This module develops students’ ability to perceive objects in three-dimensional space and to translate two-dimensional form into three-dimensional volume, mass, space, and structure. It introduces the basic elements, principles, materials and methodologies of three-dimensional design. Working with both physical medium and digital tools, students explore the use of basic materials, elements and principles of design, basic abstract components to build three-dimensional forms that accurately depict its measurement and proportion.

**Tone, Colour & Composition**
This module explores the nature and use of tone, colour, and composition in drawing. It emphasises methods of
creating tone, ways to use luminance as an organisational element, and stresses on the importance of thinking critically. In addition, the module introduces a variety of classical tonal systems and tonal illusions. The module covers systems and traditions of organising hue and saturation, and examines methods of building from tonal preliminary studies. Students will explore the artistic use of colour, and the classical forms of compositional organisation.

LEVEL 2.1
Advanced Figure Drawing
This module focuses on the human figure and gestures. Students work from life models to create full studies, short poses, and sustained studies. Students explore putting the figure into an environment, figurative composition, and introductory sequential figurative composition. The module also includes a thorough study of costume and drapery. Students will learn to increase perception, insight, draftsmanship, aesthetic vocabulary, and conceptual attitudes.

Animal Anatomy
This module introduces comparative study of the human structure and the structure of a variety of animal types. Focus will be specifically on the impact of anatomical structure on locomotion. The module also considers standard locomotion cycles and the relationship between humans and various animals. Emphasis of this module will be on the artistic application of this knowledge for artists and animators.

3D Character Animation
The module develops students’ understanding of character development, cinematic narrative and expressive movement through motion and posing by applying scripted character controls. Timing, weight, anticipation, squash and stretch, conveying simple emotions/interactions, and other fundamental animation principles are covered. Forward and inverse kinematics for skeletal animation, facial animation, including lip sync and emotion, will be explored. Animation of basic motion such as walk/run cycles, and the control of rigid and soft character models using skeletons will be introduced.

3D Modelling
This module examines the basic principles and techniques of creating 3D digital models. It provides an overview to the process of digital asset creation, and introduces techniques and critical thinking skills for organic and inorganic modelling, polygonal modelling, and patch modelling. Texture mapping, lighting, shading, rendering and camera setups are explored. Emphasis is placed on professional habits and the digital workflow.

LEVEL 2.2
Human Anatomy
This module explores the skeletal and muscular structures of the human body. From both live models and anatomical references, students will learn to understand the anatomical structure of the human body and how these anatomical elements function to create movement, attitudes and poses from head to toe. Emphasis of this module will be on the artistic application of this knowledge for artists and animators.

Character Design
This module leverages on the drawing skill and anatomy knowledge to create characters that are memorable and unique. It introduces the creative process and traditions of character design, and the basic structural strategies for creating characters. It covers the basic tools such as thumbnails, silhouette design, figure invention, props, costumes, character archetypes, marker sketches and digital painting.

Props & Environment Design
This module covers the basics of designing different types of props and environments for animation, film and games. Students will learn perspective, composition, the tonal differences between interior and exterior environments, research techniques for believable detail, clear tonal reads, and modelling within established values. Additional subjects will include lighting and material indication, the thought process before the sketch, use of thumbnails, rendering with Photoshop, use of pencil and pen, reference material.

LEVEL 3.1
Concept Development
This module introduces various idea generation and concept development techniques. Students learn the pre-production skills of concept illustration and visual development through the application of knowledge skills in drawing, storytelling and composition to communicate the concept effectively to an audience.

Digital Cinematography
This module introduces the art of cinematography for digital video and computer-generated imagery. It covers the principles and concepts of practical cinematography through physical lighting, choreography of camera movement and lighting of computer-generated environment to enhance the visual impact in storytelling.

3D Animation Production
This module introduces 3D animation production within the context of a small production pipeline. Students work in a dynamic team on a 3D animation project. Students will be responsible for interpreting the initial animatic, storyboards, and workbooks, breaking down sound and music onto exposure sheets, and learn choreography, continuity, and basic scene analysis.

LEVEL 3.2
Internship / Final-Year Project
The primary aim of this final year industry-based project is to nurture the spirit of innovation and enterprise in students and broaden their experience beyond classroom learning. It also provides students with the opportunity to apply the knowledge and skills gained in the past semesters. Using
the demo program prototyped in the earlier semester under the Concept Development module, students will develop the idea into a full working product. Local or overseas attachments are possible.

Character Animation Specialisation

Acting for Animation
This module further develops students’ ability to translate thoughts and feelings into specific gestures and actions. It surveys the history of acting in the theatre, animation and film. In addition, the module focuses on the analysis of action in the human form, gestures, timing, characterisation, communication of attitude, character relationship, storytelling through motion, emotion and thought process to create a moving and memorable acting performance.

Advanced 3D Character Animation
This module emphasises how character animation influences character personality and how sound is used to advance a story and create the mood, place and emphasis. Students become knowledgeable in multifaceted issues of human movement. The expression of emotion, timing, and the subtlety of character is explored. Lip-synching and dialogue animation are presented. It also gives students an appreciative view of character rigging for animation.

Perspective, Background & Layout
This module explores the animation pre-production skills of background and layout art. This includes the integration of existing storyboard and design elements into finished layouts that communicate the story effectively. In addition, students incorporate the fundamentals of painting applicable to both concept art and finished layouts. Additionally, students will explore the means of using drawing to create camera lens illusions, architectural space, theatrical sets, level design, matte painting, and surface texture.

2D Animation Production I
This module introduces the traditional animation production within the context of a small production pipeline. Students work in teams on a traditional animation project. They will interpret the initial animatic storyboards, and workbooks, break down sound and music onto exposure sheets, and complete rough and cleaned up animations for a final rough composite. Students learn choreography, continuity, and basic scene analysis while working within the confines of a team.

2D Animation Production II
Building on the working rough reel produced in the 2D Animation Production I module, students use a digital animation tool to convert the drawings to vector-based images. Students will then focus on character and effects clean-up work to complete the final and polished version of the project. The module pays special consideration to the workflow projections, scheduling, time management, administrative documentation, and quality control. The emphasis is on appropriate work habits.

3D Arts Specialisation

Advanced 3D Modelling
This module continues to build on students’ 3D modelling skill through the creation of hyper-realistic models. Subjects like bipedal characters and creatures will be tackled through the balance application of anatomy and technical efficiencies. Students will learn to fuse the traditional art of sculpting organic form with digital modelling techniques. It covers the use of anatomy as it pertains to modelling and speaks of the technical needs for creating quality in deformable and detailed surfaces.

Architectural Space, Design & Lighting
This module introduces students to the aesthetics and principles of 3D environment design for the theatrical sets, landscapes, terrain, objects, and architectural structures.

It covers a survey of world architectural styles together with the concepts on how to blend the emotion, mood, lighting, shadows, aesthetics and flow into the design of the architectural structures. It also covers texturing, spatial design, negative space, dramatic lighting, and other concepts that affect not only the psychology of level design but also gameplay principles.

Texture & Shading
The module covers the tools and techniques for the creation of custom 2D texture maps. Students learn about different artistic styles, levels of craftsmanship (handmade, manipulated scanned imagery and 3D compositing), repetition structures, and tile-able and seamless motifs, with grounding in traditional painting. Focus will be on the layering technique, where overlapping elements form rich and beautiful work. Texture mapping techniques will also be explored with emphasis on manual UV unwrapping.

3D Character Rigging
This module deals with issues relating to character modelling, rigging and setup based-on production requirements. Students will be presented with various character setups and explore appropriate modelling and rigging solutions for their own characters. Topics include skeletons, forward/inverse kinematics and custom control panels. Students will acquire the ability to set up a character for a wide range of complex body movement, with an emphasis on techniques for creating controls, which are realistic, flexible and can be intuitively animated.

3D Environment Modelling
This module provides the opportunity for students to create architectural interior and the natural environments representing houses, buildings, and entire worlds contained under a roof, in which to place the game characters. It explores and integrates design and technology to develop matte paintings, virtual sets and digital backgrounds. Students acquire the knowledge and practical skill sets for digital matte painting production.
DIPLOMA IN FINANCIAL INFORMATICS (FI)

The Diploma in Financial Informatics (FI) is a hybrid course that gives students a strong IT foundation with business knowledge in the dynamic banking and finance industry. It has a unique curriculum that combines the strengths of the School of InfoComm Technology and the School of Business & Accountancy.

With FI, students gain cross disciplinary skills in infocomm technology and finance. They are equipped with skills in IT and business process management, as well as hands-on experience with Enterprise Resource Planning (ERP) and Business Intelligence (BI) systems for the banking & finance industry.

Students develop relevant technical skills to analyse and manage financial data as well as business processes of enterprise systems that improve the business competitiveness within the finance sector.

In their second year, students can specialise in Banking & Finance or Financial Analytics. In the Banking & Finance Specialisation, students gain an understanding of the products, process and IT applications that are used in the financial industry, enabling them to design effective IT solutions. In the Financial Analytics specialisation, students learn how to analyse large amounts of data to help financial institutions make effective and timely decisions.

In the final year, students will undertake a four-month internship with leading banks such as DBS, OCBC, UOB or other organisations to gain industry experience.

Students also take several Interdisciplinary Studies (IS) modules that aim to broaden their minds and help them develop the spirit of innovation and enterprise. This is important for FI professionals working in a complex business environment, where problems are multifaceted in nature and require knowledge and skills in different disciplines.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

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<td>1-6</td>
</tr>
</tbody>
</table>

You must have also sat for a Science or Design & Technology or Food & Nutrition or a relevant OSIE / Applied Subject and fulfill the aggregate computation requirements.

Candidates with severe vision deficiency should not apply for the course.

CAREER PROSPECTS

FI graduates are trained to be business analysts, a critical role that bridges both business needs and technology. It gives them a head-start in their careers with banking and financial institutions, SMEs, MNCs and the public service sector. With a strong understanding of the organisation’s business objectives, business analysts are able to value-add to the organisation by achieving operational effectiveness and efficiency for business operations.
## ACCREDITATION FOR FURTHER STUDIES

The Diploma in Financial Informatics is recognised by local and overseas universities, many of which offer advanced standing to our graduates. These universities include:
- National University of Singapore
- Nanyang Technological University
- Singapore Management University
- Singapore University of Technology and Design
- University of New South Wales (Australia)
- University of Melbourne (Australia)
- Monash University (Australia)

FI graduates can also apply to the Singapore Institute of Technology to pursue relevant specialised degree programmes offered by reputable overseas university partners.

## COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td></td>
</tr>
<tr>
<td>Level 1.1 (29 hours per week)</td>
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</tr>
<tr>
<td>Business Statistics</td>
<td>5</td>
</tr>
<tr>
<td>Enterprise Information Systems</td>
<td>5</td>
</tr>
<tr>
<td>Economics</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals for IT Professionals</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Programming</td>
<td>5</td>
</tr>
<tr>
<td>Innovation Toolkit^</td>
<td>4</td>
</tr>
<tr>
<td>Level 1.2 (26 hours per week)</td>
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<tr>
<td>Accounting</td>
<td>5</td>
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<tr>
<td>Databases</td>
<td>5</td>
</tr>
<tr>
<td>Financial Markets &amp; Services</td>
<td>4</td>
</tr>
<tr>
<td>Object-Oriented Programming</td>
<td>6</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues^</td>
<td>4</td>
</tr>
<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 2</strong></td>
<td></td>
</tr>
<tr>
<td>Level 2.1 (24 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Banking &amp; Financial Products</td>
<td>5</td>
</tr>
<tr>
<td>Digital Devices &amp; Networking Technology</td>
<td>5</td>
</tr>
<tr>
<td>Developing Web Applications</td>
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</tr>
<tr>
<td>Enterprise Systems Analysis &amp; Design</td>
<td>5</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
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<tr>
<td>Level 2.2 (24 hours per week)</td>
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<tr>
<td>Enterprise Business Processes</td>
<td>5</td>
</tr>
<tr>
<td>Enterprise Project Management</td>
<td>5</td>
</tr>
<tr>
<td>Financial Management</td>
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<tr>
<td>Spreadsheet Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Prescribed/Elective module^</td>
<td>5</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 3</strong></td>
<td></td>
</tr>
<tr>
<td>Level 3.1 (23 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Financial Planning^</td>
<td>4</td>
</tr>
<tr>
<td>Enterprise Resource Planning</td>
<td>5</td>
</tr>
<tr>
<td>Prescribed/Elective module^</td>
<td>5</td>
</tr>
<tr>
<td>Prescribed/Elective module^</td>
<td>5</td>
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<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
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<tr>
<td>Level 3.2</td>
<td></td>
</tr>
<tr>
<td>Internship and/or Project</td>
<td>16</td>
</tr>
</tbody>
</table>

In the second year, students may choose to major in a specialisation option. Each option requires the completion of three prescribed modules.

### Banking & Finance Specialisation
- Corporate Banking Applications & Processes
- Customer Relationship Management
- Financial Analysis & Modelling
- Retail Banking Applications & Processes
- Risk Management
- IT Outsourcing

### Financial Analytics Specialisation
- Business Analytics
- Business Intelligence
- Data Visualisation
- Financial Analytics
- Predictive Analytics
- Quantitative Analysis

## Notes:
- ^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/
- # The prescribed/elective modules offered may change from year to year, depending on relevance and demand. They may also include modules available in other diplomas offered by the School.

## COURSE MODULES

### LEVEL 1.1

#### Business Statistics

This module explores how business problems can be solved by applying statistical principles. The main emphasis is to provide students with some basic mathematical skills to handle numerical information in a
business context, such as presenting and interpreting statistical data by using means, measures of dispersion and graphs. Topics covered include fundamentals of statistics and probability, discrete and continuous probability distributions, estimation, and correlation. This module explores how business problems can be solved by applying statistical principles. The main emphasis is to provide students with some basic mathematical skills to handle numerical information in a business context, such as presenting and interpreting statistical data by using means, measures of dispersion and graphs. Topics covered include fundamentals of statistics and probability, discrete and continuous probability distributions, estimation, and correlation.

Enterprise Information Systems
This module aims to provide students with an understanding of the use of Enterprise Information Systems to meet the needs of a typical organisation. Students will learn how Enterprise Information Systems can help an organisation gain an advantage over its competitors, and how the transformation of an organisation can lead to changes in its IT systems.

Economics
This module incorporates the study of demand and supply, resource allocation, consumer behaviour, market demand, production and cost theory, price and output of firms under conditions of perfect and imperfect competition. At the end of the module, students will be able to relate the basic concepts and principles of economics to problems and issues.

Fundamentals for IT Professionals
This module gives a broad introduction to the field of IT by exploring the roles, professional practice, ethical expectations and development paths of IT professionals. Students will appreciate the importance of problem-solving skills in providing effective IT solutions. They will see how interpersonal and team working skills can help build relationships with users, facilitate meetings, influence users in requirements definition, and help them participate as effective members of a systems development team.

Fundamentals of Programming
This module teaches programming fundamentals, including data types and variables, statements and compound statements, expressions, selection and repetition, simple computation, and use of libraries. Other key topics include the development of test cases and test plans, and providing suitable program documentation, with Java programming language used to illustrate programming concepts. Students will also learn how to apply problem-solving skills and get ample practice in expressing solutions using Java.

LEVEL 1.2
Accounting
This module covers the basic theory and concepts behind the principles of accounting. It introduces students to the accounting process and the different accounting documents used in typical organisations. Students will learn how to analyse business transactions and financial documents. They will also pick up a basic understanding of the control and accounting for cash, inventories and fixed assets, goods and service taxes, and partnership.

Databases
This module examines the fundamental principles and concepts of database systems needed to store and structure an organisation’s information and drive its business functions. Students will learn to analyse data and perform data modelling and normalisation, so as to design effective databases using relevant theories and concepts of relational database systems.

Financial Markets & Services
This module examines the role of the financial markets, their players and instruments, and the status of Singapore as a financial centre. The module will also trace the relationships between the various markets and their participants, with emphasis on current events, trends and developments in the markets.

Object-Oriented Programming
This module builds on the knowledge and skills acquired in the Fundamentals of Programming module. It aims to provide opportunities for students to develop medium-scale applications based on the Object-Oriented (OO) approach. Topics covered include Abstract Data Types (ADTs), the implementation of selected ADTs using the OO approach, and suitable sorting and search algorithms. Software robustness and correctness, and good programming practices will be emphasised.

LEVEL 2.1
Banking & Financial Products
The module aims to introduce students to the different products and services that are offered by financial institutions. Students will learn how these products are developed and the benefits it brings to the financial institutions and its customers. Suggested topics include products within consumer banking, corporate banking, trade finance and investment products.

Digital Devices & Networking Technology
This module focuses on the fundamental concepts of digital devices such as computers and mobile phones, as well as networking. It covers the basic architecture, characteristics and functions of a computer system. The module also provides an overview of current day networking system. Major networking components such as switches, hubs and transmission mediums including wireless networks are discussed.

Developing Web Applications
This module arms students with the knowledge and skills needed to develop Web applications. Students
will learn to use the latest Web technologies such as Microsoft’s .NET framework to develop effective Web applications. Students will acquire the technical skills of server-side programming to create Web-based forms, perform state management, access data, and validate user input.

Enterprise Systems Analysis & Design
This module introduces the Software Development Life Cycle (SDLC) from project planning to implementation with an emphasis on analysis and design. It uses an object-oriented approach to document business needs and design a solution system. Students will learn to understand, document and define the business needs and processing requirements of a new system. They will learn how to design solution systems based on the requirements defined and decisions obtained during analysis.

LEVEL 2.2
Enterprise Business Processes
This module introduces students to the structure of an organisation and relates it to the job responsibilities of each department. The associated business processes - from sales, purchasing and inventory management to finance - will be discussed. Students will learn about the flow of information within an organisation and the tight linkages between departments in an organisation. Students will get a chance to be involved in business process modelling to reinforce their understanding of the different roles played by an organisation’s employees.

Enterprise Project Management
This module introduces the basic concepts and methodology involved in planning and managing enterprise information systems projects. It will introduce the various stages of the project cycle and its deliverables. Students will also learn how to manage project quality and risk in the project implementation life cycle.

Financial Management
This module provides students with an introduction to the financial environment and the role of finance in business. It considers the financial objectives of firms, cash planning and cash budgeting, working capital management, the management of current assets, capital budgeting decisions using discounting techniques, and the sources of short-term and long-term funds.

Spreadsheet Engineering
The module introduces students to the use of spreadsheets (e.g. Microsoft Excel) as a tool for decision making and analysis. Students will learn excel functions and formula to format and represent data via graphs and charts for analysis. Students will also be developing simple macros.

LEVEL 3.1
Enterprise Resource Planning
This module introduces students to the basic concepts of an Enterprise Resource Planning system and its basic functions. Students will have practical experience with business processes such as sales and marketing, procurement, inventory management and finance using ERP software. Students will understand the software integration of business processes within an organisation.

Financial Planning
This module aims to provide a coherent understanding of personal financial planning in the midst of fast changes in the financial services industry and the blurring of product lines within the financial sector. The module will equip students with technical and conceptual financial planning knowledge to prepare them for a career in the financial services industry.

LEVEL 3.2
Internship and/or Project
This module provides students with the opportunity to apply the knowledge and skills gained to contribute to the design or development of an IT or process solution to solve practical problems. Students may undertake an industry-driven project, a Technopreneurship Enterprise project or a real-life IT or end-user project in local banks (e.g. OCBC, UOB, DBS) or other large organisations. These projects may include problem definition, requirements analysis, design, development and testing, delivery and presentation of the solution. Through the project, students will learn to appreciate the finer points of project planning and control issues relating to IT project development.

Banking & Finance Specialisation
Corporate Banking Applications & Processes
The module aims to introduce students to IT applications and processes for corporate banking products and services. The corporate banking processes will be discussed. Students will have an understanding of how banking applications and solutions are used by financial institutions to meet corporate customers’ needs. Suggested topics include corporate banking accounts services, trade finance, corporate treasury and derivatives, corporate loans and cash management.

Customer Relationship Management
This module provides students with a knowledge and understanding of Customer Relationship Management (CRM) and how it benefits organisations. Students will also learn about the different uses of CRM in organisations, various CRM strategies and how to manage customer information to protect the privacy of their data.

Financial Analysis & Modelling
The module aims to introduce students to frameworks used for financial statement analysis. They will be able to make use of financial reports to understand the position and financial health of an organisation. Students will also be equipped with basic financial analysis and decision making techniques. With the knowledge they will be able
to suggest IT applications and processes that could be put in place for financial institutions for further analysis of the data. Suggested topics include the interpretation of financial reports, cash flow analysis and the impact and sensitivity of uncertainties and risks.

Retail Banking Applications & Processes
The module aims to introduce students to the IT applications and processes for consumer banking products and services. The consumer banking processes will be discussed. Students will have an understanding of how banking applications and solutions are used by financial institutions to meet the customers’ needs. Some of these are governed by the central bank which has specific requirements to protect the interest of the consumers. Suggested topics include account opening process, credit controls and administration, loan processes, delivery channels and anti-money laundering.

Risk Management
The module aims to introduce students to the types of risks faced by financial institutions, in particular technology and operational risks. For example, operational risks can arise from internal business functions and processes while market risks arise from external market conditions. This module will equip students with the knowledge on some of the controls, IT applications and systems, management frameworks, policies and standards adopted by financial institutions to minimise potential losses. Suggested topics include technology risk management, operational risks, market risks and credit risks.

IT Outsourcing
This module provides students with an understanding of the need for IT outsourcing. It also discusses ways to manage outsourcing partners and the associated legal requirements to protect intellectual property rights. The module will also explore the role and responsibilities of an outsourcing partner.

Financial Analytics Specialisation

Business Analytics
This module allows students to leverage on both statistics and data mining techniques for data-driven decision-making in various business domains. The goal is to extract knowledge from real business data for actionable insight. Topics covered include Data Analytics to improve business operations and profits, Customer & Profitability Analysis, Applied Data Mining, Social Media Analytics and Text & Web Mining.

Business Intelligence
This module aims to introduce students to the importance and uses of a data warehouse. Students will be taught analytical techniques and concepts which will equip them with the technical know-how to generate useful reports required by businesses for both analytical and operational usage. They will learn how business managers and analysts throughout an organisation make better decisions using complicated analysis, data mining, prediction and forecasting.

Data Visualisation
This module covers the techniques and tools for creating effective visualisations based on principles from graphic design, perceptual psychology and cognitive science. Students will learn how to process large volumes of data to create interactive visualisations for ease of exploration. Suggested topics will include visualising patterns, proportions, relationships, spatial & temporal elements and multi-dimensional visualisations.

Financial Analytics
This module will look at the application of data mining and predictive analysis techniques in domains related to Banking and Finance. The module will involve lectures, tutorials and lab sessions. Students will use spreadsheets and/or a data mining tool to perform analytics using sample datasets from Banking and Finance domains. Topics covered include Customer Analytics (such as Customer Lifetime Value analysis), Banking Analytics (such as identifying suspicious transactions), Insurance Analytics (such as Claims Fraud detection) and Text Analytics (such as the discovery of meaningful patterns and relationships from the analysis of social media sites).

Predictive Analytics
This module aims to introduce students the statistical techniques to make predictions about future trends in business or financial services. Students will be taught the assessment techniques to identify risks and opportunities patterns found in historical and transactional data, and make intelligent decisions by evaluating the prediction models developed using software tools. Topics covered include data mining methods, such as association, classification and cluster analysis, forecasting methods and prediction models.

Quantitative Analysis
This module aims to introduce the statistical concepts and methods used to analyse and interpret business or financial data. Students will be equipped with the technical know-how to formulate statistical models, and make informed decision by evaluating the statistical models using software tools. Suggested topics include frequency distribution, probability distribution, quantitative modelling, correlation analysis and linear regression analysis.
The adoption of infocomm technology has led to greater productivity, reduction in costs, increased convenience, improvement in the quality of services, creation of new business and revenue models for businesses. However, infocomm technology can also be exploited by criminals, terrorists, syndicates and irresponsible hackers, who cause harm and create mischief.

The Diploma in Information Security & Forensics (ISF) is a practice-oriented course that equips students with critical skills related to offensive security, defensive security and digital forensics.

This course provides a strong foundation in computer networking, operating systems, cryptography, vulnerabilities and secure software development. With these skills, students can then deepen their knowledge and skills through specialised second-year modules which will lead them to the following areas: Network Security, Software Security and Digital Forensics.

In the final year, students will be able to apply their knowledge and skills to perform penetration testing on software, systems and networks, in-depth forensic investigation on digital devices and networks, and malware analysis.

Students will also learn how to secure codes and processes that go into developing applications, so that they are protected from external threats right from the start. This is called the Security Development Life Cycle process, and is a valued skill in the industry.

ISF students can also attend masterclasses by Information Security professionals, and work on projects in the area of information security and forensics with companies such as the Ministry of Home Affairs, Palo Alto Networks, e-Cop, SecureAge and CrimsonLogic.

Integrated into the curriculum are Interdisciplinary Studies (IS) electives that enable students to widen and deepen their spectrum of knowledge beyond the core modules. Their perspectives are broadened and an innovative and enterprising spirit is nurtured. This is important for ISF professionals as they work in complex business environments where problems are multi-faceted in nature and require knowledge and skills in different disciplines.

ENTRY REQUIREMENTS

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
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</thead>
<tbody>
<tr>
<td>English Language as a First Language</td>
<td>1-6</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Any two other subjects</td>
<td>1-6</td>
</tr>
</tbody>
</table>

You must have also sat for a Science or Design & Technology or Food & Nutrition or a relevant OSIE / Applied Subject and fulfil the aggregate computation requirements.

Candidates with severe vision deficiency should not apply for the course.

CAREER PROSPECTS

There is a global shortage of IT security professionals, and the Singapore Government recently launched a Masterplan to grow Singapore’s own pool of professionals to address this deficiency.

With the ISF diploma, graduates can join security agencies such as INTERPOL and the Singapore Police Force, IT solutions providers, IT consulting companies, IT security product companies, secure software development companies, and the IT security divisions of banks and financial companies. Graduates can work as a digital forensics investigator, secure software developer, security engineer, penetration tester, malware analyst and security auditor.
ACCREDITATION FOR FURTHER STUDIES

ISF graduates can pursue degrees at local and overseas universities such as:

- National University of Singapore (NUS): Bachelor of Computing (Computer Science)*
- Nanyang Technological University (NTU): Bachelor of Engineering (Computer Science) or Bachelor of Engineering (Computer Engineering)
- Singapore University of Technology & Design (SUTD): Bachelor of Engineering with a major in Information Systems Technology & Design
- Singapore Management University (SMU): Bachelor of Science in Information Systems Management
- Singapore Institute of Technology (SIT): Bachelor of Engineering in Information and Communications Technology (Software Engineering), Bachelor of Computer Science
- Johns Hopkins University (USA): Bachelor of Computer Science
- Monash University (Australia): Bachelor of Computer Science
- University of New South Wales (Australia): Bachelor of degree in Computer Science/Computer Engineering

* ISF graduates can get advance credit for selected modules if they meet the admission criteria for the Information Security Specialisation Preparatory Programme at NUS School of Computing.

COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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</thead>
<tbody>
<tr>
<td><strong>YEAR 1</strong> (29 hours per week)</td>
<td></td>
</tr>
<tr>
<td>Level 1.1</td>
<td></td>
</tr>
<tr>
<td>Computing Mathematics</td>
<td>5</td>
</tr>
<tr>
<td>Cryptography</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals for IT Professionals</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Programming</td>
<td>5</td>
</tr>
<tr>
<td>Networking Fundamentals</td>
<td>5</td>
</tr>
<tr>
<td>Innovation Toolkit</td>
<td>4</td>
</tr>
<tr>
<td>Level 1.2 (26 hours per week)</td>
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<tr>
<td>Databases</td>
<td>5</td>
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<tr>
<td>Networking Infrastructure</td>
<td>5</td>
</tr>
<tr>
<td>Operating Systems Fundamentals</td>
<td>5</td>
</tr>
<tr>
<td>Vulnerabilities 101</td>
<td>5</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues^</td>
<td>4</td>
</tr>
<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 2</strong> (24 hours per week)</td>
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<tr>
<td>Level 2.1</td>
<td></td>
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<tr>
<td>Assembly Language &amp; Python</td>
<td>5</td>
</tr>
<tr>
<td>Information Security</td>
<td>5</td>
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<tr>
<td>Server &amp; Cloud Security</td>
<td>5</td>
</tr>
<tr>
<td>Secure Software Development 1</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Level 2.2 (22 hours per week)</td>
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</tr>
<tr>
<td>Digital Forensics</td>
<td>5</td>
</tr>
<tr>
<td>Malware Analysis &amp; Antivirus Technologies</td>
<td>5</td>
</tr>
<tr>
<td>Network Security</td>
<td>5</td>
</tr>
<tr>
<td>Data Structures &amp; Algorithms</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 3</strong> (24 hours per week)</td>
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<tr>
<td>Level 3.1</td>
<td></td>
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<tr>
<td>Mobile Device Security &amp; Forensics</td>
<td>5</td>
</tr>
<tr>
<td>Elective Module*</td>
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<tr>
<td>Elective Module*</td>
<td>5</td>
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<tr>
<td>Elective Module*</td>
<td>5</td>
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<tr>
<td>World Issues: A Singapore Perspective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
</tbody>
</table>

*Elective Modules

Students are required to complete any three of the following elective modules:

- Secure Software Development 2
- Ethical Hacking
- Governance & Data Protection
- Network Forensics

Level 3.2

Internship and/or project 16

Notes:

^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/

IS Modules

The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students’ competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.
COURSE MODULES

LEVEL 1.1

Computing Mathematics
This module introduces the basic concepts of relations and functions, matrices and methods of statistics and their applications relevant to IT professionals. The main emphasis in this module is to develop students’ ability in solving quantitative problems in computing mathematics, probability and statistics. Topics covered include fundamentals of statistics and probability, discrete and continuous probability distributions.

Cryptography
This module covers the essential concepts of Cryptography, including Public Key Infrastructure (PKI), Digital Signature and Certificate, and the various encryption/decryption algorithms. Students will understand how Symmetric and Asymmetric (Public-Key) cryptographic techniques are used to support different security implementations, and the encryption/decryption algorithms used in these techniques. The role of Certificate Authority, how the digital certificates are generated, managed and distributed will also be covered in details.

Fundamentals for IT Professionals
This module aims to provide students with a broad introduction to the field of IT. It presents the basic concepts of information systems and how information technology enables improvement in the quality and timeliness of information, and the competitive advantages of organisations. The module provides students with an introduction to the soft skills in problem solving, interpersonal relationships, and team working for developing an effective IT professional. Students will understand the importance of problem solving skills in identifying problems, formulating and evaluating alternative IT solutions. They will recognise how interpersonal and team working skills can help them build relationships with users, facilitate meetings, negotiate and influence users in requirements definition, and participate as an effective member of the systems development team. Students will also gain a good understanding of the roles, professional practice, ethical expectations and development paths of the IT professionals. Given the rapidly changing nature of IT, the module will introduce the students to the importance of developing a capacity for continual learning.

Fundamentals of Programming
This module introduces the fundamentals of programming and how to develop programs using appropriate problem-solving techniques in a modular style. In this practice-oriented module, students are taught how to apply problem-solving skills using a top-down structured programming methodology and given ample practice in expressing solutions into computer programs, then test and debug the programs. Programming language, such as Python, Java or C, will be used as a programming tool to illustrate general programming concepts and techniques. Students will study various areas where application software plays a prominent part in helping organizations solve problems.

Networking Fundamentals
The module covers the terminology and technologies in current networking environments and provides a general overview of the field of networking as a basis for subsequent related modules in the course. The topics related to types of networks, network topologies, network technologies and layered protocol architecture will be taught. In addition, the students will also learn the OSI model as a reference model to understand data networks and understand the commonly used network systems such as Ethernet. The topic on TCP/IP as it forms most of the network architecture will be discussed in details. An overview of internetworking will also be presented to allow the students to have a global picture of how local area networks and wide area networks are interconnected in the real world.

LEVEL 1.2

Databases
Today’s business organisations depend on information systems in virtually all aspects of their businesses. Corporate databases are set up to hold the voluminous business transactions generated by these information systems. This module introduces students to the underlying concepts of database systems and on how to model and design database systems that reflect business requirements. Students will be taught how to analyse data needs, model the relationships amongst the data entities, apply normalisation process to relations and create the physical database. Skills to be taught include data modelling technique, transformation of data model to relations, normalisation technique and SQL (structured query language).

Networking Infrastructure
This module covers basic Local Area Networks (LAN) and Wide Area Networks (WAN) infrastructure including physical cabling system used for an enterprise network, and how hardware platforms such as switches, routers and servers are deployed in typical networks. The module also introduces students to the major networking protocols such as Ethernet, RIP, PPP, OSPF and HDLC, network operating systems and applications that run on LANs/WANs. Students will learn to configure switches and routers, and will be taught the techniques to configure and troubleshoot LANs and WANs.

Operating Systems Fundamentals
This module focuses on the fundamentals and principles of Operating Systems. It explains what general operating systems are and what they do. The module teaches concepts that are applicable to a variety of operating systems such as Windows and Linux. Students will learn about the different number and character representation methods such as binary, hexadecimal and ASCII. Concepts including processes, physical and virtual memory, understanding of files and directories, file systems, shell and OS commands will be covered.
Vulnerabilities 101
This module provides a broad overview of the various security vulnerabilities, threats and attacks in different domains (end-user, physical, data, network, software, system). Common attacks such as social engineering, backdoor, and password cracking will be covered. There will be sharing of real cases of security attacks, and students will learn how these attacks take place and propose mitigation techniques.

LEVEL 2.1
Assembly Language & Python
This module aims to provide students with the knowledge and skills needed to develop simple assembly language programs. Students will learn to use the assembly language emulator such as NASM to execute the assembly language programs. Topics include logic, arithmetic, control transfer, and data transfer instructions, data addressing modes, assembling and linking programs, modular programming, linking to higher level languages and inline assembly. Knowledge of assembly language will help students to write better programs, especially when using high level programming languages. This module also introduces high-level language such as Python. Students will learn to create programs that use expressions, variables, conditionals, loops, arrays, functions, objects and exceptions.

Information Security
This module provides an overview of the various domains of Information security. It aims to provide an appreciation of information security from an end-to-end perspective. This module covers security in seven domains: data, physical, system, network, software, end-user and organisation. Students will appreciate the various aspects of Information security and this will lead them to the more advanced modules such as “Malware Analysis & Antivirus Technologies”, “Ethical Hacking” and “Digital Forensics”.

Server & Cloud Security
This module aims to teach students the concepts and knowledge related to securing web servers and cloud models. It covers topics such as how a web server is installed and optimised securely, the various methods of attacking web servers and the appropriate countermeasures. The specific tools used to test for vulnerabilities in web servers, their applications and databases will also be covered. Cloud security topics will cover introduction to the various delivery models of cloud computing ranging from Software as a Service (SaaS) to Infrastructure as a Service (IaaS). Each of these delivery models presents an entirely separate set of security conditions to consider. An overview of security issues within each of these models will be covered with in-depth discussions of risks to consider.

Secure Software Development 1
Insecure software cost companies data thefts, large fines and regulatory burdens. Therefore, this module and the Secure Software Development 2 module provide students with the knowledge of secure software development lifecycle and the skills needed to develop secure software that is reliable, hacker resilient and recoverable upon disruptions. In this module, students begin with learning foundational concepts of object oriented programming, and web technologies such as HTML, CSS, JavaScript, PHP, and MySQL. Students are then trained to capture the security requirements that need to be designed and implemented in the software. They will learn secure software design, where implementation of several secure design principles and threat modeling are taught. From here on, students will dive into writing secure code that is resilient against injection attacks, cross-site scripting attacks, cross-site request forgery, click jacking, buffer overflows, and phishing attacks, etc. Students will learn how software vulnerabilities can be exploited and how to address the risks.

LEVEL 2.2
Digital Forensics
This module gives an insight to the process of forensics investigation. It covers the various types of computer-related crimes, techniques of gathering electronic evidence, and recovering of deleted, damaged or encrypted data. Students will also make use of advance forensic tools to perform forensic investigation. Besides the tools & techniques of investigation, students will be taught sound forensic investigation methodology and the proper handling of evidence. The module will also cover aspects of law and policies applicable to digital forensics.

Malware Analysis & Antivirus Technologies
This module provides a practical approach to the various techniques in analysing malwares and an understanding the technologies involved in creating anti-virus software. Students will learn behavioural analysis and code analysis techniques for diagnosing malwares. Students will have hands-on practice on using tools such as system monitoring utilities, disassemblers and debuggers. Antivirus technologies such as heuristics detection engine and virus signature creation will also be taught. This module carries a co-requisite: Data Structures & Algorithms (DSA).

Network Security
This module provides an in-depth knowledge on network security in a defensive view. It covers various types of firewall technologies, Virtual Private Networks (VPNs), and Intrusion Detection/Prevention Systems (IDS/IPS). Students will have a chance to configure and deploy state-of-the-art networking devices in a typical computer network. Students will be taught skills to identify the internal and external threats against a network and to propose appropriate security policies that will protect an organisation's information. Students will also learn how to implement successful security policies and firewall strategies in this module.
Data Structures & Algorithms
This module aims to provide students with the knowledge and skills to analyse, design, implement, test and document programs involving data structures. It teaches basic data structures and algorithms within the conceptual framework of abstract data types. The emphasis here is to use the class feature of an Object-Oriented language platform to give the concrete implementation of various abstract data types.

LEVEL 3.1
Mobile Device Security & Forensics
This module covers techniques and tools in the context of a forensic methodology to extract and utilise digital evidence on mobile devices. Students will learn how to use current forensic tools to preserve, acquire & examine data stored in a mobile device. The module covers basic SIM Card examination and cell phone forensics on multiple platforms such as iPhone, Android & Windows Mobile. The module takes a practice oriented approach to performing forensics investigation on mobile phones. This module carries a co-requisite: Digital Forensics.

LEVEL 3.2
Internship and/or Project
This module provides students with the opportunity to apply the knowledge and skills gained to develop an IT solution to solve a practical problem. Students may undertake an in-house Industry-driven project, a Technopreneurship Enterprise project or a real-life IT project in a local or overseas organisation. These projects may include problem definition, requirements analysis, design, development and testing, delivery and presentation of the solution. Through the project, students will learn to appreciate the finer points of project planning and control issues relating to IT project development.

Elective Modules
Secure Software Development 2
This module is a continuation of the Secure Software Development 1 module. Both modules are aimed to provide students with the knowledge of secure software development lifecycle and the skills needed to develop secure software that is reliable, hacker resilient, and recoverable upon disruptions. In this module, students will learn defensive coding techniques and processes, code analysis, code review and compiler security. Students will further learn about secure software testing and how to address the software defects that have been tracked during testing. They are made familiar with some of the tools related to logic testing, penetration testing, fuzz testing, simulation testing, regression testing and user acceptance testing. Students are taught the concepts of software acceptance, where they learn to validate and verify against a set of defined acceptance criteria, the software that is to be released or deployed. Finally, the students will learn secure installation of the software, continuous monitoring, patch management, incident management, problem management and configuration management. They will also learn how to define and enforce the software’s end-of-life criteria that is very essential for secure disposal of the data and the software.

Ethical Hacking
This module aims to develop Penetration Testers for the information security industry. They will be taught to follow a process model to locate and establish targets, find vulnerabilities, exploit the flaws to determine potential impact and business risk with the goal of helping the owner improve security practices. Students will learn the techniques intruders use to hack a system, and the steps to secure it. Students will have hands-on practice on actual pen-testing that involves reconnaissance to map out IT infrastructure, scanning vulnerable systems, and developing attack vectors to exploit loopholes in a system. Students will also be taught the necessary countermeasures to mitigate risks of exploitation through system hardening, intrusion detection and prevention.

Governance & Data Protection
This module examines the relevant frameworks to ensure that information assets are protected within an organisation. It includes the processes and policies for administering and managing a company’s IT systems that follow the compliance framework. Concepts on risk management process, risk analysis and mitigation will also be introduced. Students will learn to evaluate risks against the company’s critical assets and deploy safeguards to mitigate them. Control frameworks such as PCI (Payment Card Industry), ISO 17799/27002, and COBIT will be covered.

Network Forensics
Network equipment, such as web proxies, firewalls, IDS, routers, and even switches, contain evidence that can make or break a case. This module provides students with the knowledge and skills to recover evidence from network-based devices. It will begin with an introduction of different network devices and the type of data that are useful from forensic point of view. It then moves on to the most common and fundamental network protocols that the forensic investigators will likely face during an investigation. These include the Dynamic Host Configuration Protocol (DHCP), Network Time Protocol (NTP) and Microsoft Remote Procedure Call (RPC) protocol. The students will learn a variety of techniques and tools to perform sniffing and log analysis on the network. Commercial and Open Source tools will be used to perform deep packet analysis, SIEM tools such as Splunk will be used to perform log analysis on network devices.
The Diploma in Information Technology (IT) empowers students to become IT professionals, equipping them with problem-solving skills, knowledge of business functions as well as technical skills to harness the power of information and Internet technologies in the digital economy.

This course provides a strong foundation for the development of robust application systems for all types of businesses and industries. Core modules focus on the fundamental knowledge and skills required of IT professionals, including web applications, information systems, software development, computer systems, data communication and network systems, computing mathematics and communication skills.

Students will have the opportunity to develop their competence in integrating various IT technologies with effective IT solutions and applications to solve business problems. Integrated into the curriculum are electives and Interdisciplinary Studies (IS) modules that enable students to widen and deepen their spectrum of knowledge beyond the core modules.

Their perspectives are broadened and an innovative and enterprising spirit is nurtured. This is important for IT professionals working in a complex business environment where problems are multi-faceted in nature and require knowledge and skills in different disciplines. In their final year, students will build upon this solid foundation and specialise in niche areas such as games programming, solutions development, networking, mobile business application, cloud computing, business analytics, infocomm sales & marketing and more. To strengthen their work experience, students will have to undertake an internship in their final year in a relevant industry.

**CAREER PROSPECTS**

Singapore has a vibrant IT industry with many international IT companies based here. Graduates can join the industry as IT professionals who are able to choose from a wide variety of jobs regardless of their specialisation.

The specialisation options also give graduates a head-start in key niche areas such as Business Management, Infocomm Sales & Marketing, Business & Data Analytics, Cloud Computing, Mobile Business Application, Solutions Architect and Games Programming.

Graduates can pursue careers as programmers, application developers and administrators for network systems and the web. They can also become business solutions analysts and designers, software engineers, java specialists, enterprise software developers, mobile business application developers, system engineers, cloud operation engineers, infocomm sales and marketing professionals, business intelligence analysts or information security analysts.

**ENTRY REQUIREMENTS**

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
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</thead>
<tbody>
<tr>
<td>English Language as a First Language</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Any two other subjects</td>
<td>1-6</td>
</tr>
</tbody>
</table>

You must have also sat for a Science or Design & Technology or Food & Nutrition or a relevant OSIE / Applied Subject and fulfil the aggregate computation requirements.

Candidates with severe vision deficiency should not apply for the course.
The Diploma in Information Technology is an internationally recognised qualification. Graduates enjoy advanced standing at many local and overseas universities.

In addition, they gain module exemptions in infocomm-related degree programmes at local universities:

- National University of Singapore: Bachelor of Computing (Honours) in Computer Science or Communications & Media, Bachelor of Computing in Information Systems or Electronic Commerce and Bachelor of Engineering (Computer Engineering)
- Nanyang Technological University: Bachelor of Science (Honours) in Computer Engineering or Computer Science
- Singapore Management University: Bachelor of Science in Information Systems Management
- Singapore University of Technology & Design: Bachelor of Engineering with major in Information System Technology and Design

### COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 1.1 (29 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Computing Mathematics</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals for IT Professionals</td>
<td>5</td>
</tr>
<tr>
<td>Fundamentals of Programming</td>
<td>5</td>
</tr>
<tr>
<td>Networking Fundamentals</td>
<td>5</td>
</tr>
<tr>
<td>Problem Solving &amp; Computing</td>
<td>4</td>
</tr>
<tr>
<td>Innovation Toolkit^</td>
<td>4</td>
</tr>
<tr>
<td><strong>Level 1.2 (27 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Databases</td>
<td>5</td>
</tr>
<tr>
<td>Networking Infrastructure</td>
<td>5</td>
</tr>
<tr>
<td>Object-Oriented Programming</td>
<td>6</td>
</tr>
<tr>
<td>Operating Systems Fundamentals</td>
<td>5</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues^</td>
<td>4</td>
</tr>
<tr>
<td>Sports &amp; Wellness^</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 2</strong></td>
<td></td>
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<tr>
<td><strong>Level 2.1 (25 hours per week)</strong></td>
<td></td>
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<tr>
<td>Developing Web Applications</td>
<td>5</td>
</tr>
<tr>
<td>Management Information Systems</td>
<td>5</td>
</tr>
<tr>
<td>Object-Oriented Analysis &amp; Design</td>
<td>6</td>
</tr>
<tr>
<td>Prescribed/Elective Module^</td>
<td>5</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
<tr>
<td><strong>Level 2.2 (22 hours per week)</strong></td>
<td></td>
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<tr>
<td>Project Management</td>
<td>5</td>
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<tr>
<td>User Experience</td>
<td>5</td>
</tr>
<tr>
<td>Prescribed/Elective Module^</td>
<td>5</td>
</tr>
<tr>
<td>Prescribed/Elective Module^</td>
<td>5</td>
</tr>
<tr>
<td>Prescribed/Elective Module^</td>
<td>3</td>
</tr>
<tr>
<td>Interdisciplinary Studies (IS) elective^</td>
<td>2</td>
</tr>
</tbody>
</table>

In the second year, students may choose to major in a specialisation option. Each specialisation requires the completion of five prescribed modules. Students will also take three elective modules and undergo an internship in their final year.

#### Business & Data Analytics Specialisation
- Big Data
- Business Analytics
- Business Intelligence
- Cloud-based Business Analytics
- Data Visualisation
- Predictive Analytics
- Quantitative Analysis

#### Business Management Specialisation
- Accounting
- Business Process Modelling & Development
- Customer Relationship Management
- Economics
- IT Outsourcing
- Organisational Behaviour
- Principles of Marketing
- Service Management
- Strategic Management

#### Infocomm Sales & Marketing Specialisation**
- Customer Decision Making & Negotiation Skills
- Economics
- Enterprise Business Processes
- Infocomm Business Case Challenge
- Infocomm Sales Life Cycle Management

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## Module Name | Credit Units
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- Infocomm Sales & Marketing Strategies
- Organisational Behaviour
- Principles of Marketing

### Cloud Computing Specialisation
- Business Intelligence
- Cloud Architecture & Technologies
- Cloud-based Business Analytics
- Cloud Computing Security
- Designing & Managing Cloud Databases
- Developing Cloud Applications
- Virtualisation & Data Centre Management

### Mobile Business Application Specialisation
- Advanced Mobile Applications Development
- Advanced Object-Oriented Analysis & Design
- Digital Forensics
- Mobile Applications Development
- Mobile Business Application
- Mobile Device Security & Forensics
- Mobile & Wireless Security
- Wireless Technology
- Secure Software Development

### Solutions Architect Specialisation
- Advanced Object-Oriented Analysis & Design
- C++ Programming
- Data Structures & Algorithms
- Enterprise Applications Development
- Information Security
- Secure Software Development
- Windows Application Development
- Wireless Technology

### Games Programming Specialisation
- Game Production
- Gameplay Programming
- Data Structures & Algorithms
- Maths for Games
- Game Project Development
- Multiplayer Networking
- Artificial Intelligence for Games
- Game Interactivity

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## Notes:
^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/

### IS Modules
The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students’ competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.

^ The prescribed/elective modules and options offered may change from year to year, depending on relevance and demand. They may also include modules available in other diplomas offered by the School.

^ The modules in Levels 3.1 and 3.2 are offered on an interchangeable basis.

** The Infocomm Sales & Marketing option is offered in collaboration with Microsoft Singapore. They provided their expertise on the design, development and delivery of curriculum pertaining to the sales and marketing of infocomm products, services and solutions.

\[ \text{Microsoft Singapore proudly supports the School's commitment to jump-start the process of creating a pool of highly skilled and sought-after professionals in infocomm sales and marketing. Microsoft is a trademark of the Microsoft group of companies.} \]

*** ICT is member of the iPhone Developer University Program. Under this program, the School has incorporated iPhone apps development into its curriculum.

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## COURSE MODULES

### LEVEL 1.1

#### Computing Mathematics
This module introduces the basic concepts of relations and functions, matrices, statistical methods and relevant applications. The main emphasis is to develop students’ ability in solving quantitative problems in computing mathematics, probability and statistics.

#### Fundamentals for IT Professionals
This module gives a broad introduction to the field of IT by exploring the roles, professional practice, ethical expectations and development paths of IT professionals. Students will appreciate the importance of problem-solving skills in providing effective IT solutions. They will see how interpersonal and team working skills can help build relationships with users, facilitate meetings, influence users in requirements definition, and help them participate as effective members of a systems development team.

#### Fundamentals of Programming
This module teaches programming fundamentals, including data types and variables, statements and compound statements, expressions, selection and repetition, simple computation, and use of libraries. Other key topics include the development of test cases and test plans, and providing suitable program documentation, with Java programming language used to illustrate programming concepts. Students will also learn how to apply problem-solving skills and get ample practice in expressing solutions using Java.

#### Networking Fundamentals
The module covers the terminology and technologies in current networking environments and provides a general overview of the field of networking as a basis for subsequent related modules in the course. The topics related to types of networks, network topologies,
network technologies and layered protocol architecture will be taught. In addition, the students will also learn the OSI model as a reference model to understand data networks and understand the commonly used network systems such as Ethernet. The topic on TCP/IP as it forms most of the network architecture will be discussed in details. An overview of internetworking will also be presented to allow the students to have a global picture of how local area networks and wide area networks are interconnected in the real world.

Problem Solving & Computing
This module introduces students to problem-solving techniques, particularly those that are relevant to computing. Topics covered include algorithms, heuristics, search techniques, propositional and predicate logic, logical fallacies and proof techniques (such as proof by contradiction). Students will be introduced to these concepts via recreational puzzles, games and other everyday examples. They will be required to express their thought processes using flowcharts and structured English (i.e., pseudocode), and be shown how their solutions can be expressed using a programming language.

LEVEL 1.2

Databases
This module examines the fundamental principles and concepts of database systems needed to store and structure an organisation’s information and drive its business functions. Students will learn to analyse data and perform data modelling and normalisation, so as to design effective databases using relevant theories and concepts of relational database systems.

Networking Infrastructure
This module covers basic Local Area Networks (LAN) and Wide Area Networks (WAN) infrastructure including physical cabling system used for an enterprise network, and how hardware platforms such as switches, routers and servers are deployed in typical networks. The module also introduces students to the major networking protocols such as Ethernet, RIP, PPP, OSPF and HDLC, network operating systems and applications that run on LANs/WANs. Students will learn to configure switches and routers, and will be taught the techniques to configure and troubleshoot LANs and WANs.

Object-Oriented Programming
This module builds on the knowledge and skills acquired in the Fundamentals of Programming module. It aims to provide opportunities for students to develop medium-scale applications based on the Object-Oriented (OO) approach. Topics covered include Abstract Data Types (ADTs), the implementation of selected ADTs using the OO approach, and suitable sorting and search algorithms. Software robustness and correctness, as well as good programming practices will be emphasised.

Operating Systems Fundamentals
This module focuses on the fundamentals and principles of Operating Systems. It explains what general operating systems are and what they do. The module teaches concepts that are applicable to a variety of operating systems such as Windows and Linux. Students will learn about the different number and character representation methods such as binary, hexadecimal and ASCII. Concepts including processes, physical and virtual memory, understanding of files and directories, file systems, shell and OS commands will be covered.

LEVEL 2.1

Developing Web Applications
This module arms students with the knowledge and skills needed to develop Web applications. Students will learn to use the latest Web technologies such as Microsoft’s .NET framework to develop effective Web applications. Students will acquire the technical skills of server-side programming to create Web-based forms, perform state management, access data, and validate user input.

Management Information Systems
Information systems provide information that organisations require to be effective and efficient. The pervasiveness of information systems in organisations indicates that information plays a critical role in every business function of every industry. Real world understanding of information systems is required by IT professionals in order to integrate technology into the operations of businesses in the increasing digital and networked business world. This module introduces students to the different components that build up an information system and the challenges faced by organisations. Students will learn about the organisations and how the use of information systems affects organisations. They will have a chance to integrate their knowledge in IT with business needs in this module.

Object-Oriented Analysis & Design
This module leverages the skills acquired in Object-Oriented Programming to introduce software design and requirements analysis, so that students experience the full cycle of software development. An overview of various Software Development Life Cycles as well as an in-depth look at software development methodologies will be provided. In particular, students will learn about requirements gathering techniques and the primary artefacts of system design. They will be able to specify, design and document simple software systems using appropriate modelling tools.

LEVEL 2.2

Project Management
In this module, students will learn how to plan and control the various phases in the life cycle of an information systems project. In particular, they will learn
to establish the project charter and develop preliminary plans to facilitate the initiation, execution, monitoring and control and closure of projects. The professional code of conduct and practice issues will be discussed. This module also prepares students to conduct and manage their final-year project in a professional way.

User Experience
This module focuses on the principles and techniques for designing good user experience in software applications and other products such as ATMs, Kiosks, etc. Students will learn to apply business requirement gathering techniques as well as the analysis, design and validation phases of the user experience design life cycle, with emphasis on building empathy with users. They learn to communicate designs through deliverables such as personas, sitemaps and wireframes. Practical hands-on design activities will be guided by concepts such as information architecture, content strategy, formulation of user needs, and the application of design principles in interface, navigation, interaction and usability. The student will apply these concepts and techniques to design and prototype a web/mobile application, and to present and critique design decisions.

LEVEL 3.1
The modules in Levels 3.1 & 3.2 are offered on an interchangeable basis.

LEVEL 3.2
The modules in Levels 3.1 & 3.2 are offered on an interchangeable basis.

Internship and/or Project
This module provides students with the opportunity to apply the knowledge and skills gained to develop an IT solution to solve a practical problem. Students may undertake an in-house Industry-driven project, a Technopreneurship Enterprise project or a real-life IT project in a local or overseas organisation. These projects may include problem definition, requirements analysis, design, development and testing, delivery and presentation of the solution. Through the project, students will learn to appreciate the finer points of project planning and control issues relating to IT project development.

Business & Data Analytics Specialisation

Big Data
This introductory module covers the fundamentals of elements of Big Data: volume, velocity and variety. Students will learn various technologies & tools used to create a big data ecosystem which is able to handle storing, indexing & search. This module also covers the whole technology stack of Big Data: infrastructure, data management and analytics. Tools such as Hadoop, HDFS, and MapReduce will be taught in this module.

Business Analytics
This module allows students to leverage both statistics and data mining techniques for data-driven decision making in various business domains. The goal is to extract knowledge from real business data for actionable insight. Topics covered include data analytics to improve business operations and profits, customer and profitability analysis, applied data mining, social media analytics and text and web mining.

Business Intelligence
This module aims to introduce students to the importance and uses of a data warehouse. Students will be taught analytical techniques and concepts which will equip them with the technical know-how to generate useful reports required by businesses for both analytical and operational usage. Students learn how an organisation's business managers and analysts make better decisions through complicated analysis, data mining, prediction and forecasting.

Cloud-based Business Analytics
This module introduces the key elements of cloud analytics and concepts of building comprehensive, enterprise-scale analytic solutions that deliver actionable insights through industry standard tools. This module also provides an insight into some advance topics such as data mining, data cubes, and dashboard design related to cloud-based databases. The initiatives to bring business intelligence to cloud-based computing, especially software-as-a-service business intelligence (SaaS BI) and cloud-based social media analytics, are also discussed. Students will gain practical experience in Big Data analytics through the use of well-known industry tools such as Analysis Services in Microsoft SQL.

Data Visualisation
This module covers the techniques and tools for creating effective visualisations based on principles from graphic design, perceptual psychology and cognitive science. Students will learn how to process large volumes of data to create interactive visualisations for ease of exploration. Topics that are covered include visualising patterns, proportions, relationships, spatial and temporal elements, and multi-dimensional visualisations.

Predictive Analytics
This module introduces students to the statistical techniques used to make predictions about future trends in business or financial services. Students are taught the assessment techniques that are used to identify risks and opportunities patterns found in historical and transactional data, and to make intelligent decisions by evaluating the prediction models developed using software tools. Topics covered include data mining methods, such as association, classification and cluster analysis, forecasting methods and prediction models.
Quantitative Analysis
This module aims to introduce students the statistical concepts and methods that are used to analyse and interpret business or financial data. Students will be equipped with the technical know-how to formulate statistical models, and make informed decisions by evaluating the statistical models using software tools. Topics covered include frequency distribution, probability distribution, quantitative modelling, correlation analysis and linear regression analysis.

Business Management Specialisation

Accounting
This module covers the basic theory and concepts behind the principles of accounting. It introduces students to the accounting process and the different accounting documents used in typical organisations. Students will learn how to analyse business transactions and financial documents. They will also pick up a basic understanding of the control and accounting for cash, inventories and fixed assets, goods and service taxes, and partnership.

Business Process Modelling & Development
This module equips students with the skills for eliciting, documenting, modelling and analysing business processes within an organisation. Processes in sales, purchasing, inventory management and finance will be discussed and investigated. Students will learn how to use a Business Process Management tool to model and develop solutions that improve process efficiency and quality.

Customer Relationship Management
This module equips students with the knowledge and understanding of Customer Relationship Management and how it benefits organisations. Students will learn about the different usage of CRM in organisation, the various CRM strategies and how to manage customer information to protect privacy of data.

Economics
This module incorporates the study of demand and supply, resource allocation, consumer behaviour, market demand, production and cost theory, price and output of firms under conditions of perfect and imperfect competition. At the end of the module, students will be able to relate the basic concepts and principles of economics to problems and issues.

Strategic Management
The module introduces different perspectives of the role of strategy which contributes to organisational success. The course will examine the concepts, frameworks and techniques that are useful in gaining knowledge of the strategic management process. Case studies will be used to discuss the following topics: strategic analysis, strategic formulation and strategic implementation.

InfoComm Sales & Marketing Specialisation

Customer Decision Making & Negotiation Skills
Students will be introduced to soft skills in understanding customer biases and concerns, building rapport, handling objections, identifying informal and formal decision makers, selling functions/features/benefits, negotiating and closing sales techniques. They will also learn about reference selling and proof of concept as well as pick up presentation and communication skills. The module offers opportunities to role play and develop value proposition in sales calls within the context of ICT.

Economics
This module incorporates the study of demand and supply, resource allocation, consumer behaviour, market demand, production and cost theory, price and output of firms under conditions of perfect and imperfect competition. At the end of the module, students will be able to relate the basic concepts and principles of economics to problems and issues.
Enterprise Business Processes
This module introduces students to the structure of an organisation and relates it to the job responsibilities of each department. The associated business process - from sales, purchasing and inventory management to finance – will be discussed. Students will learn about the flow of information within an organisation and the tight linkages between departments in an organisation. Students will get a chance to be involved in business process modelling to reinforce their understanding of the different roles played by an organisation’s employees.

Infocomm Business Case Challenge
This module introduces groups of students to a case study competition where they would need to build a business solution specific to a client’s business challenges and ICT requirements. Students will pick up the tools and techniques needed to qualify the opportunity, assign team members to develop technical and business proposals, prepare a solution to the case study, and finally present it to a panel of ICT industry experts.

Infocomm Sales Life Cycle Management
This module introduces students to a customer’s ICT purchase decision making process and sales life cycle management. Students will also pick up some fundamental concepts in interpreting customer annual reports, financial ratios, industry analysis and competitive strategies so that they can recognise customer needs and wants. They will follow the sales life cycle from prospecting, qualifying, developing solutions, negotiating and closing the sales to post-sale support and services, up-selling and cross-selling.

Infocomm Sales & Marketing Strategies
This module will introduce students to the concept of market segmentation and the development of sales and marketing strategies for each segment. They will acquire an understanding of industry and customer segmentation from corporate, small and medium businesses to consumers. They will also delve into the different go-to-market strategies and selling techniques required in the context of ICT (such as consultative selling, major account selling and management, territory selling and management, partner management and consumer marketing).

Organisational Behaviour
This module provides insights into the factors that influence individual and group behaviour in an organisation. Students will learn how to use these concepts to improve interpersonal and group interaction skills.

Principles of Marketing
This module presents basic concepts and principles in the marketing of goods and services. Students will learn how products and services are planned, priced, promoted and distributed, and will gain an understanding of the interaction of marketing variables and their impact on marketing decisions.

Cloud Computing Specialisation

Business Intelligence
This module introduces students to the importance and uses of a data warehouse. Students will be taught analytical techniques and concepts which will equip them with the technical know-how to generate useful reports required by businesses for both analytical and operational usage. Students will learn how an organisation’s business managers and analysts make better decisions through complicated analysis, data mining, prediction and forecasting.

Cloud Architecture & Technologies
This module gives insight into the key concepts and technologies of computing which include cloud characteristics, service models (SaaS, PaaS, and IaaS), deployment models (Public cloud, Private cloud, Community cloud, and Hybrid cloud), and the features of cloud computing technologies. It also covers the cloud computing architecture, emerging trends and issues such as clouds for mobile applications, cloud portability and interoperability, scalability, manageability, and service delivery in terms of design and implementation issues. The module discusses the benefits and challenges of cloud computing, standards of cloud computing service delivery, and Service Level Agreement (SLAs) for cloud services. Hands-on activities are included to expose students to various cloud computing services offered by major cloud computing providers such as Amazon Web Services (AWS), Google App Engine (GAE), and Microsoft Windows Azure.

Cloud-based Business Analytics
This module introduces the key elements of cloud analytics and concepts of building comprehensive, enterprise-scale analytic solutions that deliver actionable insights through industry standard tools. Starting with familiar dealing with data in rows and columns, students are gradually introduced to building business intelligence (BI) solutions that help organisations learn about and understand their business. This module also provides insight into some advance topics such as data mining, data cubes, and dashboard design related to cloud-based databases. The initiatives to bring business intelligence to cloud-based computing, especially software-as-a-service business intelligence (SaaS BI) and cloud-based social media analytics, are discussed in this module. Students are exposed to gain practical experience in Big Data analytics using well known industry tools such as Analysis Services in Microsoft SQL.

Cloud Computing Security
This module explores the key threats and risks on a cloud computing environment and how to take operations security controls. Strategies of eliminating or mitigating cloud operations security risks to maintain
a secure cloud environment are introduced. Tools and techniques for data risk identification, monitoring, evaluation, mitigating potential data loss, security breaches and access risks are also discussed in this module. This module discusses various information security strategies such as the use of strong authentication, authorisation, role-based access control, event logging procedures, firewall, port lockdown, and encryption of data at rest and in transit, data replication and backup. Students are also exposed to various information security guidelines for cloud operations, information security standards, security technologies, and potential security issues and best practices.

Designing & Managing Cloud Databases
This module covers analysis, design, and implementation of cloud database models, data management life cycle, and data governance to manage master data. Students will be introduced query languages for cloud database development and best practices for implementing extract, transform and load (ETL) process cycle. The module provides insight into cloud storage components, and data transformation and integration methodologies for data migration into cloud databases. It will further explore laws and regulations governing data access, usage, storage and transmission. The module will also introduce the concepts and technologies of Distributed and Parallel Databases which include their design, structures, theories, algorithms and implementation. Examples of distributed and parallel platforms and frameworks for processing Big Data, such as MapReduce and Hadoop, will be also be discussed.

Developing Cloud Applications
This module covers the analysis of business and technical requirements of a cloud-based system, implementation of a cloud strategy with appropriate programming tools, deployment, and testing and debugging the cloud application. Analysis of business requirements to determine how they can be mapped into a cloud environment is discussed in this module. The module extends its discussion to cloud computing design patterns, best practices, cloud migration issues and considerations. Students are exposed to cloud computing platform such as Windows Azure to get extensive hands-on practice to build, migrate, host and scale web applications and services through the vendor’s data centres.

Virtualisation & Data Centre Management
This module introduces the foundations of virtualisation, creating and managing virtual machines for cost efficiency and agility in delivering IT services. Hands-on sessions are included to give students practical experience in virtualisation tools such as Windows Server and VMWare. It will also explore the impact of virtualisation technologies on cloud database development. The module will then proceed to provide an understanding of basic data centre design principles, physical infrastructure, and a framework for managing a data centre using appropriate tools. Tools and methods for usage metering and billing in a cloud environment are also covered in this module.

Mobile Business Application Specialisation

Mobile Applications Development
This module focuses on the design and development of applications for mobile devices like hand phones, personal digital assistants (PDAs) and handheld computers. Due to the nature of these handheld devices, issues such as memory storage, user interface and data input methods require more careful consideration and planning. At the end of this module, students will be able to develop applications that can run on mobile devices and interact wirelessly with server-side programs.

Advanced Mobile Applications Development
This module builds upon the skills and knowledge that students have acquired from the Mobile Applications Development module. It will focus on the development of advanced applications and emerging mobile operating systems. For example, students could develop applications for industries such as entertainment, games and healthcare. They will learn to develop applications for emerging operating systems such as the iPhone OS and Android.

Advanced Object-Oriented Analysis & Design
This module leverages the core analysis and design skills acquired in the Object-Oriented Analysis & Design module to introduce complex design artefacts, relevant methodologies and the analysis techniques needed to model and document complex software systems. Students will also learn to appreciate the design, deployment and management of complex software systems in relation to the best practices that the industry recommends.

Digital Forensics
This module gives an insight into the process of forensics investigation. It covers the various types of computer-related crimes, techniques of gathering electronic evidence, and recovering of deleted, damaged or encrypted data. Students will also use advanced forensic tools to perform forensic investigations. Besides the tools and techniques of investigation, students will be taught sound forensic investigation methodology and the proper handling of evidence. The module will also cover aspects of law and policies applicable to digital forensics.

Mobile Business Application
This module explores the world of mobile business applications. It gives an understanding of the underlying technologies for mobile commerce and mobile
applications and how mobile applications are not just for the consumer, but can also help a business to grow. Students will also be given an appreciation of the issues in mobile commerce such as mobile payment and security. At the end of this module, students will be able to develop mobile applications on a suitable platform.

Mobile Device Security & Forensics
This module covers techniques and tools in the context of a forensic methodology to extract and utilise digital evidence on mobile devices. Students will learn how to use current forensic tools to preserve, acquire and examine data stored in a mobile device. The module covers basic SIM Card examination and cell phone forensics on multiple platforms such as iPhone, Android & Windows Mobile. The module takes a practice-oriented approach to performing forensics investigation on mobile phones.

Mobile & Wireless Security
This module examines the concepts, techniques, issues and pitfalls relating to mobile and wireless security, including how these techniques may be implemented within an organisation’s plan and policy on security management. Students will be exposed to wireless security technologies in order to gain a better understanding of security controls, and will eventually be able to apply this knowledge to make their applications more secure.

Wireless Technology
This module equips students with a fundamental understanding of wireless communication and networking, including the architecture and technology underlying the different types of wireless networks and applications. Some technology standards such as IEEE802.11, Bluetooth and Wireless Application Protocol (WAP) will also be covered. Students will learn to determine which technology is best suited for a particular application to achieve optimal performance.

Secure Software Development
Insecure software cost companies data thefts, large fines and regulatory burdens. Therefore, this module provides students with the knowledge of secure software development lifecycle and the skills needed to develop secure software that is reliable, hacker resilient and recoverable upon disruptions. In the Secure Software Development module, students begin with learning foundational concepts of object-oriented programming, and web technologies such as HTML, CSS, JavaScript, PHP, and MySQL. Students are then trained to capture the security requirements that need to be designed and implemented in the software. They will learn secure software design, where implementation of several secure design principles and threat modeling are taught. From here on, students will dive into writing secure code that is resilient against injection attacks, cross-site scripting attacks, cross-site request forgery, click jacking, buffer overflows, and phishing attacks, etc. Students will learn how software vulnerabilities can be exploited and how to address the risks.

Solutions Architect Specialisation
Advanced Object-Oriented Analysis & Design
This module leverages the core analysis and design skills acquired in the Object-Oriented Analysis & Design module to introduce complex design artefacts, relevant methodologies and the analysis techniques needed to model and document complex software systems. Students will also learn to appreciate the design, deployment and management of complex software systems in relation to the best practices that the industry recommends.

C++ Programming
This module gives an overview of the syntax of C++ required for object-oriented programming. Students will learn how to implement classes, inheritance, polymorphism and multiple inceptions in C++. An overview of the memory management model of C++ is covered as well as basic i/o operations such as file i/o and standard i/o. The module also covers standard templates such as linked lists, trees and other abstract data types to enable the students to develop large scale C++ programs.

Data Structures & Algorithms
This module aids students in further developing their programming skills and knowledge in software development. Students will be expected to analyse software requirements/problems, and choose, design, and implement appropriate data structures and algorithms to solve the problems. Topics covered include data structures such as arrays, lists, stacks, queues, trees and their associated algorithms within the conceptual framework of abstract data types. The module also introduces students to basic performance measures and algorithms.

Enterprise Applications Development
This module helps students to develop the tools and techniques necessary to undertake the development of enterprise applications based on sound software engineering principles. The module covers the Java Project Life Cycle and introduces the necessary framework to develop enterprise applications. Topics include Java security, electronic commerce, Enterprise JavaBeans (EJB), Extensible Markup Language (XML) and JavaServer Pages (JSP). Students will then undertake, with guidance, a sophisticated real-world enterprise application based on the three-tier architecture model.

Secure Software Development
Insecure software cost companies data thefts, large fines and regulatory burdens. Therefore, this module provides students with the knowledge of secure software
development lifecycle and the skills needed to develop secure software that is reliable, hacker resilient and recoverable upon disruptions. In the Secure Software Development module, students begin with learning foundational concepts of object oriented programming, and web technologies such as HTML, CSS, JavaScript, PHP, and MySQL. Students are then trained to capture the security requirements that need to be designed and implemented in the software. They will learn secure software design, where implementation of several secure design principles and threat modeling are taught. From here on, students will dive into writing secure code that is resilient against injection attacks, cross-site scripting attacks, cross-site request forgery, click jacking, buffer overflows, and phishing attacks, etc. Students will learn how software vulnerabilities can be exploited and how to address the risks.

Windows Application Development
Building upon the Java programming modules, this module introduces additional concepts such as advanced user interface, multi-threading, streams and networking programming. Students will then develop medium to large-scale applications using Java. Appropriate tools and standards, and additional data structures and algorithms will be introduced.

Wireless Technology
This module equips students with a fundamental understanding of wireless communication and networking, including the architecture and technology underlying the different types of wireless networks and applications. Some technology standards such as IEEE802.11, Bluetooth and Wireless Application Protocol (WAP) will also be covered. Students will learn to determine which technology is best suited for a particular application to achieve optimal performance.

**Games Programming Specialisation**

**Game Production**
This module provides an overview of the game development process and introduces game design. Key concepts of game design such as storytelling, game mechanics, level design will be covered. Students will have the opportunity to design and prototype a game using an industry standard game creation system.

**Gameplay Programming**
This module presents fundamental concepts of game implementation and architecture, such as the game loop, game-system component separation, the game state manager, input/output handling and frame rate control. Basic concepts in computer graphics, such as collision detection and back buffering, will also be introduced. Consequently, students will have the opportunity to develop a game prototype without the use of a game engine.

**Data Structures & Algorithms**
This module aims to provide students with the knowledge and skills to analyse, design, implement, test and document programs involving data structures. It teaches basic data structures and algorithms within the conceptual framework of abstract data types. The emphasis here is to use the class feature of an Object-Oriented language platform to give the concrete implementation of various abstract data types.

**Maths for Games**
This module provides an in-depth examination of the various mathematical concepts that are relevant to games programming. Topics covered include vector geometry (e.g., vector arithmetic, dot product, cross product), linear transformations (e.g., rotations, reflections), matrices, trigonometry (e.g., trajectory) and physics (e.g., acceleration/deceleration, gravity).

**Game Project Development**
This module focuses on the creation of a game, either from the ground-up or with the use of an industry-standard game engine. Students are required to work in teams to design, develop and test the game, under the weekly mentorship of a tutor/client. Students are required to demonstrate aspects of teamwork, project planning, game design and good programming techniques.

**Multiplayer Networking**
This module introduces the concepts of multiplayer gaming. Students will learn to write games that can be played in a networked gaming environment. Concepts such as server architectures (client-server/peer-to-peer/hybrid), network latency, server connectivity and quality, security issues and cross-platform compatibility may be covered. Students will also have the opportunity to design and prototype a multiplayer game.

**Artificial Intelligence for Games**
This module introduces the various approaches for injecting intelligence into games. Topics covered include AI architecture (e.g., rule-based systems, finite state machines), movement, pathfinding and planning (both strategic and tactical). AI-related game design issues such as realistic non-player character behaviour and game difficulty will also be taught.

**Game Interactivity**
This module introduces game interactivity and the various game interaction devices to the students. Indicative topics include current and experimental game devices, console usability, player profiling and psychology, measuring playability and testing techniques. Students will be required to research and develop a game prototype demonstrating their understanding of game interactivity.
Electives

Client-Server Programming
Building upon the knowledge and skills acquired in Java programming modules, this module focuses on the underlying concepts of client-server development using commonly deployed databases. The module aims to introduce the building of distributed systems using Remote Method Invocation (RMI) and Java Database Connectivity (JDBC). Students will be expected to develop client-server applications based on the two-tier model.

C Programming
This module covers the constructs and idioms of the C programming language. Examples will be drawn from application domains where C’s strengths are exploited. The module will also expose students to the “pointer based” implementation of various data structures. Topics include memory manipulation and interfacing with the operating system.

Developing Office Applications
This module imparts basic skills in the use of office automation tools. Students are taught to design and create dynamic Web pages that contain information residing in various office application suites, such as spreadsheets and databases. Students will learn to analyse, design and implement integrated solutions based on typical business scenarios in an office environment. As this module is targeted at application developers, students may be expected to write programming code to integrate the various office applications.

Discrete Mathematics
This module aids students in developing the basic skills and understanding of the mathematical principles and techniques required in computing. The notations and concepts taught will enable them to translate actual problems into abstractions, formulate formal descriptions, and reason about their properties in a rigorous way. Topics include set theory, logic, relations, functions, recursion and recursive algorithms, and graph theory.

eBusiness Foundations
In the New Economy, electronic commerce offers functionality and new ways of doing business that no company can afford to ignore. This module provides an understanding of the framework in which eBusinesses operate to help students in their analysis, design and development of eBusiness solutions. Case studies and business examples complement conceptual coverage to provide a real-world context of both successful and unsuccessful implementations of eBusiness.

Internet Computing
In this module, students will develop client/server-based distributed applications using techniques such as Common Gateway Interface (CGI) and applets. They will address the issues of designing and implementing such applications with database accesses using programming languages such as C, Perl and Java. This module requires knowledge of computer networking, Java programming and databases.

Inventory Management
This module introduces techniques used for maintaining minimum stocks of various industries and commercial enterprises at minimum cost. Special emphasis is given to areas within the supply chain where cost of operations could be minimised through efficient management of inventory. An analysis of different inventory policies and the use of basic techniques in forecasting and simulation relevant for inventory management are also included.

Mobile Operating Systems
This module surveys the various mobile operating systems (OS) in the market, with a focus on the fundamentals of mobile OS and how they differ from those of conventional desktop OS. The module will also touch on some mobile development platforms. Students will learn to explain the characteristics and functions of the operating systems, which will be useful when they start developing mobile applications using the various platforms available.

Principles of Management
This module gives students an understanding of basic management principles and practices. Students will learn how managers plan, lead, organise and control activities and resources in organisations, as well as how change management, innovation and creativity enhance organisational performance.

Professional Issues
This module addresses social, legal and ethical issues faced by IT professionals. Students will learn critical thinking skills that will help them deal with ethical dilemmas likely to arise in working life. Through storytelling, case studies and workshops, students will discover value systems and how these influence moral decisions.

Programming Wireless Applications
This module highlights the development of applications for small devices such as smart cards, personal digital assistants (PDAs), mobile phones and pagers, all the way up to the set-top box. Students will acquire knowledge and hands-on experience in the client- and server-side Java software development of wireless applications. An emphasis is placed on converting concepts into software practice, with reinforcement by the development of a small client-server wireless application.
Research Studies
This module gives students an opportunity to research and present a topic on IT and its applications. Each student will be assigned a supervisor well versed in the selected topic of research and will undertake research work in consultation with the supervisor. At the end of the research period, the student will submit a report and present his findings to fellow students.

Supply Chain Management
This module introduces the concept of a supply chain and its importance in strategic management. It provides students with an understanding of key processes in managing eBusiness transactions and the use of information technology for effective supply chain management.

Technopreneurship
The rapid emergence of new infocomm technologies is empowering new capabilities as well as opportunities for creativity and entrepreneurship. This module focuses on the processes and mechanisms by which new ideas and inventions can be commercialised in the market. Students will examine case studies of real-world examples of technopreneurship. They will also learn about the issues and challenges of transforming a technological innovation into a successful product or service in the market place.

Web Database Development
This module builds upon the Databases and eCommerce Application Development modules to expand students’ knowledge and skills at developing a Web database for eCommerce applications. The module explores database tools and techniques used in the development of Internet-based transaction systems that require concurrent access to multi-user databases for data and information. Students will also learn the concept of database concurrency and integrity in the context of a web database for eCommerce.

Web Development & Administration
The module provides students with an understanding of the concepts and techniques behind developing typical web-based applications such as a Content Management System (CMS). Students will gain hands-on experience developing these types of applications, primarily using open source web development tools. They will also be equipped with the skills needed to administrate and maintain for web servers.

Web Server Administration & Security
This module equips students with the skills needed to plan, install and maintain websites and web servers. It will discuss issues such as Internet organisation and administration, website security, and server performance. Students will also cover Internet naming and addressing, website planning, web server installation and configuration, and website security.

Wide Area Networks
This module gives a broad overview of the wide area networking industry as well as details of various telecommunications and data networking topics. Introducing telecommunications concepts (point-to-point, multi-point and packet switch services) and components used to build wide area networks (WANs), this module also covers the protocols used to transport voice and data over wide areas. These include the Integrated Services Digital Network (ISDN), frame relay, Asynchronous Transfer Mode (ATM), and Synchronous Optical Networking (SONET).

Windows Programming using Visual C++
This module equips students with the knowledge and skills needed to develop Windows applications and components using Visual C++. Additional language constructs, libraries and tools will be introduced. This module also covers basic concepts and principles in the marketing of goods and services so that students gain an understanding of the interaction of marketing variables and their impact on marketing decisions. Students will also gain an understanding of the new modular software architecture – Component Object Model (COM).
The Diploma in Multimedia & Animation (MMA) is a practice-oriented course that provides students with strong design and programming fundamentals in the first year and discipline-specific core skills in the second year when they pursue a specialisation in either Game Art & Design or Interactive Art & Technology.

The Game Art & Design specialisation trains students to conceptualise, design and create an interactive entertainment experience as well as game assets – digital 3D game environment and game characters, sci-fi, surrealism or fantasy. Students will be well-versed in game design theory and game level design, and able to pick up new game engine scripting languages independently to design and script the gameplay and player interaction of any games. This specialisation prepares students for a career in game level design, digital 3D modelling and design of the characters, environments, buildings and settings for games.

The Interactive Art & Technology specialisation teaches students to conceptualise, design and develop media-rich interactive applications for a wide range of digital technologies, from web, 2D and 3D interactive platforms, to mobile devices such as iPhone and iPad. The aim is to train graduates who are competent in both art and technology, and human-centred design theories and skills. Students will be prepared for a career in concept art, visual interface design, and interactive experience design and development.

In the final year, students undertake a year-long production in ICT's Amphibi StudioTM to further develop their expertise and the spirit of innovation and enterprise.

Integrated into the curriculum are electives and Interdisciplinary Studies (IS) modules that enable students to widen and deepen their spectrum of knowledge beyond the core modules. Their perspectives are broadened and an innovative and enterprising spirit is nurtured. This is important for MMA professionals working in a complex business environment where problems are multi-faceted in nature and require knowledge and skills in different disciplines.

**ENTRY REQUIREMENTS**

To be eligible for consideration, candidates must have the following GCE ‘O’ Level examination (or equivalent) results.

<table>
<thead>
<tr>
<th>Subject</th>
<th>‘O’ Level Grade</th>
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<tbody>
<tr>
<td>English Language as a First Language</td>
<td>1-7</td>
</tr>
<tr>
<td>Mathematics (Elementary/Additional)</td>
<td>1-6</td>
</tr>
<tr>
<td>Any two other subjects</td>
<td>1-6</td>
</tr>
</tbody>
</table>

You must have also sat for a Science or Design & Technology or Food & Nutrition or a relevant OSIE / Applied Subject and fulfill the aggregate computation requirements.

Candidates with hearing deficiency or severe vision deficiency should not apply for the course. Those with colour vision deficiency may be considered, subject to passing an in-house test.

Students are required to own a MacBook and purchase art materials.

**CAREER PROSPECTS**

MMA graduates can apply for jobs in game and interactive art pre-production and production. They can look forward to an exciting career as a game level designer, game interface designer, concept artist, 3D game environment artist, interactive experience designer/developer, visual interface designer, web designer, and graphic designer. Graduates can also work in the creative and design aspects of IDM-related projects.
ACCREDITATION FOR FURTHER STUDIES

The Diploma in Multimedia & Animation is recognised by both local and overseas universities, which offer advanced standing to our graduates. MMA graduates can pursue further studies in the creative field with universities such as:

- National University of Singapore: Bachelor of Arts in Communications & New Media
- Nanyang Technological University: Bachelor of Fine Arts in Art, Design and Media
- Digipen Institute of Technology (Singapore): Bachelor of Fine Arts in Production Animation, and Bachelor of Arts in Game Design
- Royal Melbourne Institute of Technology (Australia): Bachelor of Arts in Animation & Interactive Media, Multimedia or Games Graphics Design
- Sheridan College (Canada): Bachelor of Applied Arts in Animation
- Savannah College of Art & Design (USA): Bachelor of Arts or Bachelor of Fine Arts in Interactive Design & Game Development

### COURSE CURRICULUM

<table>
<thead>
<tr>
<th>Module Name</th>
<th>Credit Units</th>
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<tbody>
<tr>
<td><strong>YEAR 1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Level 1.1 (26 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Drawing &amp; Perspective</td>
<td>4</td>
</tr>
<tr>
<td>Fundamentals for Creative Professionals</td>
<td>2</td>
</tr>
<tr>
<td>Light, Colour &amp; Design</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Animation</td>
<td>4</td>
</tr>
<tr>
<td>Principles of Programming</td>
<td>4</td>
</tr>
<tr>
<td>Storytelling &amp; Scriptwriting</td>
<td>4</td>
</tr>
<tr>
<td>Innovation Toolkit(^\text{^})</td>
<td>4</td>
</tr>
<tr>
<td><strong>Level 1.2 (24 hours per week)</strong></td>
<td></td>
</tr>
<tr>
<td>Figure Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Problem Solving &amp; Programming</td>
<td>4</td>
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<tr>
<td>3D Form &amp; Space</td>
<td>4</td>
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<tr>
<td>Tone, Colour &amp; Composition</td>
<td>4</td>
</tr>
<tr>
<td>Storyboarding</td>
<td>4</td>
</tr>
<tr>
<td>Communication &amp; Contemporary Issues(^\text{^})</td>
<td>4</td>
</tr>
<tr>
<td>Sports &amp; Wellness(^\text{^})</td>
<td>2</td>
</tr>
<tr>
<td><strong>YEAR 2</strong></td>
<td></td>
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<tr>
<td><strong>Level 2.1 (24 hours per week)</strong></td>
<td></td>
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<tr>
<td>Anatomy for the Artist</td>
<td>4</td>
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<tr>
<td>Elective Module</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective(^\text{^})</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective(^\text{^})</td>
<td>2</td>
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<tr>
<td><strong>Level 2.2 (24 hours per week)</strong></td>
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<tr>
<td>Concept Art &amp; Illustration</td>
<td>4</td>
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<tr>
<td>Elective Module</td>
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<tr>
<td>Interdisciplinary Studies (IS) elective(^\text{^})</td>
<td>2</td>
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</tbody>
</table>

**Game Art & Design Specialisation**
- 3D Animation for Games
- 3D Modelling for Games
- 3D Character Rigging
- 3D Environment Modelling
- Advanced 3D Modelling
- Advanced Game Mechanics
- Architectural Spaces, Design & Lighting
- Digital Audio Design
- Game Level Design
- Game Mechanics
- Simulation Game Production
- Texture & Shading

**Interactive Art & Technology Specialisation**
- 3D Modelling & Animation for Games
- Authoring Interactive Experience
- Designing User Experience
- Designing Visual Interface
- Developing Mobile Experience
- Developing Rich Media Applications
- Digital Audio Design
- Digital Effects
- Digital Imaging
- Digital Photography
- Digital Video & Audio
- Interactive Entertainment Production
Notes:
^ For more details on Interdisciplinary Studies (IS) electives, please log on to www.np.edu.sg/is/

IS Modules
The School of Interdisciplinary Studies (IS) delivers a broad-based curriculum, which nurtures a new generation of professionals with multidisciplinary skills and an innovative and entrepreneurial spirit to meet the challenges of a knowledge economy. IS offers both prescribed modules and electives to challenge boundaries. Prescribed modules develop students’ competencies in core areas such as Communication, Innovation and Enterprise, Culture and Communication, and Personal Mastery and Development, while elective modules provide insights into Arts and Humanities, Business, Design, and Science and Technology.

** The elective modules offered are reviewed regularly and subject to updates to ensure relevance to the industry needs and the sequence of module offering may change as deemed fit.

COURSE MODULES
LEVEL 1.1

Drawing & Perspective
This module introduces drawing from observation. The emphasis is on developing the student’s understanding of the formal elements of drawing, perspective, composition, and other perceptual concepts. It introduces line, value, composition, linear and atmospheric perspectives, expressive mark making, and also explores the basic professional habits in drawing practice.

Fundamentals for Creative Professionals
This module aims to provide students with a broad introduction to the interactive and digital media industry. Students gain a good understanding of the critical success factors, professional roles and career development paths within the industry, professional practices and ethical expectations.

Light, Colour & Design
This module explores the fundamental elements and processes of organising, displaying, and communicating ideas and information creatively to the minds of the intended audience through two-dimensional form, colour structure, and composition. It introduces the elements and principles of design, visual organisation, visual perception and communication theory. Emphasis is on concept development, problem solving, and creative process relevant to visual communication.

Principles of Animation
This module introduces the language and principles of classical animation through analysis and decomposition of movement frame-by-frame. Students will discover the importance of effective timing and spacing, and how their manipulation can affect the feel of an action.

Principles of Programming
This module introduces software development with emphasis on the process and programme design. It advocates the object-oriented way of thinking, a systematic way of problem solving of multimedia applications. It covers the three programming constructs, introduces data types and variables, and a variety of data structures and algorithm design. Other key topics include project management, debugging, development of test cases and test plans, and programme documentation as part of software quality management and assurance.

Storytelling & Scriptwriting
This module explores the nature of storytelling and exposes students to the historical traditions of storytelling in all forms. It introduces the essential components in a compelling story and the techniques to create story that will hook the audience and keep them emotionally involved, and explores at the more subtle elements of story. This module also introduces practices in screenwriting such as characterisation, narration, dialogue, script forms, and alternatives.

LEVEL 1.2

Figure Drawing
This module introduces the concepts and techniques of figure drawing. It provides students a thorough understanding of the structure and anatomy of the human figure, and how the underlying skeletal structure can affect the surface appearance of the body. It aims to develop students’ ability to create drawings that communicate the dynamics of the body structure and movement.

Problem Solving & Programming
Building upon knowledge learnt in Principles of Programming, this module covers the object-oriented design and programming concepts for interactive media applications. It shows how programs can be decomposed into classes and objects. The focus of this module is on developing appropriate data structures and algorithms to handle programming jobs.

3D Form & Space
This module develops students’ ability to perceive objects in three-dimensional space and to translate a two-dimensional form into three-dimensional volume, mass, space, and structure. It introduces the basic elements, principles, materials and methodologies of three-dimensional design. Working with both physical medium and digital tools, students explore the use of basic materials, elements and principles of design, basic abstract components to build three-dimensional form that accurately depict its measurement and proportion.

Tone, Colour & Composition
This module explores the nature and use of tone, colour, and composition in drawing. It emphasises methods of creating tone, ways to use luminance as an
organisational element, and stresses on the importance of thinking critically. In addition, the module introduces a variety of classical tonal systems and tonal illusions. The module covers systems and traditions of organising hue and saturation, and examines methods of building from tonal preliminary studies. Students will explore the artistic use of colour, and the classical forms of compositional organisation.

Storyboarding
This module explores the pre-production skills of storyboard art. It introduces the concepts of storyboard drawings, which map out camera angles, continuity, and lighting. Students learn about the basic of film grammar through the analysis of scripts, character, and set design, and translate these through drawings to create story flow, character development, mood, time, and place. Students will create both production and presentation storyboards.

LEVEL 2.1
Anatomy for the Artist
This module explores the skeletal and muscular structures of the human body, and how these anatomical elements function to create movement, attitudes and poses from head to toe. It also gives a comparative study of the human structure and the structure of a variety of animal types. Students will apply the understanding of the anatomy to drawing human and animal figures from direct observation.

LEVEL 2.2
Concept Art & Illustration
This module introduces character design and world development. It emphasises the importance of research, planning, exploratory sketches, and visual treatment in concept development of characters, props, machines, and environments that are unique and memorable. Emphasis is on the creative process with visual idea development, from roughs to clean tonal work as well as mastery of the digital technologies. It covers illustration, perspective, light, tone, colour and composition, research and basic techniques.

LEVEL 3.1
Concept Development
This module introduces various idea generation and concept development techniques. Students learn the pre-production skills of concept illustration and visual development through the application of knowledge skills in drawing, storytelling and composition to communicate the concept effectively to an audience. Emphasis is placed on the creation of original, unique and useful concepts. Students will produce a range of proof of concept collaterals.

LEVEL 3.2
Internship / Final Year Project
The primary aim of this final year industry-based project is to nurture the spirit of innovation and enterprise in students and broaden their experience beyond classroom learning. It also provides students with the opportunity to apply the knowledge and skills gained in the past semesters. Using the demo program prototyped in the earlier semester under the Concept Development module, students will develop the idea into a full working product. Local or overseas internships are possible.

Game Art & Design Specialisation

3D Animation for Games
This module develops students’ 3D game animation skills on various biped/human characters. It continues to develop students’ understanding of the concepts of motion and body mechanics, and aim to develop students’ ability to create convincing movement, expression of mood, thought, attitude, and personality in the characters with a goal to bring the characters to life. It also gives a brief introduction to acting and dialogue elements in an animation.

3D Modelling for Games
This module covers modelling techniques used for building organic and hard surface objects and environments. The skills include analysing a concept drawing; breaking it down into model elements; optimising the model to minimise mesh complexity in order to reduce render times; and simplifying the mesh. It explores the techniques in polygon, NURB, and subdiv modelling as well as deformations, texture mapping, lighting, cameras, rendering, and MEL scripting.

3D Character Rigging
This module deals with issues relating to character modelling, rigging and setup based-on production requirements. Students will be presented with various character setups and explore appropriate modelling and rigging solutions for their own characters. Topics include skeletons, forward/inverse kinematics and custom control panels. Students will acquire the ability to set up a character for a wide range of complex body movement, with an emphasis on techniques for creating controls, which are realistic, flexible and can be intuitively animated.

3D Environment Modelling
This module provides the opportunity for students to create architectural interior and the natural environments representing houses, buildings, and entire worlds contained under a roof, in which to place the game characters. It explores and integrates design and technology to develop matte paintings, virtual sets and digital backgrounds. Students acquire the knowledge and practical skill sets for digital matte painting production.
Advanced 3D Modelling
This module continues to build on students’ 3D modelling skill through creation of hyper-realistic models. Subjects like bipedal characters and creatures will be tackled through the balance application of anatomy and technical efficiencies. Students will learn to fuse the traditional art of sculpting organic form with digital modelling techniques. It covers the use of anatomy as it pertains to modelling and speaks of the technical needs for creating quality in deformable and detailed surfaces.

Advanced Game Mechanics
This module continues to introduce game mechanics, and examines the game mechanics of various genres of published electronic games to find out what drives the gameplay. It also covers the most common types of game balance in games, and examines the structure of interactive stories and branching dialogue, and how various puzzles are incorporated into interactive stories. Students learn to write game design documents, project and production plans and pitch the concepts.

Architectural Spaces, Design & Lighting
This module introduces students to the aesthetics and principles of 3D environment design for the theatrical sets, landscapes, terrain, objects, and architectural structures. It covers a survey of world architectural styles together with the concepts on how to blend the emotion, mood, lighting, shadows, aesthetics and flow into the design of the architectural structures. It also covers texturing, spatial design, negative space, dramatic lighting, and other concepts that affect not only the psychology of level design but also gameplay principles.

Digital Audio Design
This module introduces the production techniques of audio and sound effects, ambient sounds, background music and dialogue to enhance the user experience and/or to advance a story and create mood, place, and emphasis. It covers its associated technologies, the equipment used, the procedures and explores the manipulations of various envelopes on amplitude, filter and modulation and the use of low frequency oscillator and noise in designing sound. It also covers subtractive synthesising, and studies the processing and reactions of sounds in an interactive environment.

Game Level Design
This module introduces the concepts and principles of game level design. It takes students on a creative journey using a 3D game engine that starts at a conceptual beginning and arrives at a polished end. Through this journey, students will learn the process of designing compelling worlds that immerse the player in interactive environments. It introduces the game engine technology, game loop, clock, modular coding, and the use of art, sound effects and music in games. Students will create fully functional levels for a game genre.

Game Mechanics
This module studies game mechanics – the rules intended to produce enjoyable gameplay – and introduces the principles and methodologies behind the rules and play of games. It first studies board and card games, and examines what make these simple games enjoyable. It allows students to apply the game design concepts to arcade-action games, produce game prototypes, and conduct focus groups to gather feedback on their design.

Simulation Game Production
This module introduces the simulation game development industry, the production pipeline, and various professional roles and career paths, and exposes students to the game production documents. It examines the roles of different participants in the development process and how the technical development and the artistic development proceed in tandem.

Texture & Shading
The module introduces materials, texture and lighting strategies to add detail and realism to objects. It introduces different types of shaders and maps, and covers the tools and techniques for the creation of custom 2D texture maps. Students learn about different artistic styles, levels of craftsmanship, repetition structures, and tile-able and seamless motifs, with grounding in traditional painting. Texture mapping techniques will also be explored with emphasis on manual UV unwrapping.

Interactive Art & Technology Specialisation

3D Modelling & Animation for Games
This module examines the techniques of creating and animating 3D digital models using a 3D graphic and animation package. It provides an overview to the process of digital asset creation, such as modelling, texturing, shading, lighting, rigging and animating. Emphasis is placed on professional habits and the digital workflow.

Authoring Interactive Experience
This module aims to develop students’ ability to create engaging and experience-rich interactive applications. Students learn how to author high-impact interactive experience that is rich with video, graphics, text, audio, and animation using an authoring tool for various purposes, in particular for animation, visual effects and multimedia.

Designing User Experience
This module introduces experience design from information, interaction and sensorial perspectives. Students learn how to design sustained user immersion,
experience and emotion by striking a balance between forms, functions, usability and aesthetics. The cognitive aspects of engagement and psychological aspects of play or experience are discussed. This module also introduces the interactive media production within the context of a small production pipeline. Students take projects from concept to completion. Emphasis is placed on teamwork and organisational skills.

Designing Visual Interface
This module introduces the visual design process, and explores both the aesthetic and information components associated with creating effective human-computer interfaces. It covers key principles and techniques of creating aesthetically pleasing visual interfaces for digital presentations. It covers information design concepts, copywriting, and human perception and cognitive principles, and studies how to present complex information crisply, clearly and concisely, and how to create the message for branding.

Developing Mobile Experience
This module introduces various mobile digital technologies and its unique characteristics and features. It also aims to further develop the programming skill of students using the programming language of the mobile technology. The module focuses on the specific and core features of a mobile technology that will give rise to fun, rich and engaging mobile experiences such as the accelerometer, GPS, magnetometer, advanced multi-touch gestures and modern user interfaces.

Developing Rich Media Applications
This module provides students with the knowledge and skills needed to develop rich media applications with a database at the back end for any platform, be it Internet, mobile or TV. It examines various client-server architectural concepts that come with a rich client, an application server, and database. Students learn to do client- as well as server-side programming, and basic multi-users database connection and access. The module aims to introduce building of distributed systems using the remote method invocation services provided by the server technologies.

Digital Audio Design
This module introduces the production techniques of audio and sound effect, ambient sounds, background music and dialogue to enhance the user experience and/or to advance a story and create mood, place, and emphasis. It covers its associated technologies, the equipment used, the procedures and explores the manipulations of various envelopes on amplitude, filter and modulation and the use of low frequency oscillator and noise in designing sound. It also covers subtractive synthesising, and studies the processing and reactions of sounds in an interactive environment.

Digital Effects
This module gives an overview of how to create creative visual effects for motion graphics. It covers methods of composing computer-generated imagery and live images, along with layering, keying and matting, effects creation, motion control and tracking, film and lighting effects, image manipulation, retouching, colour correction, painting, stabilisation and rotoscoping.

Digital Imaging
This module explores and focuses on the electronic and creative conceptual design, image and digital colour manipulation, and illustration for digital art. It teaches students to creatively use best existing tools to create the intended effects given any creative concept. It requires students to be able to read and interpret the creative brief and requirements.

Digital Photography
This module aims to develop students’ ability to visualise, plan, compose imagery and, see all things creatively through digital photography. It focuses on developing students’ ability to observe and attend to details swiftly while introducing the mechanics of the digital camera, and the art and techniques of digital photography. It also covers the history of photography, visual thinking, composition techniques, creative effects, lighting, digital workflow, black and white photography, and studio photography.

Digital Video & Audio
The module introduces creative video production and editing methods and its practices of TV commercial and corporate video. It covers the technology, equipment, and techniques of digital video production and postproduction that includes camera, lighting, editing, effects and transitions and the techniques of combining computer-generated imagery with audio, voice narration and sound. It also provides an overview of the various compression strategies and codec used in the production and distribution of digital audio and video content.

Interactive Entertainment Production
This module introduces the interactive digital media industry, the production pipeline, and various professional roles and career paths, and exposes students to various document required in the production of interactive experience. It examines the roles of different participants in the development process and how the technical development and the artistic development proceed in tandem.