Unit Outline
ISAD5000 Advanced Optimisation Techniques
Semester 1, 2016

Unit study package code: ISAD5000
Mode of study: Internal
Tuition pattern summary: Note: For any specific variations to this tuition pattern and for precise information refer to the Learning Activities section.
Lecture: 1 x 2 Hours Weekly
Tutorial: 1 x 1 Hours Weekly
Workshop: 1 x 1 Hours Weekly
This unit does not have a fieldwork component.
Credit Value: 25.0
Pre-requisite units: Nil
Co-requisite units: Nil
Anti-requisite units: Nil
Result type: Grade/Mark
Approved incidental fees: Information about approved incidental fees can be obtained from our website. Visit fees.curtin.edu.au/incidental_fees.cfm for details.
Unit coordinator: Title: Dr
Name: Honglei Xu
Phone: +618 9266 4961
Email: H.Xu@curtin.edu.au
Location: Building: 314 - Room: 452
Teaching Staff: Name: Honglei Xu
Phone: +618 9266 4961
Email: H.Xu@curtin.edu.au
Location: Building: 314 - Room: 452
Name: Song Wang
Phone: +61 8 9266 2396
Email: Song.Wang@curtin.edu.au
Location: Building: 314 - Room: 362
Administrative contact: Name: Aimee Tournay
Phone: +61 8 9266 9595
Email: Aimee.Tournay@curtin.edu.au
Location: Building: 311 - Room: 144
Learning Management System: Blackboard (lms.curtin.edu.au)
Acknowledgement of Country
We respectfully acknowledge the Indigenous Elders, custodians, their descendants and kin of this land past and present.

Syllabus
This unit introduces advanced techniques and methods for solving optimisation problems. Topics will include basic theory and introduction of mathematical programming techniques.

Introduction
This unit introduces the techniques and methods for solving optimisation problems. Topics will include basic theory and introduction of optimisation, and linear/nonlinear programming methods, and numerical algorithms.

Unit Learning Outcomes
All graduates of Curtin University achieve a set of nine graduate attributes during their course of study. These tell an employer that, through your studies, you have acquired discipline knowledge and a range of other skills and attributes which employers say would be useful in a professional setting. Each unit in your course addresses the graduate attributes through a clearly identified set of learning outcomes. They form a vital part in the process referred to as assurance of learning. The learning outcomes tell you what you are expected to know, understand or be able to do in order to be successful in this unit. Each assessment for this unit is carefully designed to test your achievement of one or more of the unit learning outcomes. On successfully completing all of the assessments you will have achieved all of these learning outcomes.

Your course has been designed so that on graduating we can say you will have achieved all of Curtin’s Graduate Attributes through the assurance of learning process in each unit.

<table>
<thead>
<tr>
<th>On successful completion of this unit students can:</th>
<th>Graduate Attributes addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Understand the methods to solve optimisation problems</td>
<td>✅  📁  🎨</td>
</tr>
<tr>
<td>2 Apply numerical approaches to solve mathematical programming problems</td>
<td>✅  📁  🎨</td>
</tr>
<tr>
<td>3 Apply optimisation algorithms to solve problems in disciplines such as science, engineering, and finance</td>
<td>✅  📁  🎨</td>
</tr>
</tbody>
</table>

Curtin’s Graduate Attributes

<table>
<thead>
<tr>
<th>✅  📁  🎨</th>
<th>Apply discipline knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>✅  📁  🎨</td>
<td>Thinking skills (use analytical skills to solve problems)</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>Information skills (confidence to investigate new ideas)</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>Communication skills</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>Technology skills</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>Learning how to learn (apply principles learnt to new situations) (confidence to tackle unfamiliar problems)</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>International perspective (value the perspectives of others)</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>Cultural understanding (value the perspectives of others)</td>
</tr>
<tr>
<td>✅  📁  🎨</td>
<td>Professional Skills (work independently and as a team) (plan own work)</td>
</tr>
</tbody>
</table>

Find out more about Curtin’s Graduate attributes at the Office of Teaching & Learning website: ctl.curtin.edu.au

Learning Activities
Lectures and tutorial classes.
Assessment

Assessment schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Value %</th>
<th>Date Due</th>
<th>Unit Learning Outcome(s) Assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assignment 1</td>
<td>15</td>
<td>Week: 5th teaching week</td>
<td>1,2,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day: 08/04/2016</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time: before 5:00pm</td>
<td></td>
</tr>
<tr>
<td>Assignment 2</td>
<td>15</td>
<td>Week: 10th teaching week</td>
<td>1,2,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day: 20/05/2016</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time: before 5:00pm</td>
<td></td>
</tr>
<tr>
<td>Mid-Semester test</td>
<td>20</td>
<td>Week: 6th teaching week</td>
<td>1,2,3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Day: 15/04/2016</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Time: 1:00pm-3:00pm</td>
<td></td>
</tr>
<tr>
<td>Final Examination</td>
<td>50</td>
<td>TBA</td>
<td>1,2,3</td>
</tr>
</tbody>
</table>

Detailed information on assessment tasks

1. Assignment one due 5pm Friday 8 April;
2. Assignment two due 5pm Friday 20 May;
3. The mid-test will be held during the lecture time on Friday 15 April;
4. TBA.

Pass requirements

Students must achieve a Final Mark of 50 or greater to pass this unit.

Fair assessment through moderation

Moderation describes a quality assurance process to ensure that assessments are appropriate to the learning outcomes, and that student work is evaluated consistently by assessors. Minimum standards for the moderation of assessment are described in the Assessment and Student Progression Manual, available from policies.curtin.edu.au/policies/teachingandlearning.cfm

Late assessment policy

This ensures that the requirements for submission of assignments and other work to be assessed are fair, transparent, equitable, and that penalties are consistently applied.

1. All assessments students are required to submit will have a due date and time specified on this Unit Outline.
2. Late submission of assessments is not accepted in this unit. Students will receive a zero mark for any assessment item submitted late.

Assessment extension

A student unable to complete an assessment task by/on the original published date/time (eg examinations, tests) or due date/time (eg assignments) must apply for an assessment extension using the Assessment Extension form (available from the Forms page at students.curtin.edu.au/administration/) as prescribed by the Academic Registrar. It is the responsibility of the student to demonstrate and provide evidence for exceptional circumstances beyond the student’s control that prevent them from completing/submitting the assessment task.
The student will be expected to lodge the form and supporting documentation with the unit coordinator before the assessment date/time or due date/time. An application may be accepted up to five working days after the date or due date of the assessment task where the student is able to provide an acceptable explanation as to why he or she was not able to submit the application prior to the assessment date. An application for an assessment extension will not be accepted after the date of the Board of Examiners’ meeting.

**Deferred assessments**

If your results show that you have been granted a deferred assessment you should immediately check your OASIS email for details.

Deferred examinations/tests will be held from 18/07/2016 to 22/07/2016. Notification to students will be made after the Board of Examiners’ meeting via the Official Communications Channel (OCC) in OASIS.

**Supplementary assessments**

Supplementary assessments are not available in this unit.

**Referencing style**

The referencing style for this unit is APA 6th Ed.

More information can be found on this style from the Library web site: [http://libguides.library.curtin.edu.au/referencing](http://libguides.library.curtin.edu.au/referencing).

**Copyright**

© Curtin University. The course material for this unit is provided to you for your own research and study only. It is subject to copyright. It is a copyright infringement to make this material available on third party websites.

**Academic Integrity (including plagiarism and cheating)**

Any conduct by a student that is dishonest or unfair in connection with any academic work is considered to be academic misconduct. Plagiarism and cheating are serious offences that will be investigated and may result in penalties such as reduced or zero grades, annulled units or even termination from the course.

Plagiarism occurs when work or property of another person is presented as one’s own, without appropriate acknowledgement or referencing. Submitting work which has been produced by someone else (e.g. allowing or contracting another person to do the work for which you claim authorship) is also plagiarism. Submitted work is subjected to a plagiarism detection process, which may include the use of text matching systems or interviews with students to determine authorship.

Cheating includes (but is not limited to) asking or paying someone to complete an assessment task for you or any use of unauthorised materials or assistance during an examination or test.

From Semester 1, 2016, all incoming coursework students are required to complete Curtin’s Academic Integrity Program (AIP). If a student does not pass the program by the end of their first study period of enrolment at Curtin, their marks will be withheld until they pass. More information about the AIP can be found at: [https://academicintegrity.curtin.edu.au/students/AIP.cfm](https://academicintegrity.curtin.edu.au/students/AIP.cfm)

Refer to the Academic Integrity tab in Blackboard or academicintegrity.curtin.edu.au for more information, including student guidelines for avoiding plagiarism.

**Information and Communications Technology (ICT) Expectations**

Curtin students are expected to have reliable internet access in order to connect to OASIS email and learning systems such as Blackboard and Library Services.

You may also require a computer or mobile device for preparing and submitting your work.

For general ICT assistance, in the first instance please contact OASIS Student Support: [oasisapps.curtin.edu.au/help/general/support.cfm](http://oasisapps.curtin.edu.au/help/general/support.cfm)

For specific assistance with any of the items listed below, please contact The Learning Centre:
Using Blackboard, the I Drive and Back-Up files
Introduction to PowerPoint, Word and Excel

Additional information

Enrolment
It is your responsibility to ensure that your enrolment is correct - you can check your enrolment through the eStudent option on OASIS, where you can also print an Enrolment Advice.

Student Rights and Responsibilities
It is the responsibility of every student to be aware of all relevant legislation, policies and procedures relating to their rights and responsibilities as a student. These include:

- the Student Charter
- the University’s Guiding Ethical Principles
- the University’s policy and statements on plagiarism and academic integrity
- copyright principles and responsibilities
- the University’s policies on appropriate use of software and computer facilities

Information on all these things is available through the University’s "Student Rights and Responsibilities" website at: students.curtin.edu.au/rights.

Student Equity
There are a number of factors that might disadvantage some students from participating in their studies or assessments to the best of their ability, under standard conditions. These factors may include a disability or medical condition (e.g. mental illness, chronic illness, physical or sensory disability, learning disability), significant family responsibilities, pregnancy, religious practices, living in a remote location or another reason.

If you believe you may be unfairly disadvantaged on these or other grounds please contact Student Equity at eesj@curtin.edu.au or go to http://eesj.curtin.edu.au/student_equity/index.cfm for more information.

You can also contact Counselling and Disability services: http://www.disability.curtin.edu.au or the Multi-faith services: http://life.curtin.edu.au/health-and-wellbeing/about_multifaith_services.htm for further information.

It is important to note that the staff of the university may not be able to meet your needs if they are not informed of your individual circumstances so please get in touch with the appropriate service if you require assistance. For general wellbeing concerns or advice please contact Curtin’s Student Wellbeing Advisory Service at: http://life.curtin.edu.au/health-and-wellbeing/student_wellbeing_service.htm

Recent unit changes
Students are encouraged to provide unit feedback through eVALUate, Curtin’s online student feedback system. For more information about eVALUate, please refer to evaluate.curtin.edu.au/info/

To view previous student feedback about this unit, search for the Unit Summary Report at https://evaluate.curtin.edu.au/student/unit_search.cfm. See https://evaluate.curtin.edu.au/info/dates.cfm to find out when you can eVALUate this unit.

Recent changes to this unit include:
Please check lecture notes.
### Program calendar

<table>
<thead>
<tr>
<th>WK</th>
<th>Lecture</th>
</tr>
</thead>
</table>
| 1. | Construction of Optimization Models  
Classification of Optimization Problems  
One Dimensional Search Techniques  
Calculus methods - necessary and sufficient condition, global optima, local optima and critical point, unimodality, and convexity |
| 2. | One dimensional search techniques - interval of uncertainty  
Equal Interval Search (dichotomous search),  
Unequal Interval Searches:  
Fibonacci Search Method  
Golden section search. |
| 3. | One dimensional search techniques:  
Newton’s Method for Smooth Functions  
Method of False Position (Secant)  
Quadratic Fit (Powell’s Quadratic Fit or Quadratic Interpolation)  
Davidson’s Cubic Interpolation Method |
| 4. | Convex set  
Properties of convex functions  
Taylor’s theorem and its generalization  
Local and global optima  
Multivariable Search Methods for Unconstrained Problems:  
Univariate method |
| 5. | Multivariable Search Methods for Unconstrained Problems:  
Gradient-based methods  
Basic concepts  
Descent algorithms  
Steepest descent Method  
Newton method  
Modifications to Newton’s Method |
| 6. | Multivariable Search Methods for Unconstrained Problems:  
Gradient-based methods  
Line search  
Conjugate gradient methods |

**Tuition Free Week**
### 7. Multivariable Search Methods for Unconstrained Problems:

- Gradient-based methods
- Quasi-Newton Methods
- Davidon-Fletcher-Powell (DFP) formula
- BFGS Update Formula

### 8. Theory of Constrained Optimization

- Constrained optimization problems
- First-order optimality conditions
- Second-order optimality conditions
- Equality constrained optimization problems
- Lagrange Duality

### 9. Constrained Optimization

- Penalty function methods
- Quadratic programming: Equality constraints
- Quadratic programming: Inequality constraints with active set

### 10. Constrained Optimization

- Quadratic programming: Equality constraints
- Quadratic programming: Inequality constraints with active set

### 11. Constrained optimization

- Sequential quadratic approximation for nonlinear constrained optimization problems

### 12. Revision

- Study Week
- Examinations