Note: The department/program code ACS replaces the former codes 92 and 91. Students cannot hold credit in ACS-xxxx and the former 92.xxxx or 91.xxxx having the same course number (e.g., ACS-1803(3) and 92.1803(3) or 91.1803(3)).

Chair: Professor S. Liao; Professors: Y. Chen, S. Ramanna; Associate Professor: P. Atrey, S. Camorlinga; Assistant Professors: C. Henry, R. McFadyen; Instructors: J. Deng, E. Kaluzniacky.

http://www.acs.uwinnipeg.ca

DEGREES/PROGRAMS OFFERED

3-Year BA
4-Year BA
3-Year BA (Information Systems Stream)
3-Year BA (Health Informatics Stream)
3-Year BSc
4-Year BSc
Honours BSc
3-Year BSc (Information Systems Stream)
3-Year BSc (Health Informatics Stream)
Minor

Master of Science (MSc) – more information can be found in the Graduate Academic Calendar

INTRODUCTION

The Applied Computer Science major is designed to prepare students in the following core areas: Programming Fundamentals (object-oriented, event driven, algorithms), Information Management (database systems, data modeling, data warehousing, relational databases, query languages), Software Engineering (software requirements and design, software process, software project management), Operating Systems, Net-Centric Computing (internet programming, networks, security), Human Computer Interaction (GUI Design and Programming), Intelligent Systems (Machine Learning).

Our team-oriented courses are meant to strengthen communication skills, experience group dynamics, and foster self-confidence. The 4-year major includes the development of a team-based software project for a local IT organization. Our program will help develop analytical thinking and applied skills by blending theoretical and practical aspects of computer science.

The Applied Computer Science program can lead to a Bachelor of Science (3-year, 4-year, or Honours) or a Bachelor of Arts (3-year or 4-year). This major is focused in theories, professionalism, and fundamental computing knowledge. We recommend the four-year degree programs due to the greater depth of study. Additionally, there are two streams: Information Systems and Health Informatics. The Applied Computer Science major is designed to provide an excellent basis for graduate studies in either computer science or applied computing.

The Information Systems stream leads to a Bachelor of Science (3-year) or a Bachelor of Arts (3-year). The Information Systems (IS) stream is aimed at students interested in focusing on information and business needs of IT industry. The new stream is intended to prepare students in information oriented courses, and also in system and internet based technologies.

The Health Informatics stream leads to a Bachelor of Science (3-year) or a Bachelor of Arts (3-year). The Health Informatics (HI) stream provides students with more focused courses in Health information needs, infrastructure, standards, and jurisdiction. The HI stream complements offerings of the ACS department, and gives students flexibility of combining all three areas of IT, Business, and Health.

Students pursuing a 3-year or 4-year BSc in Applied Computer Science, including the IS and HI Streams, have the opportunity to take a Business Stream (see the “Science with a Business Stream” section of this Course Calendar). The Applied Computer Science program is designed to provide an excellent basis for graduate studies in computer science, information sciences, or interdisciplinary areas such as Biostatistics.

The Department offers a Masters Degree in Applied Computer Science and Society.
REQUIREMENTS FOR A 3-YEAR BA/BSc IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT  
Pre-Calculus Mathematics 40S or Applied Mathematics 40S.

GRADUATION REQUIREMENT  
90 credit hours

RESIDENCE REQUIREMENT  
Degree: Minimum 30 credit hours  
Major: Minimum 18 credit hours

GENERAL DEGREE REQUIREMENT  
Humanities: 12 credit hours in Humanities  
Science: 6 credit hours in Science for BA  
18 credit hours in Science for BSc  
Writing: Minimum 3 credit hours of Academic Writing.  
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of  
6 credit hours may be below the 1000 level.  
Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT  
Single Major: Minimum 36 credit hours/Maximum 48 credit hours in the Major subject.  
Major courses are those in Required Courses and Electives.  
Double Major: 36 credit hours in ACS, plus number of credit hours specified by other Major subject or program

Required courses:  
MATH-1401(3) Discrete Mathematics  
STAT-xxxx(3) 3 credit hours from Statistics  
Either  
ACS-1903(3) Programming Fundamentals I and  
ACS-1904(3) Programming Fundamentals II  
OR  
ACS-1905(3) Programming Fundamentals  
OR  
the courses from the electives listed below.  
ACS-2906(3) Computer Architecture and System Software  
ACS-2909(3) Internet Programming  
ACS-2913(3) Software Requirements Analysis and Design  
ACS-2814(3) Applications of Database Systems  
ACS-2941(3) Unix  
ACS-3902(3) Database Systems  
ACS-3913(3) Software Design and Architecture

Electives: Students wishing to take further courses towards the General degree with the Applied Computer Science Major should take up to 12 credit hours from the following:

ACS-1803(3) Introduction to Information Systems  
ACS-2102(3) Scientific Computing  
ACS-2916(3) Business Application Systems  
ACS-2951(3) System Administration and Networking  
ACS-3901(3) Principles of Software Project Management  
ACS-3907(3) eCommerce  
ACS-3908(3) Introduction to Perl  
ACS-3909(3) Advanced Internet Programming  
ACS-1903(3) Programming Fundamentals I  
ACS-1904(3) Programming Fundamentals II  
ACS-2814(3) Application of Database Systems  
ACS-2909(3) Internet Programming  
ACS-1903(3) Programming Fundamentals I  
ACS-2102(3) Scientific Computing

Required courses:  
ACS-1903(3) Programming Fundamentals I  
ACS-1904(3) Programming Fundamentals II  
ACS-2814(3) Application of Database Systems  
ACS-2909(3) Internet Programming  
ACS-2913(3) Software Requirements Analysis and Design

Additional Information:  
Students are strongly advised to take more than 36 credit hours in Applied Computer Science.  
Students who wish to strengthen their business background are advised to take courses in Administrative Studies.

Red River College  
The Department of Applied Computer Science welcomes the transfer of Red River College students into the 3-Year Applied Computer Science program. The University of Winnipeg will grant a total of 30 credit hours in transfer credits to Red River College students who have successfully completed the Computer Analyst/Programmer (CAP) or the Information Systems Technology (IST) 2-year Diploma programs with an average of C+ (2.5 GPA) or better. These credits can be applied to either a Science or an Arts degree. Further details regarding the transfer of credits and course requirements are available from the Department of Applied
REQUIREMENTS FOR A 3-YEAR BA/BSc (INFORMATION SYSTEMS STREAM)

ADMISSION REQUIREMENT
Essential/Consumer Math, Pre-Calculus Math 40s or Applied Math 40s.

GRADUATION REQUIREMENT
90 credit hours

RESIDENCE REQUIREMENT
Degree: Minimum 30 credit hours
Major: Minimum 18 credit hours

GENERAL DEGREE REQUIREMENT
Humanities: 12 credit hours in Humanities
Science: 6 credit hours in Science for BA
Writing: Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT
Single Major: Minimum 36 credit hours/Maximum 48 credit hours in the Major subject.
Major courses are those in Required Courses and Electives.
Double Major: 30 or 36 credit hours in each Major subject or program, as specified.

Required courses:

Year 1 courses: 9 credit hours
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming and
ACS-1903(3) Programming Fundamentals I
OR
ACS-1903(3) Programming Fundamentals I and
ACS-1904(3) Programming Fundamentals II
OR
ACS-1905(3) Programming Fundamentals and one of
the ACS courses at 2000 level or above

Year 2 courses: 12 credit hours
ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and
Design
ACS-2916(3) Business Application Systems

Electives: Students wishing to take further ACS courses towards the General degree with the Information Systems stream may take a maximum of 12 credit hours from the following:
ACS-2941(3) Unix
ACS-3830(3) Topics in Information Systems
ACS-3902(3) Database Systems
ACS-3909(3) Advanced Internet Programming
ACS-3913(3) Software Design and Architecture

Additional Electives: The following courses may also be of interest to students in this program:

Business and Administration
BUS-1201(3) Introduction to Business I
BUS-1202(3) Introduction to Business II
BUS-2003(3) Introduction to Managerial Accounting
BUS-2103(3) Fundamentals of Organizational
Behaviour
BUS-2210(3) Fundamentals of Marketing
BUS-2501(3) Fundamentals of Production and
Operational Management

Economics
ECON-1104(3) Introduction to Economic Theory

Mathematics and Statistics
MATH-1102(3) Basic Calculus
MATH-1201(3) Linear Algebra I
MATH-1401(3) Discrete Mathematics
STAT-xxxx(3) any course in Statistics

Conflict Resolution Studies
CRS-1200(6) Introduction to Conflict Resolution Studies
CRS-2210(3) Conflict Theory and Analysis
REQUIREMENTS FOR A 3-YEAR BA/BSc (HEALTH INFORMATICS STREAM)

ADMISSION REQUIREMENT
Essential/Consumer Math, Pre-Calculus Math 40s or Applied Math 40s

GRADUATION REQUIREMENT
90 credit hours

RESIDENCE REQUIREMENT
Degree: Minimum 30 credit hours
Major: Minimum 18 credit hours

GENERAL DEGREE REQUIREMENT
Humanities: 12 credit hours in Humanities
Science: 6 credit hours in Science for BA
18 credit hours in Science for BSc
Writing: Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT
Single Major: Minimum 36 credit hours/Maximum 48 credit hours in the Major subject.
Double Major: 30 or 36 credit hours in each Major subject or program, as specified.

Required courses:

Year 1 courses: 12 credit hours
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming and
ACS-1903(3) Programming Fundamentals I
OR
ACS-1903(3) Programming Fundamentals I and
ACS-1904(3) Programming Fundamentals II
OR
ACS-1905(3) Programming Fundamentals and
one of the ACS courses at 2000 level or above
ACS-1809(3) Web Design and Development

Year 2 courses: 12 credit hours
ACS-2814(3) Applications of Database Systems
ACS-2816(3) Health Information Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

Year 3 courses: 12 credit hours
ACS-3801(3) Principles in Information Systems
(Health Centric)
ACS-3901(3) Principles of Software Project Management
ACS-3816(3) Human Computer Interaction
ACS-3830(3) Topics in Information Systems (Health Centric)
ACS-3700(3) Health Internship
ACS-3923(3) Technical Writing
ACS-3902(3) Database Systems

Electives: Students wishing to take further ACS courses towards the General degree with the Health Information Systems stream may take a maximum of 12 credit hours from the following. Please note that some of these courses may have additional prerequisites.

ACS-2916(3) Business Application Systems
ACS-2941(3) UNIX
ACS-3902(3) Database Systems
ACS-3907(3) eCommerce
ACS-3909(3) Advanced Internet Programming
ACS-3911(3) Computer Networks
ACS-3913(3) Software Design and Architecture

Additional Electives: The following courses may also be of interest to students in this program:

Business and Administration
BUS-2003(3) Introduction to Managerial Accounting
BUS-2103(3) Fundamentals of Organizational Behaviour
BUS-2210(3) Fundamentals of Marketing
BUS-2501(3) Fundamentals of Production and Operational Management

Economics
ECON-1104(3) Introduction to Economic Theory

Geography
GEOG-1102(3) Introductory Human Geography – People, culture and environment

Kinesiology
KIN-2304(3) Scientific Principles of Fitness and Conditioning
KIN-2501(3) Nutrition for Health and Wellness

Psychology
PSYC-2700(3) Introduction to Clinical Psychology
REQUIREMENTS FOR A 4-YEAR BA IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT
Students must consult with the Department 4-Year Advisor in planning their studies. Students must have minimum 30 credit hours completed previously.

GRADUATION REQUIREMENT
120 credit hours

RESIDENCE REQUIREMENT
Degree: Minimum 60 credit hours
Major: Minimum 30 credit hours

GENERAL DEGREE REQUIREMENT
Humanities: 12 credit hours
Science: 6 credit hours
Social Science: 12 credit hours
Writing: Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT
Single Major: Minimum 57 credit hours/Maximum 66 credit hours.
Cognates: Minimum of 18 credit hours, maximum of 36 credit hours from Group III.
Required/Electives courses: Group I. See the 4-Year BSc Requirements.
Group II. See the 4-Year BSc Requirements.
Group III. A total of 18 credit hours must be chosen from at most three departments that offer a BA. Of these, 6 credits must be at least at the 2000 level or above. You are strongly advised to consult the Chair or the 4-Year Advisor prior to taking any Group III courses.
Combined Major: Minimum 60 credit hours from two different majors with not less than 24 credit hours from each major subject.

Prescribed courses:
ACS-1903(3) Programming Fundamentals I
ACS-1904(3) Programming Fundamentals II
ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design

REQUIREMENTS FOR A 4-YEAR BSc IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT
Students must consult with the Department 4-Year Advisor in planning their studies. Students must have minimum 30 credit hours completed previously.

GRADUATION REQUIREMENT
120 credit hours, that is, 90 credit hours meeting the requirements for the BA or BSc General plus 30 credit hours of additional credit hours.

RESIDENCE REQUIREMENT
Degree: Minimum 60 credit hours
Major: Minimum 30 credit hours

GENERAL DEGREE REQUIREMENT
Humanities: 12 credit hours
Science: 6 credit hours
Writing: Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Distribution: Minimum three (3) credit hours from each of five (5) different subjects.

MAJOR REQUIREMENT
Single Major: Minimum 57 credit hours/Maximum 78 credit hours.
Major courses are those listed in Groups I and II below.
18 credit hours in Group III.
Required courses:

Group I:
- MATH-1401(3) Discrete Mathematics
- STAT-xxxx(3) 3 credit hours from Statistics

Either
- ACS-1903(3) Programming Fundamentals I
- ACS-1904(3) Programming Fundamentals II

OR
- ACS-1905(3) Programming Fundamentals and one of the courses at 2000 level or above from the Group II electives.

ACS-2814(3) Applications of Database Systems
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2947(3) Data Structures and Algorithms
ACS-3901(3) Principles of Software Project Management

Select 9 credits from the following list:
- ACS-3909(3) Advanced Internet Programming
- ACS-3921(3) Computer Security and Privacy
- ACS-3941(3) Implementation Issues in Object-Oriented Languages
- ACS-3947(3) Algorithm Design
- ACS-3954(3) Introduction to Distributed Systems

Group II Electives: Students wishing to take further courses towards the 4-Year Degree should take up to 21 credit hours from the following:

- MATH-1201(3) Linear Algebra 1
- ACS-1803(3) Introduction to Information Systems
- ACS-2916(3) Business Application Systems
- ACS-2941(3) Unix
- ACS-2951(3) System Administration and Networking
- ACS-3907(3) eCommerce
- ACS-3908(3) Introduction to Perl
- ACS-3921(3) / 4921(3) Computer Security and Privacy

Group III Other Courses: A total of 18 credit hours must be chosen from at most three of the following departments: Business and Administration, Biology, Chemistry, Geography, Physics, Mathematics and Statistics. Of these, 6 credits must be at least at the 2000 level or above. You are strongly advised to consult the Chair or the 4-Year Advisor prior to taking any Group III courses.

Additional Courses:
- Students wishing to take further courses towards the 4-Year degree may select additional Applied Computer Science courses not already taken from Group II listed above.
- Students are encouraged to take more than 57 credit hours in Applied Computer Science.
- Students wishing to take ACS-2916(3) Business Application Systems must complete ACS-1803(3).
- Students wishing to take ACS-4954(3) Introduction to Distributed Systems are encouraged to take ACS-2941(3) or ACS-2951(3).
- Students wishing to pursue the 4-Year degree must consult with the Chair of Applied Computer Science and complete a 4-Year declaration form before registering for their eleventh course (63rd credit hour).

Combined Major: Minimum 60 credit hours from two different majors with not less than 24 credit hours from each major subject.

Prescribed courses:
- ACS-1903(3) Programming Fundamentals I
- ACS-1904(3) Programming Fundamentals II
- ACS-2814(3) Applications of Database Systems
- ACS-2909(3) Internet Programming
- ACS-2913(3) Software Requirements Analysis and Design

REQUIREMENTS FOR THE BSc (HONOURS) IN APPLIED COMPUTER SCIENCE

ADMISSION REQUIREMENT
Students must consult with and have the approval of the Department Chair or Chair-designate in planning their studies.
Students must have completed 30 credit hours.

GRADUATION REQUIREMENT
120 credit hours.
GRADUATION GPA REQUIREMENT
To graduate with a BSc (Honours), students must have a minimum GPA of 3.0 in all major (Applied Computer Science) courses which will be calculated on all course attempts in the major, and a minimum GPA of 2.75 in all non-major courses which will be calculated as for the general degree.

RESIDENCE REQUIREMENT
Degree: Minimum 60 credit hours
Honours: Minimum 30 credit hours, including 18 credit hours at the upper level (3000/4000) of which a minimum of 9 credit hours are at the 4000 level.

GENERAL DEGREE REQUIREMENT
Humanities: 12 credit hours
Writing: Minimum 3 credit hours of Academic Writing.
Maximum Introductory Courses: Students may use a maximum of 42 credit hours at the 1000 level. Of these, a maximum of 6 credit hours may be below the 1000 level.
Minimum three (3) credit hours from each of five (5) different subjects.

HONOURS REQUIREMENT
Single Honours: Minimum 60 credit hours in the Major.
Minimum 30 credit hours in the courses listed in Groups I at the upper level (3000/4000) of which a minimum of 15 credit hours must be at the 4000 level.

Required courses:
Group I:
MATH-1401(3) Discrete Mathematics
STAT-xxxx(3) 3 credit hours from Statistics
ACS-1903(3) Programming Fundamentals I and
ACS-1904(3) Programming Fundamentals II
OR
ACS-1905(3) Programming Fundamentals and one of the courses at 2000 level or above from the Group II electives.
ACS-2814(3) Applications and Database Systems
ACS-2906(3) Computer Architecture and System Software
ACS-2909(3) Internet Programming
ACS-2913(3) Software Requirements Analysis and Design
ACS-2947(3) Data Structures and Algorithms
ACS-3901(3) Principles of Software Project Management
ACS-3902(3) Database Systems
ACS-3911(3) Computer Networks
ACS-3913(3) Principles of Operating Systems
ACS-3916(3) Software Design and Architecture
ACS-4901(3) Senior Systems Development Project
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4921(3) Computer Security and Privacy
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems
ACS-4930(3) Topics in Applied Computer Science
ACS-4941(3) Implementation Issues in Object-Oriented Languages
ACS-4947(3) Algorithm Design
ACS-4950(3) Research Project in Applied Computer Science
ACS-4951(3) Research Project in Applied Computer Science
ACS-3921(3) Computer Security and Privacy
ACS-3923(3) Technical Writing
ACS-3930(3) Topics in Applied Computer Science
ACS-3941(3) Implementation Issues in Object-Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming
ACS-2102(3) Scientific Computing I: Programming Fundamentals in C
ACS-2916(3) Business Application Systems
ACS-2941(3) Unix
ACS-2951(3) System Administration and Networking
ACS-3907(3) eCommerce
ACS-3908(3) Introduction to Perl
ACS-3909(3) Advanced Internet Programming
ACS-3921(3) Computer Security and Privacy
ACS-3923(3) Technical Writing
ACS-3930(3) Topics in Applied Computer Science
ACS-3941(3) Implementation Issues in Object-Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science

Group II Electives
MATH-1201(3) Linear Algebra 1
ACS-1803(3) Introduction to Information Systems
ACS-1805(3) Introduction to Programming
ACS-2102(3) Scientific Computing I: Programming Fundamentals in C
ACS-2916(3) Business Application Systems
ACS-2941(3) Unix
ACS-2951(3) System Administration and Networking
ACS-3907(3) eCommerce
ACS-3908(3) Introduction to Perl
ACS-3909(3) Advanced Internet Programming
ACS-3911(3) Computer Networks
ACS-3913(3) Principles of Operating Systems
ACS-3916(3) Software Design and Architecture
ACS-4901(3) Senior Systems Development Project
ACS-4902(3) Advanced Database Systems
ACS-4904(3) Data Warehousing
ACS-4906(3) Conceptual Modelling
ACS-4921(3) Computer Security and Privacy
ACS-4953(3) Introduction to Machine Learning
ACS-4954(3) Introduction to Distributed Systems
ACS-3921(3) Computer Security and Privacy
ACS-3923(3) Technical Writing
ACS-3930(3) Topics in Applied Computer Science
ACS-3941(3) Implementation Issues in Object-Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science
ACS-3921(3) Computer Security and Privacy
ACS-3923(3) Technical Writing
ACS-3930(3) Topics in Applied Computer Science
ACS-3941(3) Implementation Issues in Object-Oriented Languages
ACS-3947(3) Algorithm Design
ACS-4930(6) Research Project in Applied Computer Science
ACS-4931(3) Research Project in Applied Computer Science

Students must complete an Honours BSc degree form available at the department office.

Any additional 3 credit courses in Group I or Group II except first year courses.

REQUIREMENTS FOR A MINOR IN APPLIED COMPUTER SCIENCE

Degree: Students completing any undergraduate degree program are eligible to complete the Minor.
Minor: 18 credit hours in ACS, with a minimum of 12 credit hours above the first-year level
Residence Requirement: Minimum 12 credit hours in ACS
Restrictions: Students cannot declare the same subject as a Major and a Minor.

GENERAL INFORMATION

Prerequisites
Students are advised to pay attention to the prerequisites for each Applied Computer Science course when planning a program of study. Students can visit the department website for more guidance.
Prerequisites are waived only in the case of clearly demonstrated equivalent knowledge. Only the Department Chair has the authority to grant prerequisite waivers.

**Admission to Applied Computer Science Courses**

Students are advised that a priority admission procedure may be used in the event that enrolments in Applied Computer Science courses are limited. For all courses, previous overall academic performance may be considered. For 2000-, 3000-, and 4000-level courses, grades achieved in prerequisite courses may also be considered. Priority for entry into ACS-4901(6) will be given to students who require the course for graduation in the 4-Year degree program. Only the Chair of the department has the authority to admit students to courses that are full.

**Graduate Studies**

Students planning to continue with graduate studies are advised to consult with the Department before entering Year 2 of their studies.

**Course Substitutions**

Applied Computer Science courses were formerly numbered in the 32(MATH).xxxx series and 92/91(BUSC).xxxx. All courses with 32(MATH).xxxx and 92/91(BUSC).xxxx numbers may be substituted for corresponding ACS-xxxx numbers in meeting degree requirements.

## COURSE LISTINGS

Students should consult WebAdvisor or the Timetable on the website for courses to be offered in an upcoming term.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACS-1453(3)</td>
<td>Introduction to Computers</td>
<td></td>
</tr>
<tr>
<td>ACS-1803(3)</td>
<td>Introduction to Information Systems</td>
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<tr>
<td>ACS-1805(3)</td>
<td>Introduction to Programming</td>
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</tr>
<tr>
<td>ACS-1809(3)</td>
<td>Website Design and Development</td>
<td></td>
</tr>
<tr>
<td>ACS-1903(3)</td>
<td>Programming Fundamentals I</td>
<td></td>
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<tr>
<td>ACS-1904(3)</td>
<td>Programming Fundamentals II</td>
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<td>Business Application Systems</td>
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<tr>
<td>ACS-2941(3)</td>
<td>Unix</td>
<td></td>
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<tr>
<td>ACS-2947(3)</td>
<td>Data Structures and Algorithms</td>
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<td>ACS-2951(3)</td>
<td>System Administration and Networking</td>
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<td>ACS-3700(3)</td>
<td>Health Internship</td>
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<td>ACS-3801(3)</td>
<td>Principles in Information Systems</td>
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<td>ACS-3816(3)</td>
<td>Human Computer Interaction</td>
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<td>ACS-3830(3)</td>
<td>Topics in Information Systems</td>
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<td>ACS-3901(3)</td>
<td>Principles of Software Project Management</td>
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<td>ACS-3902(3)</td>
<td>Database Systems</td>
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<td>Advanced Internet Programming</td>
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<tr>
<td>ACS-3911(3)</td>
<td>Computer Networks</td>
<td></td>
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<tr>
<td>ACS-3913(3)</td>
<td>Software Design and Architecture</td>
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<tr>
<td>ACS-3921(3)</td>
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<tr>
<td>ACS-3923(3)</td>
<td>Technical Writing</td>
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<tr>
<td>ACS-3930(3)</td>
<td>Topics in Applied Computer Science</td>
<td></td>
</tr>
<tr>
<td>ACS-3931(3)</td>
<td>Principles of Operating Systems</td>
<td></td>
</tr>
<tr>
<td>ACS-3941(3)</td>
<td>Implementation Issues in Object Oriented Languages</td>
<td></td>
</tr>
<tr>
<td>ACS-3947(3)</td>
<td>Algorithm Design</td>
<td></td>
</tr>
<tr>
<td>ACS-4901(6)</td>
<td>Senior Systems Development Project</td>
<td></td>
</tr>
<tr>
<td>ACS-4902(3)</td>
<td>Advanced Database Systems</td>
<td></td>
</tr>
<tr>
<td>ACS-4904(3)</td>
<td>Data Warehousing</td>
<td></td>
</tr>
<tr>
<td>ACS-4906(3)</td>
<td>Conceptual Modelling</td>
<td></td>
</tr>
<tr>
<td>ACS-4930(6)</td>
<td>Research Project in Applied Computer Science</td>
<td></td>
</tr>
<tr>
<td>ACS-4931(3)</td>
<td>Research Project in Applied Computer Science</td>
<td></td>
</tr>
<tr>
<td>ACS-4953(3)</td>
<td>Introduction to Machine Learning</td>
<td></td>
</tr>
<tr>
<td>ACS-4954(3)</td>
<td>Introduction to Distributed Systems</td>
<td></td>
</tr>
</tbody>
</table>

## COURSE DESCRIPTIONS

Students should consult WebAdvisor or the Timetable on the website for courses to be offered in an upcoming term.

**ACS-1453(3) INTRODUCTION TO COMPUTERS (Le3)**

This course will introduce students to the basic concepts of computers: types of computers, hardware, software, and types of application systems. Students will receive instruction in a variety of software intended for personal use. Software used will include word processing, spreadsheets, databases, charting and graphing tools, and common Internet clients and resources. There will be an extensive laboratory component.

**Note:** This course does not apply toward the Major in Applied Computer Science.

**ACS-1803(3) INTRODUCTION TO INFORMATION SYSTEMS (Le3)**

This course examines applications of information technology to businesses and other organizations. After an introduction to computers and data management, the course outlines various categories of information systems, (e.g., systems for transaction processing, managerial reporting, customer relationship management, decision support, enterprise resource planning, and e-commerce), with examples from current practice. System development, system security, systems consulting, and IT administration are also discussed. Focus is mostly on functional aspects of systems providing a valuable background for students in applied computer science, business and administration, and other disciplines. Students who require an introduction to personal computers and productivity software should take ACS-1453.
ACS-1805(3) INTRODUCTION TO PROGRAMMING (Le3, La1) This course covers elementary procedural programming concepts. Topics include: primitive data types and their manipulation, basic input and output and elementary control structures. In addition, topics related to a specific programming paradigm that is chosen for the course is covered. Students will gain hands-on programming experience in the laboratory component of the course.

ACS-1809(3) WEBSITE DESIGN AND DEVELOPMENT (Le3) This course introduces students to the concepts, programming skills, and tools related to website design and development. The topics include: website layout; creating tables, frames, menus and forms; presenting multimedia on web pages; and Internet Protocols such as HTTP and FTP. Students gain hands-on programming experience in designing websites using HTML and Cascading Style Sheets.

ACS-1903(3) PROGRAMMING FUNDAMENTALS I (Le3, La1) This course introduces fundamental programming concepts using an object-oriented programming language. Topics to be covered include primitive data types and their manipulation, control structures, classes, objects and arrays. PREREQUISITES: Pre-Calculus Mathematics 40S or Applied Mathematics 40S or a grade of at least C in ACS-1805.

ACS-1904(3) PROGRAMMING FUNDAMENTALS II (Le3, La1) This course examines more advanced programming concepts using an object-oriented programming language. Topics to be covered include inheritance, polymorphism, sorting techniques, string processing, interfaces, files and packages. PREREQUISITES: A grade of at least C in ACS-1903.

ACS-1905(3) PROGRAMMING FUNDAMENTALS (Le3, La1) This course assumes that students already have working knowledge of an object-oriented programming language as well as effective use of data types and control structures. This course begins with an overview of the object-oriented programming language and then more advanced topics in order to extend the student’s programming skill. Topics to be covered include inheritance, polymorphism, sorting techniques, string processing, interfaces, files and packages. PREREQUISITES: A minimum grade of 75 (or equivalent) in Computer Science 40S plus one of Pre-Calculus Mathematics 40S, Applied Mathematics 40S or a grade of at least C in ACS-1805.

RESTRICTIONS: Students may not receive credit in this course and the former 92/91.1902(3).

ACS-2102(3) SCIENTIFIC COMPUTING (Le3) Many problems arising in science are too difficult to solve analytically, and thus require analysis of some form by a computer. Using the language of C/C++, this course introduces the most common programming constructs used in scientific computing. The critical importance of data structures to represent information is emphasized, which naturally leads to an object-oriented approach to problem solving. The use of external libraries, such as those for numerical analysis, to solve more advanced problems are explored, with attention paid to checks that can be made on the reliability of the results.

CROSS-LISTED: PHYS-2102(3).

ACS-2814(3) APPLICATIONS OF DATABASE SYSTEMS (Le3, La1) This course introduces students with limited computing experience to the principles of data management. The emphasis is on practical database experience reinforced through assignments and weekly laboratory work. Students learn first to work with a workstation-based database system and subsequently they are introduced to the design of databases and their implementation in relational systems. Topics include tables, queries, forms, reports, importing and exporting data, structured query language, entity relationship models, the relational data model, and normalization of databases. Examples, assignments, and laboratory work are drawn from a variety of different disciplines.

RESTRICTIONS: Cannot be held with the former ACS-2914(3).

ACS-2816(3) HEALTH INFORMATION SYSTEMS (Le3) This course provides an overview of the important topics in Health Informatics. It discusses data as the building block for health care information including the basic concepts of data flow, data storage, and health record management within both private and public health care systems. It then addresses important issues such as security, privacy, and standards.

PREREQUISITES: A grade of at least C in ACS-1803(3) or permission of Department Chair.

ACS-2906(3) COMPUTER ARCHITECTURE AND SYSTEM SOFTWARE (Le3, La1) The course begins with discussions of the architecture of computer hardware and progresses to an examination of system software, including its relationship to the hardware, its structure and design, and its impact on application software, system developers, and end-users. Operating system concepts such as memory management, process management, and I/O sub-systems will be covered. Other topics include language processors, system utilities, security issues, and performance management. The course provides students a hands-on experience of programming at different levels such as high level, assembly, and machine code.

PREREQUISITES: A grade of at least C in ACS-1904(3) or ACS-1905(3).

CO-REQUISITES: MATH-1401(3).

ACS-2909(3) INTERNET PROGRAMMING (Le3) This course provides students with an overview of Internet and World Wide Web programming, development tools, resources, utilities, multimedia, and security issues. Students gain hands-on experience in a scripting language such as JavaScript, Rich Internet Applications (RIAs), Web services, and Mobile Application Development. Students not familiar with HTML and CSS are strongly encouraged to take ACS-1809(3).

PREREQUISITES: A grade of at least C in ACS-1903(3) or ACS-1905(3).

ACS-2913(3) SOFTWARE REQUIREMENTS ANALYSIS AND DESIGN (Le3) This course introduces students to the requirements definition phase of software development. It provides coverage of both traditional and object-oriented approaches to requirements analysis and design of software used in business, real-time and embedded applications. Models, notations and processes for requirements elicitation, representation, and design are discussed.

PREREQUISITES: A grade of at least C in ACS-1903(3) or ACS-1905(3).

RESTRICTIONS: Students cannot hold credit in ACS-2913(3) and ACS-2911(3) and/or ACS-2912(3).

ACS-2916(3) BUSINESS APPLICATION SYSTEMS (Le3, La1) This course firstly presents structured models for business processes and data needed in common transaction processing systems such as order entry, invoicing, accounts receivable and payable, purchasing, inventory and general ledger. Also, system support for manufacturing (e.g., supply chain management, robotics), for marketing (e.g., sales force automation), customer relationship management), and for human resource management (e.g., candidate selection,
collective bargaining support) is highlighted, and inter-system interfaces are considered. Large, organization-wide, integrated enterprise resource planning (ERP) systems are discussed in the context of a business case. System controls and security issues are outlined for the systems studied.

**PREREQUISITES:** A grade of at least C in ACS-1803(3).

**ACS-2941(3) UNIX (Le3)** This course provides students with advanced concepts and knowledge of Unix, one of the most widely used operating systems. The course introduces students to such topics as shells, filters and pipelines, the Unix file system, processes and job control, and Internet communications. Emphasis is placed on Unix shell programming, which provides valuable tools for developing powerful applications with a minimal amount of written code.

**PREREQUISITES:** A grade of at least C in ACS-1904(3) or ACS-1905(3) or the former 92/91.1902(3).

**ACS-2947(3) DATA STRUCTURES AND ALGORITHMS (Le3, La1)** This course introduces fundamental data structures using an object-oriented programming language. Topics to be covered include vectors, multidimensional arrays, linked lists, stacks, queues, trees, graphs, recursion and algorithms.

**PREREQUISITES:** A grade of at least C in ACS-1904(3) or ACS-1905(3).

**Co-REQUISITES:** MATH-1401(3).

**ACS-2951(3) SYSTEM ADMINISTRATION AND NETWORKING (Le3, La1)** This course covers basic system administration issues of Unix and Windows operating systems (OS), principles of networking, and TCP/IP (the Internet). Students are introduced to topics such as system installation and maintenance, system, and network security and setting up different application servers such as web, mail and SQL. Students will gain considerable hands-on experience in installing, managing, and trouble-shooting networks on the Linux and Windows platforms.

**PREREQUISITES:** A grade of at least C in ACS-2941(3).

**ACS-3700(3) HEALTH INTERNSHIP (A,V)** Health Internship is internship in a healthcare environment. The course facilitates professional working experience in a sponsoring health-related organization. Students will be evaluated by both the sponsor and a faculty member. Approval must be obtained from the supervising faculty member as well as from the Department Chair before enrolment.

**PREREQUISITES:** Students should normally have completed 30 credit hours in the Health Informatics Stream.

**ADDITIONAL REQUIREMENTS:** Department Chair’s permission.

**ACS-3801(3) PRINCIPLES IN INFORMATION SYSTEMS (Le3)** This course is the final course for the 3 year degree in Information Systems and the Health Informatics streams. The course can provide integration (e.g. project management), or provide more depth in specific areas of Information Systems in order to address specific thematic needs.

**PREREQUISITES:** A grade of at least C in each of ACS-2814(3) (or the former ACS-2914(3)), ACS-2809(3), ACS-2913(3), and ACS-2816 or ACS-2916(3).

**RESTRICTIONS:** Students cannot hold credit in ACS-3901(3).

**ADDITIONAL REQUIREMENT:** Department Chair’s permission.

**ACS-3816(3) / ACS-3916 HUMAN COMPUTER INTERACTION (Le3)** This course covers the fundamentals and concepts of design, implementation, and evaluation of human-computer interfaces. Topics include human cognitive aspects; user-centred design; design goals and principles; interface and interaction types; prototyping and construction; evaluation methods. In order to make a balance between theory and practice, emphasis is placed on a course-end project involving design, implementation and evaluation of the user interface for a specific application. In this double-numbered course, the course-end project work in ACS-3916 is oriented toward the Applied Computer Science stream, while in ACS-3816 it is adapted to the Information Systems and Health Informatics streams.

**PREREQUISITES:** A grade of at least C in ACS-2909(3) and ACS-2814(3) (or the former ACS-2914(3)).

**RESTRICTIONS:** Students cannot hold credit in ACS-3916(3) and ACS-3816(3).

**ACS-3830(3) TOPICS IN INFORMATION SYSTEMS (Le3)** This course treats specific topics in various areas of Information Systems of interest to the students, faculty members, and industry partners. This course integrates practical experience with the study of information systems in large organizations. The course is specifically designed for Information Systems stream students entering the workforce. Students learn the strict professional requirements like quality assurance, standard compliances, risk containment, and integration issues. The industry partner provides students with organizational level requirements and input.

**PREREQUISITES:** A grade of at least C in each of ACS-2814(3), ACS-2809(3), ACS-2913(3) and ACS-2916(3).

**RESTRICTIONS:** Students cannot hold credit in ACS-3901(3).

**ADDITIONAL REQUIREMENT:** Department Chair’s permission.

**ACS-3901(3) PRINCIPLES OF SOFTWARE PROJECT MANAGEMENT (Le3)** This course covers principles and techniques of software project management, with emphasis on the theoretical underpinnings of the competencies that are associated with software project management. The key concepts of project planning, organization, and control are covered. Specific topics covered include task breakdown, estimating, scheduling, and tracking; process and project metrics; change control; risk analysis and management; software quality and reliability models; quality assurance; and configuration management.

**PREREQUISITES:** A grade of at least C in ACS-1904, ACS-2913(3), (or the previous ACS-2911(3) and ACS-2912(3)) and ACS-2814(3) (or the former ACS-2914(3)).

**RESTRICTIONS:** Students with standing in the former 92/91.3920(6) may not hold credit for ACS-3901(3).

**ACS-3902 (3) DATABASE SYSTEMS (Le3)** This course introduces the theory of relational, network, and hierarchical models. It covers in detail the techniques utilized in various stages of a relational database software development life cycle. These techniques include ERDs, relational models, functional dependencies, normalization, and physical data storage mechanisms. Query language fundamentals including relational algebra and SQL are also covered. A project involving the design and implementation of a database is required.

**PREREQUISITES:** A grade of at least C in ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)) and ACS-2814(3) (or the former ACS-2914(3)).

**ACS-3907(3) eCOMMERCE (Le3)** In this course our students will explore new opportunities, risks, and technologies related to electronic commerce. Both business and technical issues will be addressed. Business issues will include the role of e-Commerce in the marketing plan and organizational strategy in both business-to-customer and business-to-business contexts. Technical topics will include architecture, application models, payment strategies and security. This course is designed for double majors in Applied Computer Science and Business and Administration.

**PREREQUISITES:** A grade of at least C in ACS-1803(3) or permission of Chair.

**COREREQUISITES:** ACS-1809(3) or permission of Chair.
ACS-3908(3) INTRODUCTION TO PERL (Le3, La1) This course introduces the basic concepts of the Perl language and the Common Gateway Interface (CGI) that enables web browsers to exchange data with computer programs located on a web server. Students develop skill in script programming in Perl and building dynamic web pages with CGI. Topics include variables, control structures, file I/O, functions, arrays, using modules, and object-oriented programming. 

**PREREQUISITES:** A grade of at least C in ACS-2941(3).

ACS-3909(3) ADVANCED INTERNET PROGRAMMING (Le3) This course provides students with a thorough knowledge of server-side web programming. Topics include n-tiered systems, session tracking, interfaces and stereotypes, dynamic web page design, database connections, and XML processing. Students gain considerable knowledge and experience by learning important features needed for e-commerce, applying advanced web application techniques, and utilizing web databases. 

**PREREQUISITES:** A grade of at least C in ACS-2909(3), ACS-2814(3) (or the former ACS-2914(3)) and ACS-2947(3).

ACS-3911(3) COMPUTER NETWORKS (Le3) This course is an introduction to fundamental concepts in computer networks. It covers the principles, technology, protocols, and algorithms of computer networks. The layers of the network stack are discussed, with particular focus on the internet network stack. Topics of discussion include network technologies, simple and sliding window protocols, routing and routing algorithms, congestion control, quality of service, security, and network applications. 

**PREREQUISITES:** A grade of at least C in ACS-2909(3) and ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)).

**RESTRICTIONS:** Students cannot hold credit in ACS-3911(3) and the former ACS-3811(3).

ACS-3913(3) SOFTWARE DESIGN AND ARCHITECTURE (Le3) This is an advanced course in software design that examines recent advances in the design of larger application systems. Topics include software architecture, object-oriented analysis and design, software patterns, and the Unified Modeling Language (UML). 

**PREREQUISITES:** A grade of at least C in ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)) and ACS-2947(3).

ACS-3921(3) / ACS-4921(3) COMPUTER SECURITY AND PRIVACY (Le3) This course introduces students to the security and privacy issues in computer systems. It covers the fundamental computer security techniques such as encryption methods, public key cryptography, hash function and signature schemes, key exchange protocols, authentication and access control models. The course also examines the applications of these techniques for multimedia security, intrusion detection, copyright and password protection, and protection from malicious programs. Privacy preserving techniques such as data aggregation, perturbation, k-anonymity and l-diversity, and ethical issues are also discussed. Students at the 4921 level additionally undertake a comprehensive project on a topic related to computer security and privacy. 

**PREREQUISITES:** A grade of at least C in both ACS-2906(3) and ACS-2947(3), or permission of Chair.

**RESTRICTIONS:** Students who have taken ACS-3921 will not be eligible to take ACS-4921.

ACS-3923(3) TECHNICAL WRITING (Le3) This course will discuss principles, strategies, and techniques of writing in a systems environment. Topics include process invention, structuring, and drafting strategies; identifying audience and purpose; business and technical correspondence; project documentation; user documentation; presentations, both technical and executive; and the readability of documents, from the high-level structure down to the sentence and word levels. This course will include many practical exercises in course topics. 

**PREREQUISITES:** A grade of at least C in ACS-2913(3) (or the former ACS-2911(3) and ACS-2912(3)).

ACS-3930(3) TOPICS IN APPLIED COMPUTER SCIENCE (Le3) This course treats specific topics in various areas of applied computer science of interest to the student and faculty member. 

**PREREQUISITES:** A grade of at least C in both ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)) and ACS-2947(3).

ACS-3931(3) PRINCIPLES OF OPERATING SYSTEMS (Le3) This course covers the principles and design of operating systems. In the first half of the course students are introduced to multiprogramming and become familiar with the process and thread abstractions. Students are introduced to concurrent programming. Topics include: mutual exclusion, synchronization, and inter-process communication. The second half of the course introduces students to the roles and components of operating systems, and how these components interact. Topics include process control, memory management, file systems, and input/output. 

**PREREQUISITES:** A grade of at least C in ACS-2906(3) and ACS-2947(3).

ACS-3941(3) IMPLEMENTATION ISSUES IN OBJECT ORIENTED LANGUAGES (Le3) This course focuses on advanced features of a contemporary OO language. Emphasis is on implementation issues and strengthening programming skills of students. 

**PREREQUISITES:** A grade of at least C in both ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)) and ACS-2947(3).

ACS-3947(3) ALGORITHM DESIGN (Le3) This course focuses on the connection between data structures and the corresponding algorithms, including simple analysis of computational complexity. The emphasis is on comparative study of alternate ways to implement solutions to computing problems. 

**PREREQUISITES:** A grade of at least C in both ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)) and ACS-2947(3).

ACS-4901(6) SENIOR SYSTEMS DEVELOPMENT PROJECT (Le3, P) This course applies the principles and techniques of software project management covered in ACS-3901(3) to a significant systems development project undertaken by students in teams. A project proposal, project plan, regular status reports, and a completion report are required. All work must conform to proper analysis, design, programming, and documentation standards. Each team holds status reviews at appropriate life-cycle milestones. A final presentation and a formal demonstration of the system are required at the end of the project. 

**PREREQUISITES:** A grade of at least C in ACS-2814(3) (or the former ACS-2914(3)), ACS-3901(3), ACS-3902(3), and ACS-3913(3), and a minimum average GPA of 2.0 in all ACS-xxxx courses previously taken.

**RESTRICTIONS:** Students may not hold credit in this course and the former 92/91.3920(6).

ACS-4902(3) ADVANCED DATABASE SYSTEMS (Le3) This course is a continuation of ACS-3902(3). It deals with advanced topics in database design, use, and administration. Database design topics include enhanced ER
diagrams and object-oriented data modelling. Other topics include transaction processing, concurrency control and recovery, security, and integrity. Object-oriented databases and client-server architectures will also be discussed.

**PREREQUISITES:** A grade of at least C in both ACS-2947(3) and ACS-3902(3).

ACS-4904(3) DATA WAREHOUSING (Le3) This course explores the role of data warehouses in supporting decision-making in organizations. Topics include definition of a data warehouse; extracting, cleansing, and transforming data; building and maintaining the warehouse; meta data; dimensional analysis and multidimensional modeling; multidimensional data structures; Star schemas; OLAP (On Line Analytical Processing); drilling down and across; and web deployment.

**PREREQUISITES:** A grade of at least C in all of ACS-2913(3) (or the previous ACS-2911(3) and ACS-2912(3)), ACS-2947(3) and ACS-3902(3).

ACS-4906(3) CONCEPTUAL MODELLING (Le3) This course explores the role of conceptual modelling in the development of information systems. A conceptual model is an abstraction of reality that serves as a communication mechanism between the stakeholders of a system and its developers. The course covers various approaches proposed for conceptual modelling included UML, EERD, and ORM. Students gain considerable practical experience with pertinent software tools.

**PREREQUISITES:** A grade of at least C in ACS-3902(3).

ACS-4930(6) RESEARCH PROJECT IN APPLIED COMPUTER SCIENCE (NT) This course is designed to allow a student to conduct a specific research project under the supervision of a faculty member. An essential component of the course is an oral presentation and a written report of the results. Approval for the planned project must be obtained from the supervising faculty member as well as from the Department Chair before enrolment.

**PREREQUISITES:** Students should normally have completed 30 credits in ACS.

**RESTRICTIONS:** Students must obtain written permission from the Department Chair to register for the course.

ACS-4931(3) RESEARCH PROJECT IN APPLIED COMPUTER SCIENCE (NT) This course is designed to allow a student to conduct a specific research project under the supervision of a faculty member. An essential component of the course is an oral presentation and a written report of the results. Approval for the planned project must be obtained from the supervising faculty member as well as from the Department Chair before enrolment.

**PREREQUISITES:** Students should normally have completed 30 credits in ACS.

**RESTRICTIONS:** Students must obtain written permission from the Department Chair to register for the course.

ACS-4953(3) INTRODUCTION TO DISTRIBUTED SYSTEMS (Le3) This course is an introduction to the broad field of distributed systems. It focuses on introducing students to the benefits, challenges, methods, and implementations of distributed systems. Reasons for deploying distributed systems, such as fault tolerance and agglomeration of computational resources are discussed. Other topics include implementation challenges such as synchronization and replication in the presence of faults. Common system architectures that address some of these challenges are also introduced. Students are expected to implement some of these architectures to reinforce the lecture material.

**PREREQUISITES:** A grade of at least C in all of MATH-1401(3), ACS-2906(3) and ACS-3911(3).

**EXPERIMENTAL COURSES**

ACS-2949(3) INTRODUCTION TO FORMAL LANGUAGE THEORY (Le3), (La1) This course gives an introduction to automata theory, grammars, formal languages and their applications. Topics include finite automata, regular expressions and their properties; context-free grammars, pushdown automata and properties of context-free languages; Turing machines. Applications may include lexical analysis, text editing, machine design, syntax analysis, and/or parser generation.

**PREREQUISITES:** A grade of at least C in ACS-1904(3) or ACS-1905(3), or permission of the instructor.

**COREQUISITES:** Discrete Mathematics MATH-1401(3).

ACS-4306(3) APPLIED PARALLEL PROGRAMMING (Le3, La1) The course focuses on parallel and distributed computing in high-performance scientific application, using the parallel execution model, a generalization of the traditional single threaded paradigm. The course covers multi-core processors, concurrency, parallel execution, latency, communication and coordination among processes, message passing, shared-memory models, optimization techniques, parallel algorithms, decomposition strategies, system architecture, and performance analysis and tuning. Using the language C/C++, students gain hands-on experience writing scalable parallel applications for Graphics Processing Units.

**PREREQUISITES:** A grade of at least C+ in ACS-2947(3), and a grade of at least C in ACS-3913(3).

**RESTRICTIONS:** Students who have taken ACS-4306 will not be eligible to take the Master of Science course ACS-7306.