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Established in 1998, NUS School of Computing (SoC) is Asia’s leading computing school, with an excellent record of nurturing research-driven and enterprising graduates who thrive in various sectors of the economy. From biomedicine to finance and various high-tech industries, it counts among its alumni chief executives and technology architects of multinationals, government agencies, and flourishing start-ups.

SoC comprises two academic departments and is home to 2,000 students, with a quarter of them pursuing graduate studies. Through a well-rounded curriculum taught by a distinguished faculty, its students are empowered to be innovation drivers who are capable of making the world a better place.

The School inculcates in its students computational thinking and life-long learning skills, equipping them with the right balance of scholarly excellence, professionalism, and soft skills. SoC's graduates are highly sought after. Leading computing companies such as Facebook, Google, and Microsoft send recruiters to them to recruit for their engineering centers worldwide. SoC's graduates play a pivotal role in Singapore's effort to improve productivity and streamline government, and to become a leading center for various industries such as finance, logistics, media, and technology.

The School offers undergraduate degree programmes that are undergirded by strong grounding in the fundamentals of computer science, covering four main areas of specialisation: computational biology, business, computer engineering and digital media. We also offer graduate degree programmes by coursework or research, with greater intensity in focus within these areas of specialisations.

The curricula are designed according to the recommendations of the Association for Computing Machinery (ACM), the Association for Information Systems (AIS), and the Computer Society of the Institute of Electrical and Electronic Engineers (IEEE), which are the foremost authorities in the field of computing. Consequently, the knowledge units that are to be imparted within the curricula are recognised internationally, the practices instilled are sensitive to industrial development, and the pedagogy espoused adheres to tertiary IT education standards worldwide.

The research initiatives at SoC are supported by a number of research laboratories and centres within the School. Fitted with equipment that is funded mainly by research grants, the laboratories and centres provide a common space for people with similar interests to exchange ideas and work together informally.

The School is governed by the Executive Committee, and operates in consultation with an Industry Advisory Board.

Educational Philosophy
The programmes offered by the Department of Computer Science are founded on a wide variety of disciplines, with the goal of producing computer scientists who can integrate computing-related theories and practices, recognise the importance of abstraction, and appreciate the value of good engineering design.
These programmes seek to prepare students for lifelong learning that will enable them to move beyond today's technology to meet the challenges of the future. Furthermore, they include professional practices as an integral component of the undergraduate curriculum. These practices encompass a wide range of activities including management, ethics and values, written and oral communication, and team work.

The programmes offered by the Department of Information Systems are multidisciplinary in nature. In addition to providing students with a strong foundation in computer science, these programmes also give students the benefits of learning from other disciplines, such as business studies and economics. The modules required by these programmes reflect their objectives, which are to train graduates who are able to develop and manage business information systems and who understand how Internet technology can be deployed in business and organisations. Consequently, students are given the wide option of taking less technical, more business-oriented modules offered by the Department as well as the School of Business.

The School has also gained recognition from ABET Inc., the world respected US-based accreditation agency, for its Computer Science programmes. The agency certified that the programmes are “substantially equivalent” to accredited programmes in the United States, which is the standard status that the agency offers to universities outside the United States.

Please refer to: http://www.comp.nus.edu.sg for up-to-date information on the School.
## Key Contact Information

For more detailed information, please visit the School's website at: [http://www.comp.nus.edu.sg](http://www.comp.nus.edu.sg)

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3 Undergraduate Education

The School of Computing aims to provide a sound and forward-looking education to equip graduates for careers in IT and related fields. To this end, our courses integrate problem-solving skills with a foundation in IT and business. Graduates will be able to integrate new technology and develop themselves into future IT leaders, and to proceed to further studies.

The School offers direct entry to four-year undergraduate degree programmes, designed to meet the needs of distinct segments of the IT job market, and to better serve students with different interests, background, abilities and career orientation. Four-year programmes are designed to educate tomorrow’s technical leaders who will pioneer the development of novel technology. The programmes emphasise in-depth mastery of the scientific, engineering and organisational foundations that underlay the continuing progress in information and communications technologies and their applications. The maximum candidature period for a four-year programme is five years.

3.1 Degrees Offered

The School of Computing offers five full-time Bachelor of Computing programmes, leading to:

- Bachelor of Computing in Computational Biology;
- Bachelor of Computing in Computer Science;
- Bachelor of Computing in E-Commerce;
- Bachelor of Computing in Information Systems; and
- Bachelor of Science in Business Analytics

Its Department of Computer Science jointly offers the following full-time Bachelor of Engineering programme with the Department of Electrical and Computer Engineering, Faculty of Engineering:

- Bachelor of Engineering in Computer Engineering

The School also offers a wide array of minors and special programmes to full-time undergraduate students to provide more breadth and depth in their studies.

Please refer to our School’s web page at: http://www.comp.nus.edu.sg/undergraduates for the latest details on the degree programmes.

3.2 Degree Requirements

3.2.1 Programme Structure

The overall degree requirement is based on Modular Credits, with at least 160 Modular Credits (MCs) for the four-year programmes. To graduate, a student must obtain a Cumulative Average Point (CAP) of not less than 2.00.

Each programme consists of modules divided into three main categories:

1. Programme Requirements
2. University Level Requirements (ULR)
3. Unrestricted Electives

A module can only be counted towards one category. No double counting is allowed.

University Level Requirements, which comprise about 12.5% of the total MC requirement, include General Education, Singapore Studies and Breadth electives:
There are two subject groups, within which GEMs are placed, namely,
1. Subject Group A: Science and Technology; and
2. Subject Group B: Humanities and Social Sciences.

Students will be required to read at least one GEM from Subject Group B. Each GEM is worth 4 MCs. To facilitate the broadening of knowledge, the GEMs which students select to read should not be those cross-listed with their declared major/minor areas.

Students need to read one Singapore Studies module. Singapore Studies modules carry the SS prefix in their module codes. Students should ensure that they do not register a cross-listed module bearing the GE code for fulfilment of the SS requirement.

All SoC students (in BComp ad BSc in Business Analytics programmes) matriculating in AY2014/15 onward will be required to read one module from a list of approved General Education modules with substantial communication content.

For students pursuing a Bachelor of Computing programme, the Breadth electives must be from outside the School of Computing. For students pursuing the Bachelor of Engineering (Computer Engineering) programme, the Breadth electives must be from outside both the Faculty of Engineering and School of Computing.

Unrestricted Electives enable students to pursue their academic interests and aspirations. Students may also use Unrestricted Electives to satisfy partially or wholly the requirements of other programmes. As long as the appropriate prerequisites are met, students can satisfy the Unrestricted Electives requirement by taking modules from any of the Departments/Faculties at any level.

The limit on the number of Level-1000 modules to be counted towards fulfilment of graduation requirements is 60 MCs for 160-MC programmes for students admitted from AY2007-8 onwards.

For students admitted from AY2007/8 onwards, the maximum candidature for:
1. a Bachelor with Honours degree with a minimum of 160 MCs is five years; and
2. a typical double degree programme (which may involve between 180 and 200 MCs) is six years.

Students in the Computational Biology programme must check the special requirements for fulfilment of Unrestricted Electives.

Programme Structure for Bachelor of Computing

Industrial Experience Requirement

Degrees offered by both the Department of Computer Science and Department of Information Systems will require 12 MCs of industrial experience content. Students with Polytechnic Diplomas who have completed internship during polytechnic study are exempted 6 MCs of Industry Experience Requirement and only need to complete 3-month internships through CP3201 Internship II (6 MCs) if they are enrolled for programmes in the Department of Computer Science. The 6-MC internship exemption for polytechnic graduates is awarded in recognition of their internship experience done during the polytechnic study. These exemptions will be diploma specific as not all diplomas include internships and will be done as part of the Advance Placement Credits granted for the programme requirement.

CP4101 B Comp. Dissertation
Students in the Department of Computer Science who aim for high distinction must pass the CP4101 B.Comp. Dissertation. Students with CAP of 4.0 or higher at the end of their fifth semester of undergraduate study may opt to replace the Industry Experience Requirement by B.Comp Dissertation (12 MCs). Students doing double degrees, concurrent degrees and CS special programme (except Turing Programme) and other students with CAP of 4.0 or higher, may opt to replace Industry Experience Requirement by B.Comp. Dissertation.

Programme selection or course transfer

Before the end of two semesters of studies, students will select their appropriate programmes from their respective department based on their interests, career orientations and the results of the modules taken. They are allowed to apply for transfer among different Bachelor of Computing programmes within a department during the first year of studies.

Transfer of programmes between the two departments: Computer Science and Information Systems follows the course transfer procedure administered by the NUS Office of Admissions at: http://www.nus.edu.sg/oam. Students may request to be transferred into the Bachelor of Engineering (Computer Engineering) programme at the end of the second semester. Success of transfer will depend on the quota available in the targeted programme and the academic standing of the students.

Programme Structure for Bachelor of Engineering (Computer Engineering)

Please refer to Section R2 of Part II of this bulletin for details.

3.2.2 Advanced Placement Credits and Exemptions

Students who are holders of GCE ‘A’ Levels, International Baccalaureate or equivalent qualifications* may be granted advanced placement and exemption of up to 20 MCs for Programme requirements based on performance in placement tests set by the relevant host faculty. The placement test should be taken at the point of admission to the University. SoC students can apply to sit for a placement test for CS1010 Programming Methodology if they have prior programming experience.

Polytechnic Graduates admitted to School of Computing

Polytechnic graduates who are admitted to NUS Computing Courses may receive up to 40 MCs of module exemptions from the following lists:

1. Up to 8 MCs from the University Level Requirements (ULR) (one Humanities and Social Science GEM module and one Breadth module). The 8 MCs will be counted as part of the 60-MC limit of level-1000 modules that students are allowed to read in fulfillment of the 160 MCs required for graduation.*
2. Up to 12 MCs from Unrestrictive Elective Modules (UEMs). The 12 MCs from UEM will NOT be counted as part of the 60-MC limit of level-1000 modules that students are allowed to read in fulfillment of the 160 MCs required for graduation.*

Specific exemptions* of up to 20 MCs from programme requirements comprising of one or more modules as determined by the School on a case-by-case basis. Some of these exemptions may require advance placement test.

*Note:
1. The granting of 8 MCs for ULR and 12 MCs from UEM is automatic and these MCs are tagged as Level-1000 modules.
2. The advanced placement of 20 MCs is equivalent to one semester of advanced standing.
3. The validity period for qualifications presenting for the granting of advanced placement credits is 5 years at the point of admission.

3.2.3 Workload

Students must have a workload of at least 15 MCs per semester, except in their graduating semester. Students who fail to sign up for tutorial/laboratory/recitations for their module(s) will be automatically withdrawn from class. The maximum
workload permissible per semester will be subjected to approval by the University and home faculty.

3.2.4 Continual Assessment

Continual assessment (CA) will be taken into account and it normally contributes to between 40% and 100% of the final grade of a module unless otherwise stated by the department. Homework, quizzes, tests, practicals, essays, projects, seminar presentations, performance during tutorials, field trips and other project work are bases for continual assessment.

3.2.5 Leave of Absence

Students who require leave of one semester or more should obtain approval in advance of the semester. They should first consult their academic advisors to understand the implications involved. Students must submit an online application via myISIS. Supporting documents must be attached with the application. For medical leave, students must submit the original copy of the medical certificates issued by registered general practitioners to the respective offices, by the next working day for the period of medical leave taken. For students in a Bachelor of Computing programme or Bachelor of Science in Business Analytics programme, all supporting documents must be submitted to the Office of Undergraduate Studies, School of Computing (COM1 #02-05). For students in Bachelor of Engineering (Computer Engineering) programme, all supporting documents must be submitted to Department of Electrical and Computer Engineering, Faculty of Engineering (E4-05-45). Students who apply for term leave of absence beyond Instructional Week 2 are liable to pay fees for the entire semester. Not having attended any classes nor utilizing university’s resources are not valid reasons to seek waiver from fee payment. Students who are granted leave before the end of the 2nd Instructional Week will have their modules removed from the records. Those granted leave due to medical reason beyond the 2nd Instructional Week will have Incomplete (IC) grades assigned to their modules. For LOA due to non-medical reason, Withdrawn (W) grades will be assigned to their modules. Students should apply for Special Consideration from examination instead if their application for term LOA starts from Reading week.

3.2.6 Bachelor of Computing in Computational Biology

Overview

The main objective of this programme is to provide a multidisciplinary education, to produce graduates who would be equally at ease with algorithm design and mathematical and statistical analysis as they would be with biochemistry, biology/genetics, and wet-lab know-how. Besides an opportunity to pursue a career in IT, graduates from the programme will also be equipped for a career in the fast-paced pharmaceutical, biomedical or biotechnology industries. This will help meet the demand of the local market for talents with such skill sets. Moreover, the breadth of instructions will pave the way for good students to pursue graduate studies in Bioinformatics.

Programme Structure

The programme is structured such that both Computing and Faculty of Science students share a common core multidisciplinary curriculum (lower division) in their first two years of study.

The lower division embraces a fundamental body of knowledge in which a computational biologist should be proficient. This body of knowledge consists of the following:

- Discrete mathematics and combinatorics, i.e., logic, sets, graphs, counting techniques, etc.;
- Probability and statistics, i.e., sample spaces, random variables, conditioning, distributions, design of experiments, significance tests, statistical inference, etc.;
- Algorithm design and proficiency in some current programming language, i.e., combinatorial algorithms, algorithmic paradigms, analysis and design, working knowledge of current languages (for example, C, C++, Java) and experience in writing actual nontrivial code;
- Organic chemistry and biochemistry;
Biology and genetics, including a moderate amount of wet-lab experience.

The upper division specialised track trains students in algorithmic design to facilitate the design of computationally efficient software and tools in both centralised and networking environments. Students in this track will pick up skills in software engineering, networking and advanced techniques in algorithmic design. Students may also take modules from the Computational Biology elective list.

Degree Requirements

The Computational Biology programme degree requires at least 160 MCs. Modules are classified as follows (note that every module can only be counted towards satisfying exactly one requirement):

Students will be required to satisfy 12 MCs of industrial experience (mandatory requirement) by doing:

1. A 6-month internship through CP3880 Advanced Technology Attachment Programme (12 MCs)
2. Two 3-month internships through CP3200 Internship (6 MCs) and CP3201 Internship II (6 MCs). With two internships, the student will be able to experience work in two distinct types of organizations, such as a start-up and a MNC, or in two different industries.
3. IS4010 Industry Internship Programme (12 MCs) from the IS department.
4. A 3-month internship through CP3200 Internship (6 MCs) and an Industry Course (4 MCs)\(^1\). The remaining 2 MCs may be satisfied using Unrestricted Electives.
5. iLead (16 MCs) or NOC (32 MCs)\(^2\).
6. Other forms of industry experience approved by the Department of Computer Science.

\(^1\) Possible Industry Course includes CP3101A Global Open Source Project and other relevant courses approved by the Department of Computer Science.

\(^2\) For students who opt for iLead or NOC, the additional MCs beyond the 12-MCs allocated to Industry Experience Requirement should be taken from Unrestricted Electives and/or exempted modules.

1. PROGRAMME REQUIREMENTS (Total of 120/121 MCs)

Common Essentials
CS1010 Programming Methodology\(^3\)
CS1020 Data Structures and Algorithms I\(^4\)
CS2010 Data Structures and Algorithms II\(^4\)
CS2100 Computer Organisation
CS2102 Database Systems
CS2103T Software Engineering\(^5\)
CS2105 Introduction to Computer Networks

3 CS1010 (4 MCs) can be replaced by CS1101S Programming Methodology (5 MCs).
4 CS1020 and CS2010 can be replaced by CS2020 Data Structures and Algorithms Accelerated. The remaining 2 MCs will be added to the Unrestricted Electives Requirements.
5 Students taking CS2103T Software Engineering must take CS2101 Effective Communication for Computing Professionals in the same semester. Students who are taking IEM1201x or IEM2201x module on grade basis in place of CS2101 will take CS2103 instead.

Major Requirements
Level-1000
CS1231 Discrete Structures
LSM1101 Biochemistry and Biomolecules
LSM1102 Molecular Genetics
MA1101R Linear Algebra I
MA1102R Calculus
Level-2000
CS2220  Introduction to Computational Biology
CS2101  Effective Communication for Computing Professionals

Either
LSM2101  Metabolism and Regulation
or
LSM2102  Molecular Biology
or
LSM2103  Cell Biology

Either
LSM2201A  Experimental Biochemistry
or
LSM2202A  Experimental Molecular and Cell Biology

ST2334  Probability and Statistics^6

Level-3000
CS3230  Design & Analysis of Algorithms
LSM3231  Protein Structure and Function

Either
CS3225  Combinatorial Methods in Bioinformatics
or
MA3259  Mathematical Methods in Genomics

Minimum of 12 MCs from the following list^7:
CS3103  Computer Networks and Protocols^5

Either:
CS3225  Combinatorial Methods in Bioinformatics
or
MA3259  Mathematical Methods in Genomics

CS3240  Interaction Design
CS3241  Computer Graphics
CS3243  Introduction to Artificial Intelligence
CS3244  Machine Learning

Level-4000
CS4220  Knowledge Discovery Methods in Bioinformatics
LSM4241  Functional Genomics
CP4101  B. Comp. Dissertation^9 or Industrial Experience Requirement (12 MCs)
Complete 8 MCs by taking modules from CB Elective Course List

Computational Biology (CB) Elective Course List^10
CS4221  Database Design
CS4231  Parallel and Distributed Algorithms
CS4235  Computational Geometry
CS4237  Systems Modelling and Simulation
CS4243  Computer Vision and Pattern Recognition
CS4244  Knowledge-Based Systems
6. Students should choose ST2131 (Probability) and ST2132 (Mathematical Statistics) in place of ST2334 (Probability and Statistics) if they plan to pursue higher level statistics modules.

7. With the special permission from the UROP coordinator and Computational Biology Programme Coordinator, CP3208/CP3209 Undergraduate Research in Computing I/II can be used to replace two of the Level-3000 Computational Biology electives if the project is on Computational Biology.

8. Students who take CS3103 (Computer Networks and Protocols) must also take CS3103L (Computer Networks Laboratory).

9. Students in the Department of Computer Science who aim for Honours (Highest Distinction) must pass the CP4101 B.Comp. Dissertation. Students with CAP of 4.0 or higher at the end of their fifth semester of undergraduate study may opt to replace the Industry Experience Requirement by B.Comp Dissertation (12 MCs).

10. The Computational Biology (CB) Elective Course List may be revised from time to time to include new Computational Biology electives that are introduced and approved by the Department of Computer Science.

2. UNIVERSITY LEVEL REQUIREMENTS

As specified in Section 3.2.1.

3. UNRESTRICTED ELECTIVES

As specified in Section 3.2.1. Students are required to read CM1121 Basic Organic Chemistry, and PC1432 Physics IIE towards partially satisfying Unrestricted Electives.

### Table 1: Summary of degree requirements for B.Comp. (Computational Biology)

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Subtotals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNIVERSITY LEVEL REQUIREMENTS</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>PROGRAMME REQUIREMENTS</strong></td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Common Essentials</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS1010 Programming Methodology(^{11})</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1020 Data Structures and Algorithms I(^{12})</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2010 Data Structures and Algorithms II(^{12})</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2100 Computer Organisation</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2102 Database Systems</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2103T Software Engineering(^{13})</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2105 Introduction to Computer Networks</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Major Requirements</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level-1000 CS and LS major requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS1231 Discrete Structures</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>LSM1101 Biochemistry and Biomolecules</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>------------------------------------------------------</td>
<td>---------</td>
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<tr>
<td>LSM1102</td>
<td>Molecular Genetics</td>
<td>4</td>
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<tr>
<td>MA1101R</td>
<td>Linear Algebra I</td>
<td>4</td>
</tr>
<tr>
<td>MA1102R</td>
<td>Calculus</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Level-2000 CS and LS major requirements</strong></td>
<td></td>
</tr>
<tr>
<td>CS2220</td>
<td>Introduction to Computational Biology</td>
<td>4</td>
</tr>
<tr>
<td>CS2101</td>
<td>Effective Communication for Computing Professionals</td>
<td>4</td>
</tr>
<tr>
<td>LSM2101</td>
<td>Metabolism and Regulation or Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td>LSM2102</td>
<td>Molecular Biology</td>
<td>4</td>
</tr>
<tr>
<td>LSM2103</td>
<td>Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td>LSM2201A</td>
<td>Experimental Biochemistry or Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td>LSM2202A</td>
<td>Experimental Molecular and Cell Biology</td>
<td>4</td>
</tr>
<tr>
<td>ST2334</td>
<td>Probability and Statistics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Level-3000 CS and LS major requirements</strong></td>
<td></td>
</tr>
<tr>
<td>CS3230</td>
<td>Design &amp; Analysis of Algorithms</td>
<td>4</td>
</tr>
<tr>
<td>CS3225</td>
<td>Combinatorial Methods in Bioinformatics or</td>
<td>4</td>
</tr>
<tr>
<td>MA3259</td>
<td>Mathematical Methods in Genomics</td>
<td></td>
</tr>
<tr>
<td>LSM3231</td>
<td>Protein Structure and Function</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Level-3000 Electives</strong> ; Choose any three from the following:</td>
<td></td>
</tr>
<tr>
<td>CS3103</td>
<td>Computer Networks and Protocols 16</td>
<td>4</td>
</tr>
<tr>
<td>CS3225</td>
<td>Combinatorial Methods in Bioinformatics or</td>
<td>4</td>
</tr>
<tr>
<td>MA3259</td>
<td>Mathematical Methods in Genomics</td>
<td></td>
</tr>
<tr>
<td>CS3240</td>
<td>Interaction Design</td>
<td>4</td>
</tr>
<tr>
<td>CS3241</td>
<td>Computer Graphics</td>
<td>4</td>
</tr>
<tr>
<td>CS3243</td>
<td>Introduction to Artificial Intelligence</td>
<td>4</td>
</tr>
<tr>
<td>CS3244</td>
<td>Machine Learning</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Level-4000 CS and LS major requirements</strong></td>
<td></td>
</tr>
<tr>
<td>CS4220</td>
<td>Knowledge Discovery Methods in Bioinformatics</td>
<td>4</td>
</tr>
<tr>
<td>LSM4241</td>
<td>Functional Genomics</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Either</strong></td>
<td></td>
</tr>
<tr>
<td>CP4101</td>
<td>B. Comp. Dissertation</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Industrial Experience Requirement</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Sufficient number of modules from CB Elective Course List</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>UNRESTRICTED ELECTIVES</strong></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td>160</td>
</tr>
</tbody>
</table>

11 CS1010 (4 MCs) can be replaced by CS1101S Programming Methodology (5 MCs).
12 CS1020 and CS2010 can be replaced by CS2020 Data Structures and Algorithms Accelerated. The remaining 2 MCs will be added to the Unrestricted Electives Requirements.
13 Students taking CS2103T Software Engineering must take CS2101 Effective Communication for Computing Professionals in the same semester.
14 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.
15 With the special permission from the UROP coordinator and Computational Biology Programme Coordinator, CP3208/CP3209 Undergraduate Research in Computing I/II can be used to replace two of the Level- 3000 Computational Biology electives if the project is on Computational Biology.
16 Students who take CS3103 (Computer Networks and Protocols) must also take CS3103L (Computer Networks Laboratory).
17 Students in the Department of Computer Science who aim for high distinction must pass the CP4101 B.Comp. Dissertation. Students with CAP of 4.0 or higher at the end of their fifth semester of undergraduate study may opt to replace the Industry Experience Requirement by B.Comp Dissertation (12 MCs).
Concurrent Programme with Brown University on Computational Biology

This is a fast-track programme that allows deserving students to obtain the Bachelor of Computing (Computational Biology) from NUS and a Scientiae Magister in Computational Biology in Computer Science from Brown University within five years.

Please refer to Section R7 of Part II of this bulletin for details.

3.2.7 Bachelor of Computing in Computer Science

Overview

The Bachelor of Computing (Honours) in Computer Science or BComp (CS) programme aims to nurture students for a rewarding computing career in various industry sectors. Suitable for those who love hands-on work and keen to apply computing technologies to solve real-world problems, the programme will equip students with the critical knowledge and capacity to take on the world with confidence.

At the time of graduation, students are expected to demonstrate:

- Strong knowledge of computer science foundations and fundamentals, including (a) familiarity with common computer science themes and principles, (b) high-level understanding of systems as a whole, (c) understanding of the theoretical underpinnings of computer science and their influences in practice.
- In-depth knowledge in one or more computer science specialisations.
- Individual competence in applying sound principles and rigorous thinking to (a) analyse an application problem, (b) understand user’s requirement, (c) formulate the problem in terms of computation requirements, (d) conceive novel solution ideas, (e) design appropriate solutions that meet the requirements, (f) implement the solution, (g) evaluate the effectiveness of the solution.
- Strong communication skills and ability work with, and contribute to, a multi-disciplinary team to bring a range of technologies together to develop computer systems and solutions of multi-disciplinary nature.
- Ability to engage in continuous professional development.
- Understanding of the responsibilities of an IT professional and the ethical, social, and legal issues related to computing.

Within 3-5 years from graduation, a graduate from the programme is expected to be able to:

- Have a career as IT professional engaging in research and/or development in one or more specialisation of computer science;
- Engage in a supportive or leadership role in a multi-disciplinary, collaborative, team environment;
- Engage in continuous learning of state-of-the-art advances in computer science (including graduate studies);
- Function as an ethical, legal and socially responsible member of the society;
- Apply computing knowledge and skills to contribute positively to the betterment of society.

For a well-rounded education, students pursuing this programme will also acquire knowledge in science, including life sciences, mathematics and physics.

The Computer Science program is accredited by the Computing Accreditation Commission of ABET, [http://www.abet.org](http://www.abet.org)

Graduates with the Bachelor of Computing (Honours) in Computer Science degree can position themselves in a large number of exciting fields of work, including project management, knowledge engineering, software architecture, web design, digital media and security consultancy.

Degree Requirements
The Bachelor of Computing (Computer Science) programme requires at least 160 MCs.

Students will be required to satisfy 12 MCs of Industrial Experience Requirement by doing:

1. A 6-month internship through CP3880 Advanced Technology Attachment Programme (12 MCs)
2. Two 3-month internships through CP3200 Internship (6 MCs) and CP3202 Internship II (6 MCs). With two internships, the student will be able to experience work in two distinct types of organizations, such as a start-up and a MNC, or in two different industries.
3. IS4010 Industry Internship Programme (12 MCs) from the IS department.
4. A 3-month internship through CP3200 Internship (6 MCs) and an Industry Course (4 MCs). The remaining 2 MCs may be satisfied using Unrestricted Electives.
5. iLead (16 MCs) or NOC (32 MCs).
6. Other forms of industry experience approved by the Department of Computer Science.

1. **PROGRAMME REQUIREMENTS (Total of 120 MCs)**

**Computer Science Foundation**
- CS1010 Programming Methodology
- CS1020 Data Structures and Algorithms I
- CS1231 Discrete Structures
- CS2010 Data Structures and Algorithms II
- CS2100 Computer Organisation
- CS2103T Software Engineering
- CS2105 Introduction to Computer Networks
- CS2106 Introduction to Operating Systems
- CS3230 Design and Analysis of Algorithms

18 Possible industry course includes CP3101A Global Open Source Project and other relevant courses approved by the Department of Computer Science.
19 For students who opt for iLead or NOC, the additional MCs beyond the 12-MCs allocated to Industry Experience Requirement should be taken from Unrestricted Electives and/or exempted modules.
20 CS1010 (4 MCs) can be replaced by CS1101S Programming Methodology (5 MCs).
21 CS1020 (4 MCs) and CS2010 (4 MCs) can be replaced by CS2020 Data Structures and Algorithms Accelerated (6 MCs). The remaining 2 MCs will be added to the Unrestricted Electives Requirements.
22 Students taking CS2103T Software Engineering must take CS2101 Effective Communication for Computing Professionals in the same semester.

**Computer Science Breadth & Depth**
Complete 24 MCs of CS modules by satisfying the following conditions:

1. Satisfy at least one CS Focus Area for B.Comp. (CS) by completing 3 modules in the Area Primaries, with at least one module at level-4000 or above. Computer Science Foundation modules that appear in Area Primaries can be counted as one of the 3 modules towards satisfying a Focus Area.
2. At least 12 MCs are at level-4000 or above.

Complete 8 MCs of Computer Systems Team Project modules from the following list, or modules approved by the Department of Computer Science:

- CS3201 Software Engineering Project I and CS3202 Software Engineering Project II, or
- CS3281 Thematic Systems Project I and CS3282 Thematic Systems Project II, or
- CS3283 Media Technology Project I and CS3284 Media Technology Project II

**CP4101** B.Comp. Dissertation or Industry Experience Requirement of at least 12 MCs

**IT Professionalism**
23 Students in the Department of Computer Science who aim for high distinction must pass the CP4101 B.Comp. Dissertation. Students with CAP of 4.0 or higher at the end of their fifth semester of undergraduate study may opt to replace the Industry Experience Requirement by B.Comp Dissertation (12 MCs).

24 MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver should be used to read a letter-graded module.

25 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics are recommended to replace MA1521 Calculus for Computing by MA1102R Calculus.

26 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.

27 Students who have not taken ‘O’-level Physics may replace PC1221 or PC1222 by a life-science module. PC1221 or PC1222 is waived for students with A-level Physics. The 4 MCs gained from the waiver should be used to read a letter-graded module.

28 Science modules must be either Physics, Chemistry or Life-Science or Mathematics modules. Science modules must be modules from List S1 (recommended) or List S2. Please refer to: http://www.comp.nus.edu.sg/undergraduates/documents/Scienecmodules_S1_S2.pdf for the details.

Computer Science Focus Areas for B.Comp. (CS)

CS modules are organised into Focus Areas of coherent modules according to technical areas of study. A CS Focus Area is satisfied by completing 3 modules from the Area Primaries, with at least one module at 4000-level or above. CS Foundation Modules (CFM) that appear in the Area Primaries can be counted as one of the 3 modules towards satisfying a Focus Area. In this case, a student has to read just two other modules in the Area Primaries to satisfy the Focus Area. Elective modules are grouped into the Focus Areas as a guide for indicating their related areas of study.

- Algorithms & Theory
- Artificial Intelligence
- Computer Networks
- Computer Security
- Database Systems
- Information Retrieval
- Interactive Media
- Parallel Computing
- Programming Languages
- Software Engineering
- Visual Computing
Modules classified in each focus area can be found at: http://www.comp.nus.edu.sg/undergraduates/cs_cs_focusareas.html

Enrichment

Students are encouraged to read the following enrichment modules:

- CS3882 Breakthrough Ideas for Digital Markets
- CS4880 Digital Entrepreneurship

Specialisation in Information Security

To satisfy Information Security Specialisation, students must:

- Satisfy Computer Security Focus Area, i.e., complete at least 3 Primary Modules in the Computer Security Focus Area with at least 1 Primary Module at level-4000 or above.
- Complete additional modules in the Primary and/or Elective lists of Computer Security so that 12 MCs (including the Primary Modules taken) are at level-3000 or above.
- Complete CP4101 B.Comp. Dissertation (12 MCs), which must be an independent project on a topic related to technical aspect of information security or, complete additional modules in the Primary and/or Elective lists of Computer Security so that 12 MCs are at level-4000 or above. At most one of these modules can be an IS-coded module. They are: IS4231 Information Security Management and IS4232 Topics in Information Security Management.

University Scholars Programme (Computer Science)

Students in the University Scholars Programme who choose the Bachelor of Computing (Computer Science) major will follow the Computer Science programme, but with the following variations:

1. They will not be required to read University Level Requirements (20 MCs). These are replaced by the 3 USP Inquiry Modules and 2 USP Foundation modules (Quantitative Reasoning Foundation and University Scholars Seminar).
2. They will not be required to read CS2101 Effective Communication for Computing Professionals. It is replaced by USP Foundation module: Writing and Critical Thinking.
3. They will not be required to read two Science Modules (8 MCs). These are replaced by 2 USP Inquiry modules in Sciences and Technologies basket.
4. They will read UROP modules (CP3208 and CP3209) in place of CS3201 and CS3202 or CS3281 and CS3282. CP3208 and CP3209 are independent study modules (ISMs) which will also be counted as 2 USP Inquiry modules in Sciences and Technologies basket.

Table 2: Summary of degree requirements for Bachelor of Computing (Computer Science)

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Subtotals</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIVERSITY LEVEL REQUIREMENTS</td>
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<td>20</td>
</tr>
<tr>
<td>PROGRAMME REQUIREMENTS</td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Computer Science Foundation</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>CS1010 Programming Methodology</td>
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</tr>
<tr>
<td>CS1020 Data Structures and Algorithms I</td>
<td>4</td>
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</tr>
<tr>
<td>CS2010 Data Structures and Algorithms II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1231 Discrete Structures</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2100 Computer Organisation</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2103T Software Engineering</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>MCs</td>
</tr>
<tr>
<td>-------------</td>
<td>----------------------------------------------------------</td>
<td>-----</td>
</tr>
<tr>
<td>CS2105</td>
<td>Introduction to Computer Networks</td>
<td>4</td>
</tr>
<tr>
<td>CS2106</td>
<td>Introduction to Operating Systems</td>
<td>4</td>
</tr>
<tr>
<td>CS3230</td>
<td>Design and Analysis of Algorithms</td>
<td>4</td>
</tr>
</tbody>
</table>

**Computer Science Breadth and Depth**

Complete 24 MCs of CS modules by satisfying the following conditions:
1. Satisfy at least one CS Focus Area for B.Comp.(CS) by completing 3 modules in the Area Primaries, with at least one module at level-4000 or above. Computer Science Foundation modules that appear in Area Primaries can be counted as one of the 3 modules towards satisfying a Focus Area.
2. At least 12 MCs are at level-4000 or above.

Complete 8 MCs of Computer Systems Team Project modules from the following list, or modules approved by the Department of Computer Science:
- CS3201 Software Engineering Project I and CS3202 Software Engineering Project II, or
- CS3281 Thematic Systems Project I and CS3282 Thematic Systems Project II, or
- CS3283 Media Technology Project I and CS3284 Media Technology Project II

**Computer Systems Team Project modules**

- CS4101 B.Comp. Dissertation or Industrial Experience Requirement

**IT Professionalism**
- IS1103FC Computing and Society
- CS2101 Effective Communication for Computing Professionals

**Mathematics and Sciences**
- MA1301 Introductory Mathematics
- MA1521 Calculus for Computing
- MA1101R Linear Algebra I
- ST2334 Probability and Statistics
- PC1221 Fundamentals of Physics I or PC1222 Fundamentals of Physics II

- 3 Science Modules

**UNRESTRICTED ELECTIVES**

<table>
<thead>
<tr>
<th></th>
<th>20</th>
</tr>
</thead>
</table>

**Grand Total**

|             | 160 |

29 Students in the Department of Computer Science who aim for Honours (Highest Distinction) must pass the CP4101 B.Comp. Dissertation. Students with CAP of 4.0 or higher at the end of their fifth semester of undergraduate study may opt to replace the Industry Experience Requirement by B.Comp Dissertation (12 MCs).

30 MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver should be used to read a letter-graded module.

31 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics are recommended to replace MA1521 Calculus for Computing by MA1102R Calculus.

32 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.

33 Students who have not taken O’level Physics may replace PC1221 or PC1222 by a life-science module. PC1221 or PC1222 is waived for students with A-level Physics. The 4 MCs gained from the waiver should be used to read a letter-graded module.

34 Science modules must be either Physics, Chemistry or Life-Science or Mathematics modules. Science modules must be modules from List S1 (recommended) or List S2. Please refer to:
3.2.8 Bachelor of Computing in Computer Science – von Neumann Programme

Overview

The von Neumann Programme for Bachelor of Computing (Computer Science) programme, [vNP] is one of the two special programmes in Computer Science. vNP aims to nurture students who aspire to engage in industry careers emphasising the design of complex computing systems. It is most suitable for students who love to solve complex real-world problems and develop complex computer-based systems for real-world applications. Students pursuing Bachelor of Computing (Computer Science) degree will be eligible for admission into vNP at the end of their first or second semester of studies based on their CAP and interview. Students in this programme will be assigned CS professors and industry partners as their mentors, who will help them to blend academic knowledge and industrial experience into their studies.

Degree Requirements

The von Neumann Programme requires at least 160 MCs. Students in the programme must maintain a minimum CAP of 4.00 in every semester of their studies.

Students will be required to satisfy 12 MCs of industrial experience (mandatory requirement) by doing:

a) A 6-month internship through CP3880 Advanced Technology Attachment Programme (12 MCs)

b) Two 3-month internships through CP3200 Internship (6MCs) and CP3202 Internship II (6 MCs). With two internships, the student will be able to experience work in two distinct types of organizations, such as a start-up and a MNC, or in two different industries.

c) IS4010 Industry Internship Programme (12 MCs) from the IS department.

d) A 3-month internship through CP3200 Internship (6 MCs) and an Industry Course (4 MCs) 5. The remaining 2 MCs may be satisfied using Unrestricted Electives.

e) iLead (16 MCs) or NOC (32 MCs)36.

f) Other forms of industry experience approved by the Department of Computer Science.

Possible Industry Course includes CP3101A Global Open Source Project and other relevant courses approved by the Department of Computer Science.

For students who opt for iLead or NOC, the additional MCs beyond the 12-MCs allocated to Industry Experience Requirement should be taken from Unrestricted Electives and/or exempted modules.

1. PROGRAMME REQUIREMENTS (Total of 124 MCs)

Computer Science Foundation

CS1010  Programming Methodology
CS1020  Data Structures and Algorithms I
CS1231  Discrete Structures
CS2010  Data Structures and Algorithms II
CS2100  Computer Organisation
CS2103T Software Engineering
CS2105  Introduction to Computer Networks
CS2106  Introduction to Operating Systems
CS3230  Design and Analysis of Algorithms

Note 44:
CS1010 (4 MCs) can be replaced by CS1101S Programming Methodology (5 MCs).

Computer Science Breadth & Depth

Complete 24 MCs of CS modules by satisfying the following conditions:

1. Satisfy at least one vNP Focus Area by completing 3 modules in the Area Primaries, with at least one module at
level-4000 or above. Computer Science Foundation modules that appear in Area Primaries can be counted as one of the 3 modules towards satisfying a Focus Area.

2. At least 12 MCs are at level-4000 or above.
3. Complete CS3213 Software Systems Design

Complete the following modules:
- CS3281 Thematic Systems Project I (with large-scale complex systems development)
- CS3282 Thematic Systems Project II (with large-scale complex systems development)
- CP4101 B.Comp. Dissertation or Industry Experience Requirement of at least 12 MCs

**IT Professionalism**
IS1103FC Computing and Society
CS2101 Effective Communication for Computing Professionals

**Mathematics & Sciences**
MA1301 Introductory Mathematics
MA1521 Calculus for Computing
MA1101R Linear Algebra I
ST2334 Probability and Statistics
PC1221 Fundamentals of Physics I or
PC1222 Fundamentals of Physics II
3 Science Modules

37 CS1010 (4 MCs) can be replaced by CS1101S Programming Methodology (5 MCs).
38 CS1020 and CS2010 can be replaced by CS2020 Data Structures and Algorithms Accelerated. The remaining 2 MCs will be added to the Unrestricted Electives Requirements.
39 Students taking CS2103T Software Engineering must take CS2101 Effective Communication for Computing Professionals in the same semester.
41 MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver should be used to read a letter-graded module.
42 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics are recommended to replace MA1521 Calculus for Computing by MA1102R Calculus.
43 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.
44 Students who have not taken ‘O’-level Physics may replace PC1221 or PC1222 by a life science module. PC1221 or PC1222 is waived for students with A-level Physics. The 4 MCs gained from the waiver should be used to read a letter-graded module.
45 Science modules must be either Physics, Chemistry or Life-Science or Mathematics modules. Science modules must be modules from List S1 (recommended) or List S2. Please refer to: http://www.comp.nus.edu.sg/undergraduates/documents/Sciencemodules_S1_S2.pdf for the details.

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2. **UNIVERSITY LEVEL REQUIREMENTS (20 MCs)**

3. **UNRESTRICTED ELECTIVES (16 MCs)**

**vNP Focus Areas for B.Comp. (CS)**

The following CS Focus Areas for B.Comp.(CS) are elected as vNP Focus Areas:
- Computer Networks
- Computer Security
- Database Systems
- Parallel Computing
- Programming Languages
- Software Engineering

**Enrichment**

Students are encouraged to read the following enrichment module:
- CS3882 Breakthrough Ideas for Digital Markets
- CS4880 Digital Entrepreneurship

**Specialisation in Information Security**

To satisfy Information Security Specialisation, students must:

- Satisfy Computer Security Focus Area, i.e., complete at least 3 Primary Modules in the Computer Security Focus Area with at least 1 Primary Module at level-4000 or above.
- Complete additional modules in the Primary and/or Elective lists of Computer Security so that 12 MCs (including the Primary Modules taken) are at level-3000 or above.
- Complete CP4101 B.Comp. Dissertation (12 MCs), which must be an independent project on a topic related to technical aspect of information security or, complete additional modules in the Primary and/or Elective lists of Computer Security so that 12 MCs are at level- 4000 or above. At most one of these modules can be an IS-coded module. They are: IS4231 Information Security Management and IS4232 Topics in Information Security Management.

**University Scholars Programme (Computer Science)**

Students in the University Scholars Programme who choose the Bachelor of Computing (Computer Science) major will follow the Computer Science programme, but with the following variations:

1. They will not be required to read University Level Requirements (20 MCs). These are replaced by the 3 USP Inquiry Modules and 2 USP Foundation modules (Quantitative Reasoning Foundation and University Scholars Seminar).
2. They will not be required to read CS2101 Effective Communication for Computing Professionals. It is replaced by USP Foundation module: Writing and Critical Thinking
3. They will not be required to read two Science Modules (8 MCs). These are replaced by two USP Inquiry modules in Sciences and Technologies basket.
4. They will read CS3281 and CS3282 as independent study modules (ISMs) which will be counted as two USP Inquiry modules in Sciences and Technologies basket.

**Table 3: Summary of degree requirements for Bachelor of Computing (Computer Science) – von Neumann Programme (vNP)**

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Subtotals</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIVERSITY LEVEL REQUIREMENTS</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>PROGRAMME REQUIREMENTS</td>
<td></td>
<td>124</td>
</tr>
<tr>
<td>Computer Science Foundation</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>CS1010 Programming Methodology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1020 Data Structures and Algorithms</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1231 Discrete Structures</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2010 Data Structures and Algorithms</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>CS2100</td>
<td>Computer Organisation</td>
<td>4</td>
</tr>
<tr>
<td>CS203T</td>
<td>Software Engineering</td>
<td>4</td>
</tr>
<tr>
<td>CS2105</td>
<td>Introduction to Computer Networks</td>
<td>4</td>
</tr>
<tr>
<td>CS2106</td>
<td>Introduction to Operating Systems</td>
<td>4</td>
</tr>
<tr>
<td>CS3230</td>
<td>Design and Analysis of Algorithms</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Computer Science Breadth &amp; Depth</strong></td>
<td>48</td>
</tr>
<tr>
<td>CS3213</td>
<td>Software Systems Design</td>
<td>4</td>
</tr>
<tr>
<td>CS3281</td>
<td>Thematic Systems Project I (with large-scale complex systems development)</td>
<td>4</td>
</tr>
<tr>
<td>CS3282</td>
<td>Thematic Systems Project II (with large-scale complex systems development)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Satisfy 1 vNP Focus Area with 3 CS modules at level-4000 or above</strong></td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>After satisfying a vNP Focus Area, a student may choose to satisfy other CS Focus Areas.</td>
<td></td>
</tr>
<tr>
<td>CP4101</td>
<td>B. Comp. Dissertation or Industrial Experience Requirement</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><strong>IT Professionalism</strong></td>
<td>8</td>
</tr>
<tr>
<td>IS1103FC</td>
<td>Computing and Society</td>
<td>4</td>
</tr>
<tr>
<td>CS2101</td>
<td>Effective Communication for Computing Professionals</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>Mathematics and Sciences</strong></td>
<td>24</td>
</tr>
<tr>
<td>MA1301</td>
<td>Introductory Mathematics</td>
<td>4</td>
</tr>
<tr>
<td>MA1521</td>
<td>Calculus for Computing</td>
<td>4</td>
</tr>
<tr>
<td>MA1101R</td>
<td>Linear Algebra I</td>
<td>4</td>
</tr>
<tr>
<td>ST2334</td>
<td>Probability and Statistics</td>
<td>4</td>
</tr>
<tr>
<td>PC1222</td>
<td>Fundamentals of Physics II</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td><strong>3 Science Modules</strong></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td><strong>UNRESTRICTED ELECTIVES</strong></td>
<td>16</td>
</tr>
<tr>
<td></td>
<td><strong>Grand Total</strong></td>
<td>160</td>
</tr>
</tbody>
</table>

46 CS1010 (4 MCs) can be replaced by CS1101S Programming Methodology (5 MCs).
47 CS1020 (4 MCs) and CS2010 (4 MCs) can be replaced by CS2020 Data Structures and Algorithms Accelerated (6 MCs). The remaining 2 MCs will be added to the Unrestricted Electives Requirements.
48 Students in the Department of Computer Science who aim for Honours (Highest Distinction) must pass the CP4101 B.Comp. Dissertation. Students with CAP of 4.0 or higher at the end of their fifth semester of undergraduate study may opt to replace the Industry Experience Requirement by B.Comp Dissertation (12 MCs).
49 MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver should be used to read a letter-graded module.
50 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics are recommended to replace MA1521 Calculus for Computing by MA1102R Calculus.
51 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.
52 Science modules must be either Physics, Chemistry or Life-Science or Mathematics modules. Science modules must be modules from List S1 (recommended) or List S2. Please refer to: http://www.comp.nus.edu.sg/undergraduates/documents/Sciencemodules_S1_S2.pdf for the details.

3.2.9 Bachelor of Computing in Computer Science – Turing Programme
Overview

The Turing Programme for Bachelor of Computing (Computer Science) programme [TP] is yet another special programme in Computer Science. TP aims to nurture students who aspire to engage in pure research careers in Computing. It is most suitable for students who love to solve technically challenging problems and are able to handle theoretical and practical work. Students will be selected for admission to TP at the end of their first or second semester of studies based on their CAP and interview. Students in TP are expected to build sufficient track records by the time they graduate to gain admission into Ph.D. Programmes in top schools including SoC. Students pursuing the Bachelor of Computing (Computer Science) degree will be eligible for admission into TP at the end of their first or second semester of studies based on their CAP and interview. Students in this programme will be assigned CS professors as their mentors to help them to build their research track records.

Degree Requirements

The Turing Programme for Bachelor of Computing (Computer Science) requires at least 160 MCs. Students in the programme must maintain a minimum CAP of 4.00 in every semester of their studies.

1. PROGRAMME REQUIREMENTS (Total of 126 MCs)

Computer Science Foundation
CS1101S Programming Methodology
CS1231 Discrete Structures
CS2020 Data Structures and Algorithms Accelerated
CS2100 Computer Organisation
CS2103T Software Engineering
CS2105 Introduction to Computer Networks
CS2106 Introduction to Operating Systems
CS3230 Design and Analysis of Algorithms
CS3230R Design and Analysis of Algorithms

Computer Science Breadth & Depth
Complete 26 MCs of CS modules by satisfying the following conditions:
1. Satisfy at least one CS Focus Area for B.Comp.(CS) by completing 3 modules in the Area Primaries, with at least one module at level-4000 or above. Computer Science Foundation modules that appear in Area Primaries can be counted as one of the 3 modules towards satisfying a Focus Area.
2. At least 12 MCs are at level-4000 or above.
3. At least 2 R-modules.
4. Read CS4232 Theory of Computation.

Complete the following modules:
- CS2309 CS Research Methodology
- CS3281 Thematic Systems Project I (with research content)
- CS3282 Thematic Systems Project II (with research content)
- CP4101 B.Comp. Dissertation (with research content)

IT Professionalism
IS1103FC Computing and Society
CS2101 Effective Communication for Computing Professionals

Mathematics & Sciences
MA1301 Introductory Mathematics
MA1521 Calculus for Computing
MA1101R Linear Algebra I
53 Students taking CS2103T Software Engineering must take CS2101 Effective Communication for Computing Professionals in the same semester.
54 CS4232 can be counted towards satisfying Algorithms & Theory Focus Area.
55 CS3281 and CS3282 may be replaced by CP3208 and CP3209 Undergraduate Research in Computing I and II with approval of Department of Computer Science.
56 MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver should be used to read a letter-graded module.
57 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics are recommended to replace MA1521 Calculus for Computing by MA1102R Calculus.
58 Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.
59 Science modules must be either Physics, Chemistry or Life-Science or Mathematics modules. Science modules must be modules from List S1 (recommended) or List S2. Please refer to: http://www.comp.nus.edu.sg/undergraduates/documents/Sciencemodules_S1_S2.pdf for the details.

2. UNIVERSITY LEVEL REQUIREMENTS (20 MCs)

3. UNRESTRICTED ELECTIVES (14 MCs)

Enrichment

Students are encouraged to read the following enrichment modules:
- CS3882 Breakthrough Ideas for Digital Markets
- CS4880 Digital Entrepreneurship

Student Exchange Programme (SEP)

Students in this programme have the opportunity to go for exchange or internships to approved universities and laboratories overseas. The exchange or internship may include coursework or research components that can be mapped to the CS modules approved by the Department of Computer Science.

Specialisation in Information Security

To satisfy Information Security Specialisation, students must:
- Satisfy Computer Security Focus Area, i.e., complete at least 3 Primary Modules in the Computer Security Focus Area with at least 1 Primary Module at level-4000 or above.
- Complete additional modules in the Primary and/or Elective lists of Computer Security so that 12 MCs (including the Primary Modules taken) are at level-3000 or above.
- Complete CP4101 B.Comp. Dissertation (12 MCs), which must be an independent project on a topic related to technical aspect of information security or, complete additional modules in the Primary and/or Elective lists of Computer Security so that 12 MCs are at level- 4000 or above. At most one of these modules can be an IS-coded module. They are: IS4231 Information Security Management and IS4232 Topics in Information Security Management.

University Scholars Programme (Computer Science)

Students in the University Scholars Programme who choose the Bachelor of Computing (Computer Science) major will follow the Computer Science programme, but with the following variations:
1. They will not be required to read University Level Requirements (20 MCs). These are replaced by the 3 USP Inquiry Modules and 2 USP Foundation modules (Quantitative Reasoning Foundation and University Scholars Seminar).

2. They will not be required to read CS2101 Effective Communication for Computing Professionals. It is replaced by USP Foundation module: Writing and Critical Thinking.

3. They will not be required to read two Science Modules (8 MCs). These are replaced by 2 USP Inquiry modules in Sciences and Technologies basket.

4. They will read UROP modules (CP3208 and CP3209) in place of CS3281 and CS3282. CP3208 and CP3209 are independent study modules (ISMs) which will also be counted as 2 USP Inquiry modules in Sciences and Technologies basket.

**Table 4: Summary of degree requirements for Bachelor of Computing (Computer Science) – Turing Programme**

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Subtotals</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>UNIVERSITY LEVEL REQUIREMENTS</strong></td>
<td></td>
<td>20</td>
</tr>
<tr>
<td><strong>PROGRAMME REQUIREMENTS</strong></td>
<td></td>
<td>126</td>
</tr>
<tr>
<td>Computer Science Foundation</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>CS1101S Programming Methodology</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>CS1231 Discrete Structures</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2020 Data Structures and Algorithms Accelerated</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>CS2100 Computer Organisation</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2103T Software Engineering</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2105 Introduction to Computer Networks</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2106 Introduction to Operating Systems</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS3230 &amp; CS3230R Design and Analysis of Algorithms</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td><strong>Computer Science Breadth &amp; Depth</strong></td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>CS2309 CS Research Methodology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Satisfy 1 CS Focus Area, with 3 CS modules at Level - 4000 or above, with 2 R-modules, with CS4232 Theory of Computation</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>CS3281 Thematic Systems Project I (with research content)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS3282 Thematic Systems Project II (with research content)</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CP4101 B.Comp. Dissertation (with research content)</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><strong>IT Professionalism</strong></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>IS1103FC Computing and Society</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS2101 Effective Communication for Computing Professionals</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td><strong>Mathematics and Sciences</strong></td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>MA1301 Introductory Mathematics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MA1521 Calculus for Computing</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MA1101R Linear Algebra I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ST2334 Probability and Statistics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>PC1222 Fundamentals of Physics II</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3 Science Modules</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td><strong>UNRESTRICTED ELECTIVES</strong></td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>
60. MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver should be used to read a letter-graded module.

61. Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics are recommended to replace MA1521 Calculus for Computing by MA1102R Calculus.

62. Students pursuing a double degree in Computer Science and Mathematics/Applied Mathematics will take ST2131 Probability and ST2132 Mathematical Statistics in place of ST2334 Probability and Statistics.

63. Science modules must be either Physics, Chemistry or Life-Science or Mathematics modules. Science modules must be modules from List S1 (recommended) or List S2. Please refer to: http://www.comp.nus.edu.sg/undergraduates/documents/Sciencemodules_S1_S2.pdf for details.

3.2.10 Bachelor of Computing in Electronic Commerce

Objective

The four-year joint E-Commerce programme (EC) is offered by School of Computing (SoC) and School of Business (BIZ). The programme will have a mix of Information Technology (IT) and Business knowledge areas.

Graduates of the EC programme will be in demand by companies in the E-Business space - an area which large companies cannot ignore in today's new media age. E-Commerce students will develop into experts on Internet business. They will learn the basics of e-commerce, such as accounting, marketing, e-payment and e-economy, social computing, web forums and social networks, web user characteristics, e-loyalty and e-migration, and Internet technology. Students will become strategists in analysing and influencing e-commerce, such as web traffic, web opinion, virtual markets, virtual economy, electronic word of mouth, collaborative mobile and social e-commerce. Typical jobs include e-commerce entrepreneurship, online marketing, web design, web analysis, and web consultancy.

University Scholars Programme (E-Commerce)

Students in the University Scholars Programme who choose the Bachelor of Computing (E-Commerce) major will take the E-Commerce programme, but with the following variations:

1. They will not be required to read University Level Requirements (20 MCs). These are replaced by the 3 USP Inquiry Modules and 2 USP Foundation modules (Quantitative Reasoning Foundation and University Scholars Seminar).

2. They will not be required to read IS2101 Business and Technical Communication. It is replaced by USP Foundation module: Writing and Critical Thinking.

3. They will have 8 (instead of 20) MCs under Unrestricted Electives.

4. They will read UROP modules (CP3208 and CP3209) in place of the EC team project module (IS4102). CP3208 and CP3209 are independent study modules (ISMs) which will be counted as 2 USP Inquiry modules in Sciences and Technologies Basket.

5. They will be required to take 44 MCs (11 modules) from the Programme Electives. Among these modular credits, at least 12 MCs (3 modules) must be at level-4000.

Table 5: Summary of degree requirements for B.Comp. (E-Commerce)

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Sub totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIVERSITY LEVEL REQUIREMENTS</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>PROGRAMME REQUIREMENTS</td>
<td>120</td>
<td></td>
</tr>
</tbody>
</table>
## Core Modules

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>MCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS1010J</td>
<td>Programming Methodology</td>
<td>4</td>
</tr>
<tr>
<td>CS1020</td>
<td>Data Structures and Algorithms I</td>
<td>4</td>
</tr>
<tr>
<td>IS1103FC</td>
<td>Computing and Society</td>
<td>4</td>
</tr>
<tr>
<td>IS1105</td>
<td>Strategic IT Applications</td>
<td>4</td>
</tr>
<tr>
<td>IS1112FC</td>
<td>E-Business Essentials</td>
<td>4</td>
</tr>
<tr>
<td>IS2101</td>
<td>Business and Technical Communication</td>
<td>4</td>
</tr>
<tr>
<td>IS2150</td>
<td>E-Business Design and Implementation</td>
<td>4</td>
</tr>
<tr>
<td>CS3240</td>
<td>Interaction Design</td>
<td>4</td>
</tr>
<tr>
<td>IS3230</td>
<td>Principles of Information Security</td>
<td>4</td>
</tr>
<tr>
<td>IS3150</td>
<td>Digital and New Media Marketing</td>
<td>4</td>
</tr>
<tr>
<td>IS4150</td>
<td>Mobile and Ubiquitous Commerce</td>
<td>4</td>
</tr>
<tr>
<td>IS4102</td>
<td>E-Business Capstone Project</td>
<td>8</td>
</tr>
<tr>
<td>IS4260</td>
<td>E-Commerce Business Models</td>
<td>4</td>
</tr>
<tr>
<td>ST1131</td>
<td>Introduction to Statistics</td>
<td>4</td>
</tr>
</tbody>
</table>

## Programme Electives (PE)

**Programme Electives**

**Option 1:**
Choose 7 modules from the Programme Elective List below to make up 28 MCs. 3 of the 7 modules must be at level-4000.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>MCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS3235</td>
<td>Computer Security</td>
<td></td>
</tr>
<tr>
<td>IS3221</td>
<td>Enterprise Resource Planning Systems</td>
<td></td>
</tr>
<tr>
<td>IS3222</td>
<td>IT and Customer Relationship Management</td>
<td></td>
</tr>
<tr>
<td>IS3223</td>
<td>IT and Supply Chain Management</td>
<td></td>
</tr>
<tr>
<td>IS3242</td>
<td>Software Quality Management</td>
<td></td>
</tr>
<tr>
<td>IS3243</td>
<td>Technology Strategy and Management</td>
<td></td>
</tr>
<tr>
<td>IS3260</td>
<td>Health Informatics</td>
<td></td>
</tr>
<tr>
<td>IS3260</td>
<td>Gamification for Organisations and Individuals</td>
<td></td>
</tr>
<tr>
<td>IS3261</td>
<td>Mobile Apps Development</td>
<td></td>
</tr>
<tr>
<td>IS4224</td>
<td>Service Systems</td>
<td></td>
</tr>
<tr>
<td>IS4225</td>
<td>Strategic IS Planning</td>
<td></td>
</tr>
<tr>
<td>IS4226</td>
<td>IT Outsourcing and Offshoring Management</td>
<td></td>
</tr>
<tr>
<td>IS4227</td>
<td>Enterprise Service Oriented Architecture</td>
<td></td>
</tr>
<tr>
<td>IS4228</td>
<td>Information Technologies in Financial Services</td>
<td></td>
</tr>
<tr>
<td>IS4231</td>
<td>Information Security Management</td>
<td></td>
</tr>
<tr>
<td>IS4232</td>
<td>Topics in Information Security Management</td>
<td></td>
</tr>
<tr>
<td>IS4233</td>
<td>Legal Aspects of Information Technology</td>
<td></td>
</tr>
<tr>
<td>IS4234</td>
<td>Control and Audit of Information Systems</td>
<td></td>
</tr>
<tr>
<td>IS4240</td>
<td>Business Intelligence Systems</td>
<td></td>
</tr>
</tbody>
</table>

**Option 2:**
Choose CP4101 and 4 modules from Programme Elective List below to make up 28 MCs.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>MCs</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS3235</td>
<td>Computer Security</td>
<td></td>
</tr>
<tr>
<td>IS3221</td>
<td>Enterprise Resource Planning Systems</td>
<td></td>
</tr>
<tr>
<td>IS3222</td>
<td>IT and Customer Relationship Management</td>
<td></td>
</tr>
<tr>
<td>IS3223</td>
<td>IT and Supply Chain Management</td>
<td></td>
</tr>
<tr>
<td>IS3242</td>
<td>Software Quality Management</td>
<td></td>
</tr>
<tr>
<td>IS3243</td>
<td>Technology Strategy and Management</td>
<td></td>
</tr>
<tr>
<td>IS3260</td>
<td>Health Informatics</td>
<td></td>
</tr>
<tr>
<td>IS3260</td>
<td>Gamification for Organisations and Individuals</td>
<td></td>
</tr>
<tr>
<td>IS3261</td>
<td>Mobile Apps Development</td>
<td></td>
</tr>
<tr>
<td>IS4224</td>
<td>Service Systems</td>
<td></td>
</tr>
<tr>
<td>IS4225</td>
<td>Strategic IS Planning</td>
<td></td>
</tr>
<tr>
<td>IS4226</td>
<td>IT Outsourcing and Offshoring Management</td>
<td></td>
</tr>
<tr>
<td>IS4227</td>
<td>Enterprise Service Oriented Architecture</td>
<td></td>
</tr>
<tr>
<td>IS4228</td>
<td>Information Technologies in Financial Services</td>
<td></td>
</tr>
<tr>
<td>IS4231</td>
<td>Information Security Management</td>
<td></td>
</tr>
<tr>
<td>IS4232</td>
<td>Topics in Information Security Management</td>
<td></td>
</tr>
<tr>
<td>IS4233</td>
<td>Legal Aspects of Information Technology</td>
<td></td>
</tr>
<tr>
<td>IS4234</td>
<td>Control and Audit of Information Systems</td>
<td></td>
</tr>
<tr>
<td>IS4240</td>
<td>Business Intelligence Systems</td>
<td></td>
</tr>
</tbody>
</table>

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**Programme Elective List**

- CS4880 Digital Entrepreneurship
- IS3220 Service Science
- IS3240 Economics of E-Business
- IS3241 Enterprise Social Systems

- ACC1002X Financial Accounting
- ACC2002 Managerial Accounting
- **BSP1004X** Legal Environment of Business
- **BSP1005X** Managerial Economics
- DSC2006 Operations Management
- DSC3201 Supply Chain Management
- FIN2004 Finance
- MNO1001X Management and Organisation
- MKT1003X Principles of Marketing
- MKT2412 Global Marketing
- TR2201 Entrepreneurial Marketing
- TR2202 Technological Innovation
- TR3001 New Product Development

---

**Student Requirements:**

Students are required to choose 2 out of the 4 modules in this list:

- CS4880 Digital Entrepreneurship
- IS3220 Service Science
- IS3240 Economics of E-Business
- IS3241 Enterprise Social Systems

(All modules are 4 MCs).

---

**Student Requirements:**

Students are required to choose 3 modules from this list of School of Business modules:

- ACC1002X Financial Accounting
- ACC2002 Managerial Accounting
- **BSP1004X** Legal Environment of Business
- **BSP1005X** Managerial Economics
- DSC2006 Operations Management
- DSC3201 Supply Chain Management
- FIN2004 Finance
- MNO1001X Management and Organisation
- MKT1003X Principles of Marketing
- MKT2412 Global Marketing
- TR2201 Entrepreneurial Marketing
- TR2202 Technological Innovation
- TR3001 New Product Development

(All modules are 4 MCs).
64 Students can choose to take on any current 12 MCs or more internship-related programmes within the School of Computing (e.g., CP3880 Advanced Technology Attachment Programme (ATAP)) and/or within NUS (e.g., Innovative Local Enterprise Achiever Development (iLEAD) and NUS Overseas College (NOC)) in place of IS4010 Industry Internship Programme to satisfy the industry experience requirement.

65 Students are encouraged to use their unrestricted electives to take modules that will build up their business domain knowledge. Having a strong knowledge of a business domain will provide EC graduates a favourable advantage in employment opportunities in the industry.

3.2.11 Bachelor of Computing in Information Systems

Objective

The four-year IS programme will provide students with a deep appreciation of the organisational context of ICT; strong proficiency in the design and development of value-adding infocomm solutions; and strong proficiency in the cost effective management of infocomm projects. This multidisciplinary education on information systems focuses on the application and management of information technology to enhance the effectiveness of organisations and businesses. It also analyses the impact and trends of technology and the relevant implications for the economy and society.

IS graduates will be equipped with relevant knowledge to target short- to medium-term positions such as techno-strategist, ICT solutions architect, systems integrator, business process consultant/analyst, and infocomm project manager. Possible employers include end users of ICT, system integrators, consulting firms, market research firms, regulatory agencies and investment advisors.

Specialisations

Students can also package their own specialisations by reading modules that satisfy the specialisation requirements. Specialisations provide students the opportunity to gain focused, in-depth knowledge in specialised areas where information systems are deployed.

These two specialisations have been identified to be critical and essential in today’s business environment:

1. Services Science, Management and Engineering Specialisation
2. Information Security Specialisation

To be awarded with specialisations, students have to complete 6 modules (24 MCs) in the list of modules included for a specialisation.

Services Science, Management and Engineering Specialisation

For the Services Science, Management and Engineering Specialisation, students have to complete two compulsory modules:

- IS3220 Service Science
- IS4224 Service Systems

and choose four modules from the following elective modules:

- IS3221 Enterprise Resource Planning Systems
• IS3222 IT and Customer Relationship Management
• IS3223 IT and Supply Chain Management
• IS4225 Strategic IS Planning
• IS4226 IT Outsourcing and Offshoring Management
• IS4227 Enterprise Service-Oriented Architecture

Information Security Specialisation
For the Information Security Specialisation, students have to complete six modules from the following elective modules:
• CS3235 Computer Security
• IS3230 Principles of Information Security
• IS3242 Software Quality Management
• IS3261 Mobile Apps Development for Enterprise
• IS4231 Information Security Management
• IS4232 Topics in Information Security Management
• IS4233 Legal Aspects of Information Technology
• IS4234 Control and Audit of Information Systems

University Scholars Programme (Information Systems)

Students in the University Scholars Programme who choose the Bachelor of Computing (Information Systems) major will take the IS programme, but with the following variations:
1. They will not be required to read University Level Requirements (20 MCs). These are replaced by the 3 USP Inquiry Modules and 2 USP Foundation modules (Quantitative Reasoning Foundation and University Scholars Seminar).
2. They will not be required to read IS2101 Business and Technical Communication. It is replaced by USP Foundation module: Writing and Critical Thinking.
3. They will have 8 (instead of 20) MCs under Unrestricted Electives
4. They will read UROP modules (CP3208 and CP3209) in place of the IS team project module (IS3102). CP3208 and CP3209 are independent study modules (ISMs) which will be counted as 2 USP Inquiry modules in Sciences and Technologies Basket.
5. They will be required to take 24 MCs (6 modules) from the Programme Electives. Among these modular credits, at least 12 MCs (3 modules) must be at level-4000.

Table 6: Summary of degree requirements for B.Comp. (Information Systems)

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Sub totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIVERSITY LEVEL REQUIREMENTS</td>
<td></td>
<td>20</td>
</tr>
<tr>
<td>PROGRAMME REQUIREMENTS</td>
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<td>120</td>
</tr>
<tr>
<td>Core Modules</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>CS1010J Programming Methodology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1020 Data Structures and Algorithms I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1231 Discrete Structures</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS1103FC Computing and Society</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS1105 Strategic IT Applications</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS2101 Business and Technical Communication</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ACC1002X Financial Accounting</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Course Code</td>
<td>Course Title</td>
<td>Credits</td>
</tr>
<tr>
<td>-------------</td>
<td>--------------------------------------------------</td>
<td>---------</td>
</tr>
<tr>
<td>CS2100</td>
<td>Computer Organisation</td>
<td>4</td>
</tr>
<tr>
<td>CS2102</td>
<td>Database Systems</td>
<td>4</td>
</tr>
<tr>
<td>CS2105</td>
<td>Introduction to Computer Networks</td>
<td>4</td>
</tr>
<tr>
<td>IS2102</td>
<td>Requirements Analysis and Design</td>
<td>4</td>
</tr>
<tr>
<td>IS2103</td>
<td>Enterprise Systems Development Concepts</td>
<td>4</td>
</tr>
<tr>
<td>IS2104</td>
<td>Software Team Dynamics</td>
<td>4</td>
</tr>
<tr>
<td>IS3101</td>
<td>Management of Information Systems</td>
<td>4</td>
</tr>
<tr>
<td>IS3102</td>
<td>Enterprise Systems Development Project</td>
<td>8</td>
</tr>
<tr>
<td>IS4100</td>
<td>IT Project Management</td>
<td>4</td>
</tr>
<tr>
<td>MA1301</td>
<td>Introductory Mathematics</td>
<td>4</td>
</tr>
<tr>
<td>MA1521</td>
<td>Calculus for Computing</td>
<td></td>
</tr>
<tr>
<td>or</td>
<td>MA1312 Calculus with Applications</td>
<td></td>
</tr>
<tr>
<td>ST2334</td>
<td>Probability and Statistics</td>
<td>4</td>
</tr>
</tbody>
</table>

**Programme Electives (PE)** 24

**Option 1:**
Choose 7 modules to make up 28 MCs from the list of Programme Electives below. 3 of the 7 modules must be at level-4000.

**Option 2:**
Choose CP4101 and 4 modules to make up 28 MCs from the list of Programme Electives below.

CP4101  B.Comp. Dissertation

**Programme Elective List**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS2106</td>
<td>Introduction to Operating Systems</td>
</tr>
<tr>
<td>CS3235</td>
<td>Computer Security</td>
</tr>
<tr>
<td>CS3240</td>
<td>Interaction Design</td>
</tr>
<tr>
<td>IS3220</td>
<td>Service Science</td>
</tr>
<tr>
<td>IS3221</td>
<td>Enterprise Resource Planning Systems</td>
</tr>
<tr>
<td>IS3222</td>
<td>IT and Customer Relationship Management</td>
</tr>
<tr>
<td>IS3223</td>
<td>IT and Supply Chain Management</td>
</tr>
<tr>
<td>IS3230</td>
<td>Principles of Information Security</td>
</tr>
<tr>
<td>IS3240</td>
<td>Economics of E-Business</td>
</tr>
<tr>
<td>IS3241</td>
<td>Enterprise Social Systems</td>
</tr>
<tr>
<td>IS3242</td>
<td>Software Quality Management</td>
</tr>
<tr>
<td>IS3243</td>
<td>Technology Strategy and Management</td>
</tr>
<tr>
<td>IS3250</td>
<td>Health Informatics</td>
</tr>
<tr>
<td>IS3260</td>
<td>Gamification for Organisations and Individuals</td>
</tr>
<tr>
<td>IS3261</td>
<td>Mobile Apps Development for Enterprise</td>
</tr>
<tr>
<td>CS4880</td>
<td>Digital Entrepreneurship</td>
</tr>
<tr>
<td>IS4202</td>
<td>Global Virtual Project</td>
</tr>
<tr>
<td>IS4203</td>
<td>IT Adoption and Change Management</td>
</tr>
<tr>
<td>IS4224</td>
<td>Service Systems</td>
</tr>
<tr>
<td>IS4225</td>
<td>Strategic IS Planning</td>
</tr>
<tr>
<td>IS4226</td>
<td>IT Outsourcing and Offshoring Management</td>
</tr>
<tr>
<td>IS4227</td>
<td>Enterprise Service-Oriented Architecture</td>
</tr>
<tr>
<td>IS4228</td>
<td>Information Technologies in Financial Services</td>
</tr>
<tr>
<td>IS4231</td>
<td>Information Security Management</td>
</tr>
<tr>
<td>IS4232</td>
<td>Topics in Information Security Management</td>
</tr>
<tr>
<td>IS4233</td>
<td>Legal Aspects of Information Technology</td>
</tr>
<tr>
<td>IS4234</td>
<td>Control and Audit of Information Systems</td>
</tr>
<tr>
<td>IS4240</td>
<td>Business Intelligence Systems</td>
</tr>
<tr>
<td>IS4241</td>
<td>Social Media Network Analysis</td>
</tr>
<tr>
<td>IS4243</td>
<td>Information Systems Consulting</td>
</tr>
<tr>
<td>IS4250</td>
<td>Healthcare Analytics</td>
</tr>
</tbody>
</table>

**Specialisations**

To be awarded the Information Security Specialisation, students have to complete six modules from the following list of modules:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS3235</td>
<td>Computer Security</td>
</tr>
<tr>
<td>IS3230</td>
<td>Principles of Information Security</td>
</tr>
<tr>
<td>IS3242</td>
<td>Software Quality Management</td>
</tr>
<tr>
<td>IS3261</td>
<td>Mobile Apps Development for Enterprise</td>
</tr>
<tr>
<td>IS4231</td>
<td>Information Security Management</td>
</tr>
<tr>
<td>IS4232</td>
<td>Topics in Information Security Management</td>
</tr>
<tr>
<td>IS4233</td>
<td>Legal Aspects of Information Technology</td>
</tr>
<tr>
<td>IS4234</td>
<td>Control and Audit of Information Systems</td>
</tr>
</tbody>
</table>

To be awarded the Services Science, Management and Engineering Specialisation, students have to satisfy the following:
Compulsory modules:
- IS3220 Service Science
- IS4224 Service Systems

Choose four from the following list of modules:
- IS3221 Enterprise Resource Planning Systems
- IS3222 IT and Customer Relationship Management
- IS3223 IT and Supply Chain Management
- IS4225 Strategic IS Planning
- IS4226 IT Outsourcing and Offshoring Management
- IS4227 Enterprise Service-Oriented Architecture
- IS4010 Industry Internship Programme

Unrestricted Electives

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<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>12</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
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<tr>
<td>160</td>
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</tr>
</tbody>
</table>

66 MA1301 is waived for students with A-level Mathematics. The 4 MCs gained from the waiver are added to the MCs for Unrestricted Electives but need to be graded.

67 MA1521 to be chosen if student wants to keep the option of switching to the Computer Science stream.

68 Students can choose to take on any current 12 MCs or more internship-related programmes within the School of Computing (e.g., CP3880 Advanced Technology Attachment Programme (ATAP)) and/or within NUS (e.g., Innovative Local Enterprise Achiever Development (iLEAD) and NUS Overseas College (NOC)) in place of IS4010 Industry Internship Programme to satisfy the industry experience requirement.

69 Students are encouraged to use their unrestricted electives to take modules that will build up their business domain knowledge. Having a strong knowledge of a business domain will provide IS graduates a favorable advantage in employment opportunity in the industry.

3.2.12 Bachelor of Science in Business Analytics

Objective

The emerging phenomena of Big Data - large pools of data sets that can be captured, communicated, aggregated, stored, and analyzed - has presented companies and organisations with trillions of bytes of information about their customers, suppliers, and operations. Millions of networked sensors are also embedded in various devices such as mobile phones and tablet computers to sense, create, and communicate data. Big data is now part of every industry sector and function of the global economy. It is increasingly the case that modern economic activity, innovation, and growth have to take place with data and the related analytic processes, methods and outputs. The discipline of business analytics (BA) enables companies and organisations to realise the full potential of data generated from various business processes, sources and devices, thus improving their speed and effectiveness in generating business insights and intelligence for optimal decision making purposes.

Programme Introduction

The Bachelor of Science (Business Analytics) degree programme is an inter-disciplinary undergraduate degree programme offered by the School of Computing with participation from the Business School, Faculty of Engineering, Faculty of Science, and Faculty of Arts and Social Sciences. This is a four-year direct honours programme which offers a common two-year broad-based inter-disciplinary curriculum where all students will read modules in Mathematics, Statistics, Economics, Accounting, Marketing, Decision Science, Industrial and Systems Engineering, Computer Science and Information Systems. Students in their third and fourth years of study may choose elective modules from two lists of either functional or methodological elective modules. Functional elective modules span business functions or sectors of marketing, retailing, logistics, healthcare, etc. Methodological elective modules include those related to big data techniques, statistics, text mining, data mining, social network analysis, econometrics, forecasting, operations research, etc. In sum, these elective modules span the most exciting and challenging areas of business analytics practice in the industry today.

Programme Learning Objectives
Learning objectives of the Bachelor of Science (Business Analytics) degree programme are:

- To understand the conceptual and methodological foundations of analytical methods and techniques for business analytics, as referenced from disciplines such as computing, engineering, science, mathematics, statistics, business and economics
- To appreciate and understand current business analytics problems in the industry worldwide and be able to identify and resolve practically relevant business analytics questions and issues
- To apply appropriate analytic tools and techniques to resolve complex business analytics problems in various industry sectors and domains
- To cultivate the practices of independent and group learning on the part of students that will prepare them to function effectively for diverse careers in business analytics

Table 7: Summary of degree requirements for B.Sc. (Business Analytics)

<table>
<thead>
<tr>
<th>Modules</th>
<th>MCs</th>
<th>Sub totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNIVERSITY LEVEL REQUIREMENTS</td>
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<td>20</td>
</tr>
<tr>
<td>PROGRAMME REQUIREMENTS</td>
<td></td>
<td>120</td>
</tr>
<tr>
<td>Core Modules</td>
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<td>84</td>
</tr>
<tr>
<td>ACC1002X Financial Accounting</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>BT1101 Introduction to Business Analytics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1010S Programming Methodology</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>CS1020 Data Structures and Algorithms I</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>EC1301 Principles of Economics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS1103FC Computing and Society</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS1105 Strategic IT Applications</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS1112FC E-Business Essentials</td>
<td>4</td>
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</tr>
<tr>
<td>MA1311 Matrix Algebra and Applications, or MA1101R Linear Algebra I°</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>MA1521 Calculus for Computing, or MA1102R Calculus I°</td>
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</tr>
<tr>
<td>MKT1003X Marketing</td>
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<tr>
<td>BT2101 IT and Decision Making</td>
<td>4</td>
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<tr>
<td>IE2110 Operations Research I°, or DSC3214 Introduction To Optimisation</td>
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<tr>
<td>IS2101 Business and Technical Communication</td>
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<td>ST2131 Probability</td>
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<tr>
<td>ST2132 Mathematical Statistics</td>
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</tr>
<tr>
<td>BT3101 Business Analytics Capstone Project</td>
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<td></td>
</tr>
<tr>
<td>BT3102 Computational Methods for Business Analytics</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>DSC3215 Stochastic Models in Management</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>IS4240 Business Intelligence Systems</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>ST3131 Regression Analysis</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Programme Electives (PE)</td>
<td>24</td>
<td></td>
</tr>
</tbody>
</table>

**Option 1:**
Choose 6 modules to make up 24 MCs from both List A and List B, with at least 2 modules from each list. 5 of 6 modules must be at 4000 level.

**Option 2:**
Choose BT4101 and 3 modules to make up 24 MCs from both List A and List B, with at least 1
module from each list. 2 of 3 modules must be at 4000 level.

BT4101 B.Sc. Dissertation

List A (Functional):
DSC3224 Dynamic Pricing and Revenue Management
IE3120 Manufacturing Logistics
IS3240 Economics of E-Business
BT4211 Data-Driven Marketing
BT4212 Search Engine Optimization and Analytics
DSC4213 Analytical Tools for Consulting
IS4250 Healthcare Analytics
MKT4415C Seminars in Marketing: Applied Market Research

List B (Methodological):
DSC3216 Forecasting for Managerial Decisions
BSP4513 Econometrics: Theory & Practical Business Application
BT4221 Big Data Techniques and Technologies
BT4222 Mining Web Data for Business Insights
IS4241 Social Media Network Analysis
IE4210 Operations Research II
ST4240 Data Mining
ST4245 Statistical Methods for Finance

IS4010 Industry Internship Programme

UNRESTRICTED ELECTIVES

Grand Total

70 Students are encouraged to take these MA module options should they wish to pursue a more rigorous treatment of the subject topics covered.

71 Students are encouraged to take IE2110 should they wish to choose IE4210 as an elective module.

72 Students can choose to take on any current 12 MCs or more internship-related programmes within the School of Computing (e.g., CP3880 Advanced Technology Attachment Programme (ATAP)) and/or within NUS (e.g., Innovative Local Enterprise Achiever Development (iLEAD) and NUS Overseas College (NOC)) in place of IS4010 Industry Internship Programme to satisfy the industry experience requirement.

University Scholars Programme (Business Analytics)

Students in the University Scholars Programme (USP) who choose the Bachelor of Science (Business Analytics) degree programme will do so with the following variations:

- They will not be required to read IS2101 Business and Technical Communication in the Core modules requirement. It is replaced by USP Foundation module of Writing and Critical Thinking.
- They will read the UROP module (CP3208) in place of the Business Analytics Capstone Project module (BT3101) in the Core modules requirement. CP3208 is an independent study module (ISM) which will be counted as 1 USP Inquiry module in the Sciences and Technologies domain.
- They will not be required to read University Level Requirements (20 MCs). These are replaced by the 3 USP Inquiry modules and 2 USP Foundation modules (Quantitative Reasoning and University Scholars Seminar).
- They will not be required to read Unrestricted Electives (20 MCs). These are replaced by the USP Reflection module of Senior Seminar and 4 USP Inquiry modules.
- In summary, the breakdown of 12 USP modules will fit into these MCs requirement categories:
  - Core: 1 Foundation module (Writing and Critical Thinking replacing IS2101), 1 Inquiry module (CP3208/USP-ISM replacing BT3101)
  - ULR: 3 Inquiry modules and 2 Foundation modules
  - UE: 1 Reflection module and 4 Inquiry modules

3.2.13 Bachelor of Engineering in Computer Engineering
3.3 Multidisciplinary Programmes

3.3.1 Double Degree Programme with another Faculty within NUS

Students interested in pursuing a double degree with another faculty within NUS can do so by discussing their plans with their academic advisors, as well as the School of Computing’s Office of Undergraduate Programmes. Such a self-designed programme provides maximal flexibility for students to pursue multidisciplinary education that fits their goals of education.

Some of the self-planned popular double degree programmes are joint with Mathematics, Quantitative Finance, Business and Geography, to name a few.

Students will apply for the double degree programme by submitting their applications to the Vice-Dean (Undergraduate Programmes), School of Computing Undergraduate Office, after completing between 60 and 80 MCs. They must obtain the approval of the Faculty in which they are seeking to do the second degree, and ensure that they have met the minimum CAP requirement of 4.00 for consideration and acceptance into the second degree programme.

A student may decide to withdraw or can be asked to withdraw from the double degree programme by withdrawing from the second degree. However, he/she is not allowed to withdraw from the first degree (i.e., the originally offered degree) programme and transfer to the second degree programme. All modules which the student has taken to fulfil the requirements of the second degree will be reflected in the transcript and included in the computation of the CAP.

For Students admitted with effect from AY 2011/12 onwards:
Students who have not achieved a CAP of 4.00 in modules contributing to the original degree, and a CAP of 3.50 for the degree for any two consecutive semesters will be required to withdraw from the double degree programme by withdrawing from the second degree programme.

The NUS double degree framework is given below:

(A) University Level Requirements

Students need to satisfy one set of Singapore Studies (SS) and General Education Module (GEM) requirements only. The prevailing rules relating to satisfying the GEM requirements in the different subject groups shall apply. In accordance with the existing GEM requirements:

- Students taking double degree combinations involving degrees from Faculties in Group A (Science and Technology) and Group B (Humanities and Social Sciences) must take one GEM each from the Subject Group A and Subject Group B.
- Students taking double degree combinations in which one of the degrees is from the School of Design and Environment (which comes under both Group A and B) must take one GEM each from Group A and Group B.
- Students taking double degree combinations involving degrees from Faculties in Group A (Science and Technology) or within the same Faculty in Group A must take at least one GEM from Group B (Humanities and Social Sciences). Students taking double degree combinations involving degrees from Faculties in Group B (Humanities and Social Sciences) or within the same Faculty in Group B must take at least one GEM from Group A (Science and Technology).
- If a student reads GEMs which are cross-listed with the second programme, and uses them to fulfil the major requirement for the second degree, then the student should take other additional GEMs to fulfil the GE requirement.

Students will not be required to take breadth modules if the degrees are from two different Faculties, as modules taken from one Faculty will satisfy the breadth requirements of the other Faculty. Students must take breadth modules if the degrees are within the same Faculty.
(B) Faculty Requirements

A student reading for a double degree within the same Faculty will only need to fulfil one set of faculty requirements. If the two degrees are from two Faculties, both sets of faculty requirements will have to be fulfilled.

(C) Major Requirements

At least two thirds of each major must be fulfilled by distinct (i.e., not overlapping) modules. A minimum 60% of major credits of each of the degrees must be letter graded and factored in the CAP of each degree.

(D) Unrestricted Electives

Students will not be required to take Unrestricted Elective (UE) Modules. However, if UE modules are taken, these can be used to count towards the requirement of either degree programme. Modules double counted towards the major requirements of both degrees may not be double counted towards a Minor as well.

(E) Maximum Period of Candidature

The maximum period of candidature will be six years. The two degree programmes must be undertaken and completed within a single continuous candidature period (save for the usual provisions for leave of absence).

(F) Computation of CAP

- The CAP for both degree programmes will be computed separately and the two CAPs, one each for the respective degree programme will be reflected separately on the transcript.
- Students are required to classify their modules every semester by declaring which modules they want to use to fulfil the requirements of each of the two degrees.
- The grades from modules (Singapore Studies, GEMs, faculty requirements or majors) that may be double counted will be used twice to compute the CAP for each of the two degrees.
- If Unrestricted Elective (UE) modules have been taken, the grades obtained will be used to compute the CAP for either one of the two degrees.

(G) Minimum MC Requirements for Double Degrees

The minimum MC requirements for double degrees are as follows:
- Double Honours Degrees – 200 MCs
- Double Honours and Bachelor Degrees – 180 MCs
The actual total MCs will be dependent on the requirements of each of the two degrees and how much double counting is permitted as specified by the respective Faculties/Departments.

(H) Award of Degree

Two separate degrees will be awarded and two degree scrolls issued, one for each degree.

3.3.2 Double Degree Programme in Computer Science/ Information Systems and Business Administration/ Business Administration (Accountancy) (Honours/non-Honours)

Please refer to http://www.nus.edu.sg/registrar/nusbulletin/Otherprogs/ddp.html#5_4.

3.3.3 Double Degree Programme in Computer Science and Mathematics/Applied Mathematics (Honours/non-Honours)

Please refer to
3.3.4 Double Degree Programme with French Grandes Écoles

The School offers Double Degree programmes with French Grandes Écoles, École Polytechnique (X), École Centrale Paris (ECP), École Supérieure d’Electricité (Supéléc), École Nationale des Ponts et Chaussées (ENPC), École Nationale des Mines de Paris (ENSM), TELECOM ParisTech (École Nationale Supérieure des Télécommunications) and ENSTA ParisTech (École Nationale Supérieure de Techniques Avancées), seven premiere French institutions. The Double Degree Programme (DDP) with French Grandes Écoles provides the opportunities to learn from the best of both worlds, exposure to foreign cultures, networking with Singaporeans and foreigners, and proficiency in a third language.

Outstanding candidates for the double degree programme are selected in their first year. The successful candidates will undergo language preparation, spend their third and fourth year in the French institution, and return to NUS for their fifth (final) year. Students will graduate with a Diplôme d’Ingénieur from the French Grande École and a M.Sc. or M.Comp. from NUS.

For more details, please see the International Relations Office website:
http://www.nus.edu.sg/iro/nus/students/prog/others/ddpfrench/index.html

3.3.5 Double Major Programmes

A second major will consist of at least 48 MCs of modules of which:

1. Only 8 MCs can be double counted.
2. At least 16 MCs must be at Level-3000 or above.

The requirements of a Double Major are as follows:

(A) University Level Requirements

Students need to satisfy one set of Singapore Studies (SS) and General Education Module (GEM) requirements only. The prevailing rules relating to satisfying the GEM requirements in the different subject groups shall apply. Students will be required to take breadth modules but modules in the second major from outside the Faculty/School of the primary major can be counted towards these requirements.

(B) Faculty Requirements

Students need to fulfil the faculty requirements of the primary major.

(C) Major Requirements

Students are required to completely fulfil all the requirements of the primary major and the second major. Up to 8 MCs of the modules in the second major can be used to double count towards either the Faculty, Primary Major or Minor requirements.

Students may not need to take Unrestricted Elective (UE) Modules if the ULR and two majors add up to 160MCs or more. USP students must satisfy the prevailing USP requirements. The Advanced Modules can only be drawn from the primary major. The prevailing rules/policy concerning the S/U will apply for Double Major students.

(D) Computation of Cumulative Average Points (CAP)

Since students are graduating with only one degree, there will be a common CAP for both majors.

(E) Minimum MCs Requirements for Double Majors
The minimum MCs requirements for the Double Majors are as follows:

<table>
<thead>
<tr>
<th>Single Degree, Double Major Programmes</th>
<th>Minimum MC requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>With Honours</td>
<td>160</td>
</tr>
<tr>
<td>Without Honours</td>
<td>120</td>
</tr>
</tbody>
</table>

If the above minimum requirements are achieved, it would be possible to complete a Double Major with Honours in one subject within four years. The actual total MCs will depend upon the requirements of the second major.

**(F) Residency Requirement**

The residency requirement is 50% of the minimum required MCs for the Double Major programme or 80 MCs, whichever is the higher.

**(G) Maximum Period of Candidature**

The maximum period of candidature for a Double Major is the same as that for a single major under the same degree.

**(H) Awards**

A Double Major student will only be eligible for award of medals and prizes associated with the primary major unless the medal/prize is to be awarded for best performance in a module. The second major will only be mentioned in the transcript and not on the degree scroll.

3.3.5.1 Double Major in either Management or Management (Technology)

SoC students interested in doing a double major programme from the School of Business may refer to section B3 of Part II of this bulletin for double major in either Management or Management (Technology). Details on these two double major programmes are available at: http://bba.nus.edu/major.htm and http://bba.nus.edu/tech.htm respectively. Students are required to apply for the second major and each application will be reviewed on a case-by-case basis.

3.3.5.2 Double Majors in the Faculty of Arts and Social Sciences

SoC students can refer to: http://www.fas.nus.edu.sg/undergrad/toknow/academic_requirements/double_majors.html for details.

3.3.5.3 Double Majors in the Faculty of Science

SoC students can refer to: http://www.science.nus.edu.sg/undergraduates/curriculum/majors/ for details.

3.3.6 Minor Programmes

A Minor programme is a coherent course of study. It provides significant depth, but unlike a specialisation, it does so in an additional area outside of the Major. By doing this, it contributes to the breadth of learning envisaged for undergraduate education.

The modular credit (MC) requirement for a Minor programme should be at least 24 MCs. Up to 8MCs (out of 24MCs) may be used to meet the requirements for both the Minor and a Major or another Minor, subject to the agreement of the particular department(s), faculty/faculties or programme(s) hosting the Minor.
At least 12 MCs (out of 24 MCs) for any Minor programme must be taken from outside the entire set of modules that are listed for the major(s)/another minor that the student is taking/has taken.

Relevant General Education Modules (GEMs) may be included in the list of modules approved for a Minor. Students who read such a GEM may count it towards both the General Education and Minor requirements. The MCs under the Breadth and Unrestricted Elective module requirements can be used to satisfy the Minor programme requirements.

Modules counted towards fulfillment of the Minor requirements must be letter graded. A module taken on Satisfactory/Unsatisfactory basis cannot be used to satisfy the Minor requirements.

In normal cases, a minor can accept up to 8 MCs of ungraded substitutable modules read at an NUS partner university in the region under study, and a minimum standard of performance is achieved before credit transfer can be effected.

The Minor programme(s) will be reflected in the student’s transcript. Computing students are free to read any minor, subject to availability. Examples include Mathematics, Optical and Semiconductor Technology, and Technopreneurship minors.

The following two minors are offered to students outside the School of Computing:
- Computer Science
- Information Systems

### Minor in Computer Science

**Objective**

This minor will provide students from non-computing disciplines a competent level of programming skill, as well as basic knowledge in the fundamental fields of computing.

**Structure**

To be awarded a minor in Computer Science, students must pass six modules from the three categories below, with a total of at least 24 MCs.

**Category I:**
Complete the following three modules:

<table>
<thead>
<tr>
<th>CODE</th>
<th>TITLE</th>
<th>MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS1010/E/FC/S</td>
<td>Programming Methodology</td>
<td>4</td>
</tr>
<tr>
<td>CS1020</td>
<td>Data Structures and Algorithms I</td>
<td>4</td>
</tr>
<tr>
<td>CS2100</td>
<td>Computer Organisation</td>
<td>4</td>
</tr>
</tbody>
</table>

**Category II:**
Complete two modules from the following list:
3.3.6.2 Minor in Information Systems

Objective

Information Technology (IT) has become a key component of organisations today. Its impact is felt from the way organisations are structured all the way to the design, development, manufacture and marketing of products. It enables organisational and operational processes. It is also embedded in products and services. It is vital that this key resource is efficiently managed.

The aim of this minor is to introduce students to the key concepts involved in the management of IT. The target audience for this minor consists of both users of technology as well as providers of technology. The course should benefit would-be managers, engineers and entrepreneurs.

Structure

To be awarded a minor in Information Systems, a student must pass a total of six modules, with a total of at least 24 MCs. The student must pass these three modules:

Set A

<table>
<thead>
<tr>
<th>CODE</th>
<th>TITLE</th>
<th>MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT1001*</td>
<td>Introduction to Computing</td>
<td>4</td>
</tr>
<tr>
<td>IS1103</td>
<td>Computing and Society</td>
<td>4</td>
</tr>
<tr>
<td>IS1105</td>
<td>Strategic IT Applications</td>
<td>4</td>
</tr>
</tbody>
</table>

or

Set B

<table>
<thead>
<tr>
<th>CODE</th>
<th>TITLE</th>
<th>MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS1010/E/FC/S</td>
<td>Programming Methodology</td>
<td>4</td>
</tr>
</tbody>
</table>
and any three modules from the following list

<table>
<thead>
<tr>
<th>CODE</th>
<th>TITLE</th>
<th>MCS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IT2001*</td>
<td>Network Technology and Management</td>
<td>4</td>
</tr>
<tr>
<td>IS3101</td>
<td>Management of Information Systems</td>
<td>4</td>
</tr>
<tr>
<td>IS3150</td>
<td>Digital and New Media Marketing</td>
<td>4</td>
</tr>
<tr>
<td>IS3221</td>
<td>Enterprise Resource Planning Systems</td>
<td>4</td>
</tr>
<tr>
<td>IS3222</td>
<td>IT and Customer Relationship Management</td>
<td>4</td>
</tr>
<tr>
<td>IS3230</td>
<td>Principles of Information Security</td>
<td>4</td>
</tr>
<tr>
<td>IS3240</td>
<td>Economics of E-Business</td>
<td>4</td>
</tr>
<tr>
<td>IS3241</td>
<td>Enterprise Social Systems</td>
<td>4</td>
</tr>
<tr>
<td>IS3243</td>
<td>Technology Strategy and Management</td>
<td>4</td>
</tr>
</tbody>
</table>

* GEK1511 can be used to replace IT1001 to fulfil the minor requirements.

* Engineering students (Course codes: EEE%, CPE% and ENG1) are precluded from reading IT2001.

Note:
Some of these modules require prerequisites from outside this list. Students must have the prerequisites to take them.

### 3.4 Enrichment Programmes

#### 3.4.1 Advanced Technology Attachment Programme

The Advanced Technology Attachment Programme (ATAP) is a premium industrial attachment programme placing the better among our students in reputable and established organisations for the benefit of both. The objective of the six-month attachment programme is to enable students to apply their computing knowledge in computing-related projects through attachments at organisations.

ATAP aims to broaden students’ education by enabling them to appreciate the application of computing knowledge to industry-related projects. Students’ progress on projects will be monitored during attachment, and their performance will be assessed at the end of the attachment, based on the interim and final project reports. Students will be given 12 MCs with Completed Satisfactory (CS) grade upon successful completion of the programme.

For more details, please refer to: http://www.comp.nus.edu.sg/undergraduates/beyond_atap.html.

#### 3.4.2 Student Internship Programme

This internship programme is similar to ATAP in objective and quality, but unfolds in three rather than six months. It places students in established organisations, both local and overseas, so that they may work on industry related projects from government agencies and multinationals in sectors ranging from financial services to interactive digital media and bioinformatics research during their special terms which span from May to July annually. Students will receive 6 credits with Completed Satisfactory (CS) grade under CP3200 on successful completion of the internship.
3.4.3 Undergraduate Research Opportunity Programme

The School of Computing offers the Undergraduate Research Opportunity Programme (UROP) in Computing to provide opportunities for research in computing by talented undergraduate students.

The aim of this programme is to foster intellectual exchange and collaboration between undergraduates and academic staff members. It allows undergraduates to participate in active research at the School of Computing, and to experience first-hand the challenges and exhilaration of research, discovery and invention. Students will be working at the frontiers of computing research and this exposure will complement their coursework.

Students will conduct research under the supervision of faculty members of the School of Computing. Typically, the research involves the following activities: problem formulation, literature survey, attending research seminars, proposal and implementation of solution, evaluation, and documentation and presentation of results. The relative importance of each of the above research activities can vary widely, depending on the chosen research topic (ranging from basic research to applied research to innovative application development).

Two modules are offered under the UROP (Computing) programme:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>MCs</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP3208</td>
<td>Undergraduate Research in Computing I</td>
<td>4</td>
<td>Pass 60 MCs and with approval from respective department.</td>
</tr>
<tr>
<td>CP3209</td>
<td>Undergraduate Research in Computing II</td>
<td>4</td>
<td>CP3208</td>
</tr>
</tbody>
</table>

A student participating in UROP (Computing) takes a two module (8 MCs) sequence spread over two semesters – CP3208 in the first semester, followed by CP3209 in the second semester. Even though each UROP (Computing) module is a one semester module, it is understood that this will also include compulsory full-time research work during the vacation preceding the semester.

It is expected that the student will complete an initial research study on the project in CP3208 (vacation and first semester) and complete the research project in CP3209 (the following vacation and second semester).

Eligibility and Workload

To be eligible for UROP (Computing), a student must have
1. Completed the prerequisites of CP3208, and
2. A minimum CAP of 3.80 (out of 5).

A student who applies for UROP (Computing) is committed to take the two module (8 MCs) sequence of CP3208 and CP3209. CP3208 and CP3209 must be completed before (and not concurrently with) CP4101 (B. Comp. Dissertation). Therefore, a student should plan to finish the CP3208-CP3209 sequence before starting CP4101.

A student can take only one UROP (Computing) module per semester. CP3208 or CP3209 will contribute 4 MCs each to the semester workload.

Administration

The programme is administered by the Office of Special Programmes in the School of Computing. Application for UROP
(Computing) is open for either semester. Eligible students can get the application forms from the Office of Special Programmes. More details can be found at: http://www.comp.nus.edu.sg/undergraduates/beyond_urop.html

3.4.4 University Scholars Programme

The University Scholars Programme (USP) is a bold initiative to develop the personal, intellectual and leadership abilities of promising men and women enrolled at the National University of Singapore. It aims to foster active learners who can:

- Think and write critically, clearly and effectively;
- Synergise existing ideas, and create new ones;
- Make path-breaking connections within a discipline and among diverse disciplines; and
- Reflect deeply on themselves and their place in society.

The School of Computing is one of the participating faculties in the University Scholars Programme. Computing students who are admitted to the USP are called University Scholars. They can choose to read any one of these four-year honours programmes in the School:

- Bachelor of Engineering in Computer Engineering
- Bachelor of Computing in Computer Science
- Bachelor of Computing in E-Commerce and
- Bachelor of Computing in Information Systems.

Scholars will also have the unique privilege of declaring his or her final choice of faculty after three to four semesters (provided the criteria are met).

For details on the general University Scholars Programme requirements, please see the Scholars Programme website at: http://usp.nus.edu.sg

Specific requirements for Computing degrees

Students in the University Scholars Programme (USP) who opt for the School of Computing can choose any of the four-year programmes from the School. For each of these programmes, USP students will have to meet the same degree requirements as other SoC students but with the following variations:

All USP students will be taking the following under the Scholars Programme:

The three-tier structure will be as follows:

1. **Foundations**: 3 modules at 12 MCs

Three modules, all compulsory, are:

- Writing and Critical Thinking
- Quantitative Reasoning Foundation
- University Scholars Seminar

The modules will be offered at level-2000.

2. **Inquiry**: 8 modules at 32 MCs

Eight modules are divided equally between Humanities and Social Sciences and Sciences and Technologies baskets. Every USP student will take four modules from each basket. Students take at least one and up to three ISMs in place of regular inquiry modules. Each ISM will be counted as equivalent to one inquiry module in the appropriate basket. Modules will be offered at both levels 2000 and 3000, and will include current first-tier modules, and some current USP-based advanced modules.
3. **Reflection**: 1 module at 4 MCs

A single module, the Senior Seminar, designed to bring students together towards the end of their degree in order to reflect on disciplinary knowledge.

**Module Substitutions**

Students taking single degrees will be able to substitute a maximum of four inquiry modules. SEP students will be able to substitute two inquiry modules per semester of overseas study.

Please refer to the USP website at: http://usp.nus.edu.sg for more details.

3.4.5 **NUS Overseas Colleges Programme**

The NUS Overseas Colleges programme is an internship programme with strong emphasis on technology entrepreneurship. The focus is on internship in a high-technology start-up located in an entrepreneurial and academic hub. Selected candidates will spend 12 months with a high-technology start-up and be required to take entrepreneurship courses at a designated partner university.

This programme incorporates a Bachelor (Honours) (with technopreneurship minor) degree. NUS students who participate in any 12-month NOC programme can obtain up to 40 MCs maximum. The composition will be:

- 12 MCs (maximum) for entrepreneurship courses;
- 8 MCs for discipline based courses; and
- 20 MCs for internship work.

For more information on this programme, please refer to: http://www.nus.edu.sg/noc/

3.4.6 **Student Exchange Programme**

The NUS Student Exchange Programme (SEP) provides students with the opportunity to study in an overseas partner university, usually for a semester or two, with approval of the School, to further enhance their learning experience. Students from either partner university pay fees only at their home institution while on exchange. The new experience provided by SEP is a once-in-a-lifetime opportunity that will enrich the life of the student forever.

Some of the partner universities include Uppsala University, McMaster University, University of Texas Austin, University of British Columbia, McGill University, University of California, University of Melbourne, Carnegie Mellon University and University of Illinois, Urbana Champaign.


3.4.7 **Incubation Project**

Students who wish to experience the entrepreneurship spirit that permeates the School are welcome to bring their idea, put it into a business plan, and bring it into fruition. The School Incubation Centre provides support to students for their ideas to be germinated into a money-making business. Students could also earn credits towards their degree requirement through registering for CP3109 Incubation Project module. In this module, students will submit their reports to the Incubation Centre Review Committee. The committee will assess students' ability in managing and operating their companies.

Besides the various technopreneurship modules offered by NUS, the School also offers a module on digital entrepreneurship that cover trends in the digital marketplace and emerging high-growth opportunities for digital businesses. The module will highlight issues facing companies with new products and services in an ever-changing digital marketplace. It also focuses on opportunity identification and sources of competitive differentiation, particularly as they relate to digital innovation.
3.5 Financial Assistance and Awards

3.5.1 Faculty-administered Scholarships

The School administers the following scholarships:

- Computing Scholarship
- Kwan Im Thong Hood Cho Computing Scholarship
- Lim Hong Chin Memorial

Details can be found at: http://www.comp.nus.edu.sg/undergraduates/

3.5.2 Faculty-administered Awards/Funds

The School administers the following two Awards/Funds:

**Computing Alumni Assistance Award**

The Award will subsidise undergraduates special educational expenses and/or other financial requirements of self-contained educational programmes as determined by the Selection Panel for a one-off assistance up to a maximum value of THREE THOUSAND dollars ($3,000.00) per award.

More details can be found at: http://www.comp.nus.edu.sg/undergraduates/support_computing_alumni.html

**Computing Bursary**

The Bursary, established from the School’s pooled endowed fund, will serve as additional top-up to needy SoC students to cover their tuition fees. Needy students should apply to the Office of Financial Aid before they can be considered for this bursary. The School will provide top up of at least $500 per student per academic year subject to the availability of funds.

**Computing Student Development Fund**

The Fund will subsidise students’ overseas study trips and certification course such as those by SAP, IBM, Oracle and Sun and to send graduate students to participate in top academic conferences as determined by the Selection Panel for a one-off assistance up to a maximum value of ONE THOUSAND AND FIVE HUNDRED dollars ($1,500.00) per student per academic year.

More details can be found at: http://www.comp.nus.edu.sg/undergraduates/support_computing_stud_dev_fund.html

3.5.3 Faculty-administered Prizes

Medals and book prizes are awarded to top students at the various stages of study, in recognition of their outstanding academic performance, in addition to the Dean’s List. The following are faculty-administered prizes for undergraduates:

<table>
<thead>
<tr>
<th>Book Prizes</th>
<th>Basis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Prize</td>
<td>Best undergraduate student throughout the course of study in either Computing or Computer Engineering course</td>
</tr>
<tr>
<td>Tata Consultancy Services Asia Pacific Prizes</td>
<td>Best second- and third-year students throughout the course of study in either Computing or Computer Engineering course</td>
</tr>
</tbody>
</table>
4 Graduate Education

The Graduate Studies’ Office offers comprehensive postgraduate programmes through advanced and in-depth course curriculum, which develops and enhances the candidate’s knowledge, and prepares them to address the complex IT issues at their workplaces.

4.1 Research Programmes

The School welcomes graduates with good academic potential and strong interest in research to be a part of the Graduate Programme. A premier research-based programme leading to a doctoral degree, it is available in both the Department of Computer Science and Department of Information Systems.

Students in this programme spend the first two semesters on advanced courses before embarking on a research project that culminates in a research dissertation.

4.1.1 Degrees Offered

The School of Computing offers the following research degree programmes:
- Doctor of Philosophy (Ph.D.)
- Master of Science (M.Sc.), if the candidate fails the Qualifying Examination but is allowed to complete as a M.Sc. candidate

4.1.2 Degree Requirements

<table>
<thead>
<tr>
<th>Structure of Programme (Computer Science)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Year 1</strong></td>
</tr>
<tr>
<td>Semester 1</td>
</tr>
<tr>
<td>2 graduate modules + CS6101 (Exploration of CS Research)</td>
</tr>
<tr>
<td>Semester 2</td>
</tr>
<tr>
<td>2 graduate modules + Research</td>
</tr>
<tr>
<td><strong>Year 2</strong></td>
</tr>
<tr>
<td>Semester 1</td>
</tr>
<tr>
<td>2 graduate modules + QE</td>
</tr>
<tr>
<td>Semester 2</td>
</tr>
<tr>
<td>Research</td>
</tr>
<tr>
<td><strong>Year 3</strong></td>
</tr>
<tr>
<td>Semester 1</td>
</tr>
<tr>
<td>Research</td>
</tr>
<tr>
<td>Semester 2</td>
</tr>
<tr>
<td>Research + Thesis Proposal + Doctoral Seminar</td>
</tr>
<tr>
<td><strong>Year 4</strong></td>
</tr>
<tr>
<td>Semester 1</td>
</tr>
<tr>
<td>Research</td>
</tr>
<tr>
<td>Semester 2</td>
</tr>
<tr>
<td>Research</td>
</tr>
<tr>
<td>Ph.D. Defence (Seminar Presentation + Oral Defence)</td>
</tr>
</tbody>
</table>

CS Ph.D. candidates who are required to complete six graduate modules (24 modular credits) will need to take at least one module each in any three of the four clusters – Algorithm and Theory, Computer Systems, Knowledge Systems or Media Technologies. Out of the six graduate modules, at least two (8 modular credits) must be at level 6000, and at least another three modules must be at level 5000 (or above). These modules may belong to the four clusters or may be offered by other departments. CS Ph.D. students are allowed to take at most one level 4000 module. Students should complete all coursework requirements by the end of third semester.

Ph.D. students admitted to the Department of Information Systems (IS) will follow the structure for the IS Ph.D. programme:
All IS Ph.D. candidates are required to complete five common core modules, spanning the different streams of IS research. This is compulsory for all students to increase their breadth of knowledge. The five modules consist of three modules that cover research methods, one module that covers theories, and one module for a seminar on recent topics in all three IS research tracks (behavioral, technical, and economics).

Upon completion of the common core modules, IS Ph.D students would be directed to a more structured set of modules in one of the three different tracks that they can choose from. Based on their choice of track, they will follow a logically structured curriculum of two track core and two electives modules that ensures breadth and depth of knowledge in their area.

All Ph.D. candidates are required to achieve a minimum CAP of 3.5 (B grade) for the modules taken.

All PhD candidates must pass their Qualifying Examination I (QE I) within 18 months after admission. A maximum of two attempts will be allowed.

Students of both departments are expected to work on the graduate research paper (GRP) with a faculty member immediately after the first semester’s exam, and to participate in lab activities with the view of producing a quality paper that can eventually lead to at least a rank two and above publication/journal by the third semester. The GRP is part of the Qualifying Examination (QE II) requirement.

The student is expected to show competence in embarking on the Ph.D. research. The GRP presentation will be evaluated by a panel at the end of the third semester.

Ph.D. students taking the CS QE are evaluated based on a research-based paper which should contain critical review of research papers and demonstrates problem-solving abilities of the student, both assigned by the student’s supervisor. The QE paper will be assigned according to one of the six research clusters for evaluation (Algorithms and Theory, Artificial Intelligence, Computer Systems, Database and Data Mining, Media or Programming Languages and Software Engineering). Students will be required to give a presentation to the panel.

All students’ Thesis Advisory Committee (TAC) will be set up after passing the QE, and the student should present his/her research to the TAC. This is to ensure that the TAC is in touch with the student’s research progress.

By end of Year 3, candidates are expected to complete their thesis proposal. The thesis proposal should highlight the significance of the research topic, its goal, the approach adopted, and work to be done. It should be precise and
convincing to the examiners that the candidate is proposing a novel area of research and the goal is achievable. The thesis proposal comprises of an open seminar presentation (doctoral seminar), followed by a close-door oral examination. Those who pass the thesis proposal will proceed to the final phase of research. Ph.D. students are normally expected to finish their Ph.D. candidature within four years by passing the thesis examination and oral defence.

**Duration of Programme**

The following maximum candidature periods are inclusive of periods of approved study leave:

- Masters: 36 months
- Ph.D.: 60 months

### 4.1.3 Financial Assistance and Awards

**NUS Research Scholarship**

Financial Assistance in the form of the NUS Research Scholarship is available, on a competitive basis to all full-time students who meet the criteria. The Research Scholarship will carry monthly emoluments, plus full tuition fee subsidy. Candidates with good undergraduate degrees in computer science or information systems are invited to apply for research scholarships. These are for pursuing full-time Ph.D. programme in the School. They are tenable for one year in the first instance and renewable annually for up to four years for Ph.D. candidates, subject to satisfactory performance. Research scholars who passed their Ph.D. Qualifying Examination will be awarded an additional top up of S$500 per month during their Ph.D. candidature.

**Teaching Assistantships**

Research scholars are required to assist in departmental work such as conducting tutorials/laboratory demonstration, preparation of teaching materials, invigilating at examinations etc., subject to the following conditions:

- The total time spent on teaching duties and other departmental work must not exceed 16 hours a week (1st April to 31st March).
- The assignment of teaching duties and departmental work would be subject to the satisfactory progress of the research scholar.
- Remunerations for teaching duties and departmental work range from S$30 to S$60 per hour. Research scholars are to perform such work for up to 6 hours per week without any remuneration for one semester after having passed their QE.

**Graduate Awards**

The following graduate awards are given to encourage and recognise continuous and sustained research excellence in graduate research students:

**Research Achievement Award**

This award will be given to outstanding Ph.D. students each academic year, encouraging students to strive towards continuous research achievement during their Ph.D. candidature.

**Award Criteria:**

1. Be either a full-time or part-time Ph.D. student throughout the whole semester at the time of award presentation.
2. Achieved outstanding performance (over a one-year period) in terms of:
   - Publications in Rank-1 journals/conferences
   - Registration for patent
   - Significant system development of either commercial interest or wide usage by organisations not related to the development work
3. In all cases, the student must be a significant contributor/primary author of the achievement.
4. Awards will be given out twice a year.

The recipients of this award will each receive a certificate and $250 cash prize.

**Dean’s Graduate Research Excellence Award**

The Dean’s Graduate Award is a prestigious award to be given to senior Ph.D. students who have made significant research achievements during their Ph.D. study, and the award criteria are:

- Deserving recipients to be given this award once throughout their candidature;
- Nomination to be made by supervisors;
- Award only given once per academic year;

Winners will each receive a certificate and $1,000 cash prize.

The judging criteria for Dean’s Graduate Awards will be the same as the Research Achievement Award. In addition, nominees must produce strong evidence of sustained research achievements during their course of study.

Students who have been awarded one of the awards will not be able to receive the other simultaneously.

**Part-time Employment: Graduate Student Researcher (GSR)**

**Duties**

- To assist the Principal Investigator (PI) in specific research duties.

**Eligibility**

- All full or part-time graduate students (except NUS Staff).
- International Student
  - Maximum working hours is capped at 16 hours per week.
  - Non-graduating (exchange and non-exchange) students are not eligible to apply.
- Local Student (Singaporean/SPR)
  - For Research Scholar, maximum working hours is capped at 16 hours per week.
  - For non-Research Scholar, no limit to number of working hours.

**Remuneration**

S$12 per hour (Bachelor’s degree)
S$15 per hour (at least Honours or equivalent)

4.2 Coursework Programmes

The Master of Computing Programme is a comprehensive and challenging graduate programme with area specialisations. It encompasses latest research findings, both applied and fundamental. The programme also provides advanced and in-depth knowledge of IT to prepare the students for challenges in IT career.

4.2.1 Degrees Offered

- Master of Computing
- Master of Science in Business Analytics
4.2.2   Degree Requirements

4.2.2.1   Master of Computing

The Master of Computing programme (M.Comp.) offered by the School of Computing, is a comprehensive and challenging graduate programme with area specialisations. It encompasses latest research findings, both applied and fundamental. The programme also provides advanced and in-depth knowledge of IT to prepare the students for challenges in IT career.

Degree Requirements

Structure of Programme

Students are required to pass ten modules, with at least five modules selected from one of the following specialisations:
- Computer Science; or
- Infocomm Security; or
- Information Systems

The remaining five modules can be chosen from Level-5000 to 6000 modules offered by the School of Computing. Students are allowed a maximum of two Level-4000 modules and two modules (must be at least Level-5000) from other faculties.

The details of the pool of modules available are listed in Annex A in our website:
http://www.comp.nus.edu.sg/graduates/m_structure.html

Dissertation Option

The Master of Computing students will be allowed the flexibility of taking the dissertation option which is equivalent to FOUR graduate level modules (16 modular credits).

The dissertation option gives individual students the opportunity for independent study and research in the area of their selected specialisation. This will be carried out under the supervision of an academic staff, and the selection of the topic/area will be done in consultation with the supervisor in the area of expertise.

Duration of Programme

Part-time and full-time candidates taking M.Comp. programme must complete the coursework requirements within the period as shown:

<table>
<thead>
<tr>
<th></th>
<th>Part-Time</th>
<th>Full-Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Candidature</td>
<td>2 years</td>
<td>1 year</td>
</tr>
<tr>
<td>Maximum Candidature</td>
<td>3 years</td>
<td>3 years</td>
</tr>
</tbody>
</table>

Workload

The maximum and minimum workload for part-time candidates are 12 and 4 modular credits respectively, while the maximum and minimum workload for full-time candidates are 20 and 12 modular credits respectively.

Graduation Requirements

Candidates must achieve a final CAP of 3.0 (average grade of B-) to graduate, otherwise their candidature will be
A. Financial Assistance and Awards

Loans

All students who are enrolled in full-time coursework programme can request for loans up to 90 percent of their fees. For more information, please refer to: http://www.nus.edu.sg/registrar/edu/gd-fees.html

Awards

In recognition of the excellent performance of the graduate coursework students, the Microsoft Prize will be awarded to the Master of Computing student with the best cumulative average point (CAP) throughout the course of study.

4.2.2.2 Master of Science in Business Analytics

Please refer to Section XX of Part II of this bulletin for details.