

GRADUATE STUDENT GUIDE

**PROGRAMMES
DE 2^e ET 3^e
CYCLES EN
GÉNIE
MÉCANIQUE**

Mai 2021

TABLE OF CONTENTS

1.	INTRODUCTION	2
2.	THE PROGRAMS OF 2ND AND 3RD CYCLES IN MECHANICAL ENGINEERING.....	3
2.1	The program committee.....	3
2.2	The person responsible for the program committee.....	4
2.3	Studies and Research Program of the Student	5
2.4	Term Registration	6
2.5	Requirements for Graduation	7
2.5.1	<i>Graduate Microprogram in Mechanical Engineering - Mechatronics and Robotic.....</i>	<i>7</i>
2.5.2	<i>Graduate Microprogram in Mechanical Engineering – Advanced thermofluid.....</i>	<i>7</i>
2.5.3	<i>Master's.....</i>	<i>8</i>
2.5.4	<i>Doctorate</i>	<i>9</i>
2.5.5	<i>Registration when initial submission is done.....</i>	<i>10</i>
2.6	Doctoral qualification examinations.....	10
2.7	Progress of the studies and financial support plan.....	12
2.8	Methods of research and analysis of information	12
2.9	Mechanical Engineering Seminar for students to master's degree	13
2.10	Master's dissertation and Ph. D. thesis	13
2.11	Writing in the English language	13
2.12	Manuscript-based thesis.....	14
2.13	Fast-track to a Ph. D.	17
2.13.1	<i>Fast-track to a PH. D.....</i>	<i>17</i>
2.13.2	<i>Integrated transition from master MM-GMC to doctorate (new)</i>	<i>18</i>
2.14	Evaluation jury of the dissertation or thesis.....	20
2.15	At the time of initial submission (master's and Ph. D.).....	21
2.16	Prepare the Ph. D. thesis defense	23
2.17	Final submission (Master's and Ph. D.).....	25
3.	GENERAL INFORMATION.....	26
3.1	The Department of Mechanical Engineering	26
3.2	The Association of Graduate Students.....	27
3.3	Teaching Assistance	27
3.4	Workspace, Keys, Borrowed material	29
3.5	Mail and e-Mail	29
3.6	Posting of General Information for Graduate Students	30
3.7	Photocopies.....	30
3.8	Library	30
3.9	Test-Rigs and Instrumentation.....	30
3.10	Computer Hardwares and Softwares for Research	31
	APPENDIX A – Writing guide for the Phd oral examination (GMC-8000) and for the masters collaboration plan.....	32
	APPENDIX B - Financial assistance and support to success	34
	APPENDIX C1 – GMC-7047 Méthodologie de la recherche	43
	APPENDIX C2 - GMC-7042 Séminaire de génie mécanique.....	44
	APPENDIX D - Guide for the doctoral written qualification examination	46
	Mathematics.....	47
	<i>Field 1: Fluid mechanics.....</i>	<i>48</i>
	<i>Field 2: Energetics.....</i>	<i>49</i>
	<i>Field 3: Applied mechanics.....</i>	<i>50</i>
	<i>Field 4: Dynamics and vibrations.....</i>	<i>51</i>
	<i>Field 5: Control systems and mechatronics</i>	<i>53</i>
	<i>Field 6: Materials and fabrication.....</i>	<i>54</i>
	<i>Field 7: Industrial production.....</i>	<i>55</i>

A WORD FROM THE PROGRAM DIRECTOR

The Student Guide has been updated this year to better reflect recent changes that have taken place in our institution and our programs. Following the implementation of the softwares Capsule, monPortail and Banner for managing studies, we have for instance brought precisions regarding the requirements for graduation and the procedures for initial and final submission of the dissertation and thesis. We also propose improvements in the programs.

An important change, starting from Fall 2019, is in place for the master : the redaction and submission of the *plan de collaboration (collaboration plan)* during the first session is now compulsory. This tool was already used and required in the course GMC-7047. Due to this change, the optional course GMC-7047 (Méthodes de recherche et analyse de l'information, 1 credit) will be replaced by an equivalent compulsory course GMC-7053 (Méthodes de recherche et analyse de l'information, 2 credits). This change will be effective starting from Winter 2020. This will bring the compulsory credits to 3 for the master, leaving 9 credits for optional courses. At Fall 2019, the students may either choose GMC-7047 or GMC-7053 as an optional course.

For the master's degree, the form *Plan de collaboration (collaboration plan)* and its companion document *Detailed description of the research project*, and also the course *Séminaire de génie mécanique (GMC-7042)* have been upgraded. For the Ph. D. degree, the qualification examination (GMC-8002) now focuses on two fields instead of three and the role of the thesis committee (*comité d'encadrement*) is expanded. It was also necessary to have procedures to write a manuscript-based mémoire or thesis and to fast-track or integrated passage to a Ph. D. program, two approaches that have become common practice nowadays.

As from Fall 2019, Université Laval introduces a *Politique pour prévenir et combattre les violences à caractère sexuel (Prevention and fight against sexual violences policy)*. An obligatory training shall be followed by all students in the first six months following the start of their first session of registration in their program.

There are currently about 70 students registered in a master's degree in Mechanical Engineering (MM-GMC) and about 35 in a doctorate program (D-GMC). With our 25 professors well recognized in their field of expertise, our laboratories equipped with advanced technologies, our competent staff and over 60 years of experience, the Department of Mechanical Engineering of Université Laval can provide you with quality training. More importantly, it is you, our graduate students, who make this reputation with your hard work and your commitment. We are very proud to have you onboard.

Please allow me to wish you great success in your graduate studies, and also wish to you that the academic training acquired at Université Laval will bring you a thriving career!

Benoît Lévesque, eng., Ph.D., August 30th 2021

1. INTRODUCTION

This guide has been prepared for students registered for a 2nd or 3rd cycle program in Mechanical Engineering. It is meant to provide them with:

- a) A summary of rules governing their studies, found in various official documents issued by Université Laval.
- b) Information specific to the programs in Mechanical Engineering.

For more detailed and official information, the student should refer to the sites and the following documents:

- Programs, courses and class schedules:
<http://www.gmc.ulaval.ca/enseignement/cours/> /
[ULaval_programmes-cours-horaires.html](http://www.ulaval.ca/ULaval_programmes-cours-horaires.html)
- Faculty of graduate and postdoctoral studies (thesis and dissertation, submission, etc.):
<http://www.fesp.ulaval.ca/>
- Bursary and financial aid office: <http://www.bbaf.ulaval.ca/>
- Regulation:
On studies: [Reglement des etudes.pdf](#)
Disciplinary rules: [Reglement disciplinaire.pdf](#)
Regarding intellectual property:
https://www.ulaval.ca/fileadmin/Secrtaire_general/Reglements/Reglement-invention-brevet-et-Reglement-propriete-intellectuelle-UL.pdf
- Student life office (general information, welcome, international students):
<http://www.bve.ulaval.ca/>
- International students:
<http://www2.ulaval.ca/international/etudiants-internationaux/immigration.html>
[Guide pratique des étudiants étrangers/International Student's Handbook](#)
- Your rights:
Student rights declaration:
[Declaration des droits.pdf](#)
Ombudsman <http://www.ombudsman.ulaval.ca/>

2. THE 2ND AND 3RD CYCLES PROGRAMS IN MECHANICAL ENGINEERING

2.1 THE PROGRAM COMMITTEE

The program committee consists of the program director, two (2) professors from the Department of Mechanical Engineering appointed for 2 years by the “Conseil de la faculté” (Faculty council) on the Dean’s recommendation and two (2) representatives of the 2nd and 3rd cycles students appointed for one year by their association.

According to the “[Règlement des Études](#)” (regulation on studies), articles 63 and 64, this committee:

- a) ensures the quality of the program, the adequacy of the program in line with developments in the field of knowledge and the needs of society, as well as respect for the aims and objectives of the program, as adopted by the University Council, and taking into account, where appropriate, approved changes;
- b) ensures the quality and relevance of training activities and other means used to achieve the program goals and, after consulting the departments concerned, proposes the modifications to be made and forwards them to the approval authorities;
- c) works on the recruitment and assist the program director in fulfilling its responsibilities regarding the admission, welcome and supervision of students;
- d) decides on the means to implement in order to promote the progress of the students in the program.

2.2 THE PERSON RESPONSIBLE FOR THE PROGRAM COMMITTEE

The students will complete most of the administrative tasks required by its program with the person responsible for the program committee. These tasks are:

- registration at the beginning of a semester;
- choice of courses;
- submission of the academic program;
- submission of the master's dissertation or Ph. D. thesis.

The students must first contact their supervisor and then the person responsible for the program committee (also responsible for the graduate programs) regarding any problems related to their studies. The latter person works with the staff from the "Secrétariat des études" (studies secretariat) which records the guidelines in Banner. This person is:

Mr Benoît Lévesque, eng., Ph. D.
Adrien-Pouliot Building, room PLT-3306-B
Telephone: 418 656-7853
Email: directeur.cycles23.gmc@gmc.ulaval.ca

The program director is also in charge of the following tasks :

- studies the admission requests submitted in every graduate program;
- approves of the academic program (choice of courses, research project, schedule of activities) of every student undertaking a master's or Ph. D. degree;
- supervises the progress of the student and controls its conformity with the academic program previously approved of;
- supervises the evaluation process of the master's dissertation or Ph. D. thesis.

2.3 STUDIES AND RESEARCH PROGRAM OF THE STUDENT

Several 2nd and 3rd cycles programs are offered to the student. Section 2.5 gives more information on the content of these programs.

Graduate Microprogram in Mechanical Engineering - Mechatronics and Robotics

This program will allow you to consolidate your theoretical, technical and methodological knowledge in the field of mechatronics and robotics. Concretely, you will develop skills combining mechanics, electronics and computers and will be able to integrate them into robotics and mechatronics applications. These interdisciplinary fields of expertise also cover several applications in the fields of aeronautics, medical technologies, transportation, industrial automation and collaborative robotics.

Graduate Microprogram in Mechanical Engineering – Advanced thermofluid

This program aims to provide extensive training in fluid mechanics and thermodynamics. The targeted fields are aerodynamics, hydrodynamics, heat exchanges, combustion, energy production. It is designed to allow students to deepen their knowledge of the physical phenomena involved, as well as the fundamental mathematical theories that allow them to be understood, while consolidating their analytical, synthesis and critical sense in the use of this knowledge.

These two microprograms can only be attended part-time. The duration of studies can therefore extend to more than two semesters.

Master's degree with dissertation in Mechanical Engineering

During the first session of registration, the student must take the course GMC-7053 *Méthodes de recherche et analyse de l'information* (methods of research and analysis of information). At the end of the course, the student jointly with his research supervisor, write and sign the schedule of studies and the research program following elements listed in of the form *Plan de collaboration* (*collaboration plan*) (see section 2.8 and Appendix A for more informations). The student gives a signed copy of this program to the program director at the end of the session.

For a full-time student (12 credits or more per semester), this program should not exceed 4 semesters and 45 credits, although it is possible to prolong the Master's degree en route.

Optional courses have to be chosen from the list given in the program description and are limited to the number needed to obtain 9 credits (usually 3 courses). The courses of the program are listed in section 2.5.

It is possible to build an individualized track by taking courses in the second and third cycles other than those listed if the supervisor and the program director approves of it. They will appear initially in the "Info supplémentaire" (additional info) section in their Capsule dossier. They can be transferred to the curriculum at all times in a personalized way with the approval of the program director.

Towards the end of the program, the students must present a seminar in connection with their research subject. For this, the students must register to the course GMC-7042 (typically at the last session). To fulfill the requirements of this course, the student must attend a minimum of eight seminars. A form must be completed to prove the assistance at these seminars (see section 2.9 for more details).

Doctorate's degree (Ph. D.) in Mechanical Engineering

A summary of the program requirements is given in section 2.5. Students registered for a Ph. D. program present their project during their second qualification examination ([Examen oral GMC-8000](#)) which should be taken in their second semester, but no later than during the third. For a full-time student, the program should not exceed 8 semesters and 90 credits. Optional courses have to be chosen from the list given in the program description and are limited to the number needed to obtain 9 credits (usually 3 courses). The courses of the program are listed in section 2.5.

It is possible to build an individualized track by taking courses in the second and third cycles other than those listed if the supervisor and the person responsible for the program approves of it. They will appear initially in the “Info supplémentaire” (additional info) section in Capsule. They can be transferred to the curriculum at all times in a personalized way with the approval of the program director.

2.4 TERM REGISTRATION

During the registration period preceding the beginning of every semester, the student must register online on the website of the self-service of studies “Mon Portail” at the following address <https://monportail.ulaval.ca>.

During the semester preceding the approbation of his or her program, the student must refer to his supervisor for the choice of the courses to be taken. For the following semesters, the student must follow the *Plan de collaboration (collaboration plan)* approved by the program committee. If the courses chosen are no longer available, the student must consult with his or her supervisor in order to choose new courses.

It is the student's responsibility to be aware of the periods during the year when he can register, make modifications to his choice of courses or withdraw a class without failure, with or without refund.

Before registering in monPortail, students should consult their progress report (“rapport de cheminement”). Registration to credits is made by consulting “Recherche de cours”. The choice of a course GMC-xxxx at a given semester will give the necessary NRC number (5 digit reference course number). In case of difficulty or question, the staff from the “Secrétariat des études” (studies secretariat) or the program direction can help. Errors and courses that are not listed in the right block must be reported immediately to the program direction.

2.5 REQUIREMENTS FOR GRADUATION

2.5.1 Graduate Microprogram in Mechanical Engineering - Mechatronics and Robotic

This microprogram requires 12 credits distributed as follows:

Bloc Exigence commune (3 crédits)	
<u>GMC-7046</u>	Éléments de robotique
Note : If the 1st cycle course GMC-3351 has been followed by the student, the student shall take 12 credits in the following list.	
Cours (9 crédits)	
<u>GEL-7063</u>	Commande industrielle
<u>GIF-7001</u>	Vision numérique
<u>GIF-7005</u>	Introduction à l'apprentissage machine
<u>GLO-7021</u>	Introduction à la robotique mobile
<u>GMC-7004</u>	Sujets spéciaux (génie mécanique)
<u>GMC-7015</u>	Mécanique des manipulateurs
<u>GMC-7018</u>	Acquisition, traitement de données
<u>GMC-7025</u>	Fabrication assistée par ordinateur
<u>GMC-7048</u>	Analyse et synthèse cinématique des mécanismes

This microprogram can only be attended part-time. The duration of studies can therefore extend to more than two semesters.

2.5.2 Graduate Microprogram in Mechanical Engineering – Advanced thermofluid

This microprogram requires 12 credits to be taken in the following list:

Cours (12 crédits)	
<u>GMC-7001</u>	Couches limites
<u>GMC-7012</u>	Mécanique des milieux continus
<u>GMC-7014</u>	Mécanique des fluides avancée
<u>GMC-7020</u>	Turbulence
<u>GMC-7044</u>	Transfert de chaleur approfondi
<u>GMC-7049</u>	Thermodynamique avancée

This microprogram can only be attended part-time. The duration of studies can therefore extend to more than two semesters.

2.5.3 Master's ([Maîtrise en génie mécanique - avec mémoire \(M. Sc.\)](#))

This program requires 45 credits distributed as follows (from winter 2020)* :

Activités de formation communes (3 credits)		
<u>GMC-7053</u>	Méthodes de recherche et analyse de l'information	Registration at the 1 st semester
<u>GMC-7042</u>	Séminaire de génie mécanique	Registration at the 4 th semester
Bloc Recherche (33 credits)		
<u>GMC-6801</u>	Activité de recherche - mémoire 1	7.0 credits at the 1st semester
<u>GMC-6802</u>	Activité de recherche - mémoire 2	7.0 credits at the 2nd semester
<u>GMC-6803</u>	Activité de recherche - mémoire 3	9.0 credits at the 3rd semester
<u>GMC-6804</u>	Activité de recherche - mémoire 4	10.0 credits at the 4th semester
Concentrations (9 crédits)		
Cheminement sans concentration (choisir 9 crédits parmi les cours suivants)		
GCI-7030, GEL-7015, GEL-7017, GEL-7021, GIN-7022, GIN-7052 GMC-7000 à GMC-7006, GMC-7010 à GMC-7015, GMC-7018, GMC.7020, GMC-7022, GMC-7023, GMC-7025, GMC-7026, GMC-7029 à GMC-7031, GMC-7043, GMC-7044, GMC-7046, GMC-7048 à GMC-7051, GMC-7054		
Génie industriel (choisir 9 crédits parmi les cours suivants)		
GIF-7005, GIF-7006, GIN-7000 à GIN-7002, GIN-7010, GIN-7011, GIN-7013 à GIN-7016, GIN-7021, GIN-7022, GIN-7052, GIN-7900, GMC-7009, GMC-7017, GMC-7021, GMC-7023, GMC-7025, GMC-7026, GSO-6080 à GSO-6083, GSO-6112, MQT-6007, MQT-6009, MQT-6021, MQT-7000, MQT-7002, RLT-7014, SIO-6021		

* For the students registered in the program before winter 2020 : the *activités communes* include only 1 credit (GMC-7042) the *concentrations* include 11 credits. The course GMC-7053 is optionnal and is part of the concentration courses list.

Registration for the activities in the research block (“bloc recherche”) provides the number of credits indicated in the table above for means of graduation and payment of tuition fees. Registration to one of these activities results in full-time studies.

The progress report (“rapport de cheminement”) in Capsule allows you to see which activities in the research block (“bloc recherche”) have already been done in order to choose an activity that has not been selected yet. If all research activities GMC-6801 to GMC-6804 have been completed and the initial submission is not done yet, the student can register for additional activities as follows:

TRE-6800	Poursuite de recherche mémoire 1 (maximum 1 registration)
TRE-6801	Poursuite de recherche mémoire 2 (maximum 4 registrations)

The program direction may accept courses other than those listed above in the regular path, as long as the request is justified and recommended by the supervisor. It is possible to take English language classes, but these cannot pass as eligible courses for the program.

The research project as well as the courses to be taken and the schedule of the work activities are written down in the *Plan de collaboration (collaboration plan)* and must be approved by the program committee before the end of the second semester. See Appendix A for details.

2.5.4 Doctorate ([Doctorat en génie mécanique \(Ph. D.\)](#))

This program requires 90 credits distributed as follows:

Exigence commune (5 crédits)		
<u>GMC-8002</u>	Examen de doctorat écrit	3.0 Cr (avant la fin du 2 ^e trimestre)
<u>GMC-8000</u>	Examen de doctorat oral	1.0 Cr (avant la fin du 3 ^e trimestre)
<u>GMC-8001</u>	Communication orale de doctorat	1.0 Cr (avant la fin du 7 ^e trimestre)
Recherche (76 crédits)		
<u>GMC-8831</u>	Activité de recherche - thèse 1	7.0 crédits/activité temps plein
<u>GMC-8832</u>	Activité de recherche - thèse 2	7.0 crédits/activité temps plein
<u>GMC-8833</u>	Activité de recherche - thèse 3	10.0 crédits/activité temps plein
<u>GMC-8834</u>	Activité de recherche - thèse 4	10.0 crédits/activité temps plein
<u>GMC-8835</u>	Activité de recherche - thèse 5	10.0 crédits/activité temps plein
<u>GMC-8836</u>	Activité de recherche - thèse 6	10.0 crédits/activité temps plein
<u>GMC-8837</u>	Activité de recherche - thèse 7	11.0 crédits/activité temps plein
<u>GMC-8838</u>	Activité de recherche - thèse 8	11.0 crédits/activité temps plein
<p><i>Notez que les étudiants dont la première inscription a été faite avant A2009 sont inscrits dans la série GMC-8801 à GMC-8808, ceux de A2009 à A2011 sont dans la série GMC-8811 à GMC-8818, ceux de A2011 à A2017 sont dans la série GMC-8821 à GMC-8828, ceux de A2017 et suivantes le sont dans la série GMC-8831 à GMC-8838.</i></p>		
Cours de concentrations (9 crédits)		
Cheminement sans concentration (choisir 9 crédits parmi les cours suivants)		
GCI-7030, GEL-7015, GEL-7017, GEL-7021, GIN-7021, GIN-7022, GIN-7052, GMC-7000 à GMC-7006, GMC-7010 à GMC-7015, GMC-7018, GMC-7020, GMC-7022, GMC-7023, GMC-7025, GMC-7026, GMC-7029 à GMC-7031, GMC-7042 à GMC-7044, GMC-7046 à GMC-7051, GMC-7053*, GMC-7054		
Cheminement Génie industriel (choisir 9 crédits parmi les cours suivants)		
GIF-7005, GIF-7006, GIN-7000 à GIN-7002, GIN-7010, GIN-7011, GIN-7013 à GIN-7015, GIN-7021, GIN-7022, GIN-7052, GIN-7900, GMC-7023, GMC-7025, GMC-7026, GSO-8012, MQT-7000, MQT-7002, MQT-8001, RLT-7014		

* Les cours GMC-7047 (1 crédit) et GMC-7053 (2 crédits) sont mutuellement exclusifs.

Registration for the activities in the research block (“bloc recherche”) provides the number of credits indicated in the table above for means of graduation and payment of tuition fees. Registration to one of these activities results in full-time studies.

The progress report (“rapport de cheminement”) in Capsule allows you to see which activities in the research block (“bloc recherche”) have already been done in order to choose an activity that has not been selected yet. If all research activities GMC-8831 to GMC-8838 have been completed and the initial submission is not done yet, the student can register for additional activities as follows:

TRE-8800	Poursuite de recherche thèse 1 (maximum 2 registrations)
TRE-8801	Poursuite de recherche thèse 2 (maximum 5 registrations)

The program direction may accept courses other than those listed above in the regular path, as long as the request is justified and recommended by the supervisor. It is possible to take English or French language classes, but these cannot pass as eligible courses for the program.

Every student who is registered in the doctorate program in Mechanical Engineering is subjected to *two qualification examinations* with an aim of ensuring that he has a minimum of knowledge in Mechanical Engineering and competences necessary to conclude his research project. Moreover, halfway of his studies, the student will have to make *an oral communication* to present the progress of his research.

Thesis committee

The thesis committee is formed at the first semester of admission of the student with the approval of the program direction. It is composed of at least the thesis supervisor and two other teachers working in the same field of research, including his or her co-supervisor if applicable (so normally, three professors). This committee ensures the follow-up of the student during his research project. In particular, the thesis committee evaluates the oral exam and the oral communication of the candidate.

The professors of the thesis committee must meet the requirements of the composition of the thesis jury (see section 2.14). The members of the thesis committee are usually, but not necessarily, part of the thesis jury.

2.5.5 Registration when initial submission is done

When the initial submission was made and the dissertation or thesis is still under evaluation at the next semester, registration is not mandatory. However, to continue to enjoy the privileges offered to the students of Université Laval, it is possible to register to:

TRE-7802	Thèse ou mémoire déposé pour évaluation
----------	---

This registration gives the status of full-time student (12 credits) even if the student only pays the related fees. An attestation of studies may be provided by the Registrar's Office.

2.6 DOCTORAL QUALIFICATION EXAMINATIONS

GMC-8002 Examen de doctorat écrit

The first qualification examination *must be normally taken before the end of the second semester*. (Normally at the first semester.) Usually, the examination is planned *at the beginning of the last month of the semester*. For this, the student must be registered to the 3 credit course [GMC-8002](#) *Examen de doctorat écrit* during this semester.

The purpose of this examination is to give students time to review and consolidate their knowledge and to ensure that they have the necessary background to succeed in class and to undergo a doctoral research in Mechanical Engineering.

The supervisor of the student decides on the examined subjects. The subjects are selected among the seven fields listed in Appendix D.

These written examinations are in two fields: mathematics and the research field of the candidate. Unless otherwise stated, no reference books are allowed for these exams, but students are entitled to have a hand-written summary on a 8½ x 11 page (both sides) for each 3 hour exam. Examples of exam and solved exercises are available in the Intranet section on the website of the Department of Mechanical Engineering and/or at the Department of Mechanical Engineering.

The complete written examination includes four subjects of 90 minutes spread over two non-consecutive half days. The mathematics exam lasts 180 minutes and includes two subjects, the first of which is compulsory. The examination in the research field of the candidate may have one or two subjects, depending on the field, for a total of 180 minutes.

The grades for these exams are those of the 2nd and 3rd cycles of Mechanical Engineering:

A+ [90.00 - 100]	A [86.00 - 89.99]	A- [82.00 - 85.99]
B+ [78.00 - 81.99]	B [74.00 - 77.99]	B- [70.00 - 73.99]
C+ [66.00 - 69.99]	C [50.00 - 65.99],	E [0.00 - 49.99] Failure

The passing mark is 60 % in each field. Any mark lower than 35 % for a field or a failure in two fields yields to the immediate exclusion from the program. The authorized repeats take place in the following semester. Any new failure involves the exclusion from the program. The marks indicated on the report will be the average of the two fields with following weighting: 50 % for the field of research, 50 % for the field of mathematics.

GMC-8000 Examen de doctorat oral

The *second* examination is a non-public oral examination which the student must take before the end of his third semester. For this, the student must be registered to the one (1) credit course **GMC-8000 Examen de doctorat oral**. In preparation for this examination, the student must provide his thesis committee, at least two weeks before the planned date for his examination, with a written report of at most twenty (20) pages (including the bibliography and with a font equivalent to Times New Roman 12 points, 2,5 cm margins) including the problematic of his research, a review of the literature on the subject, the methodology which he intends to use for his work, the list and the availability of the necessary equipment (softwares and experimental), a schedule which should not exceed eight semesters, the list of the courses already done and the courses to follow to complete his program (minimum 9 credits) and supervision modalities. See Appendix A for a more detailed list.

At the examination, the student presents his research project during 30 minutes. He is then questioned by his thesis committee on his subject and knowledge necessary to its realization. The committee bases its evaluation on the contents of the report, the oral presentation and the quality of the answers to the questions. Following this examination, the student can be authorized to continue his project, can have to redo his report while conforming to the requirements of the committee or can be excluded from the program. He is notified of the conclusions of the committee in the days following the examination with the grade Pass (P) or Failure (N) which will be shown on the term report.

GMC-8001 Communication orale de doctorat

Between the 5th and the 7th semester, the doctorate student must make an *oral communication*, in which he presents the progress of his research to the critics of his thesis committee. For this, the student must be registered for the one (1) credit course **GMC-8001 Communication orale de doctorat**. This step aims to help students by providing guidance for their research project.

The presentation lasts 30 minutes. A revised and updated version of the document presented for the oral examination (at most 20 pages, font equivalent to Times New Roman 12 points, 2.5 cm margins) must be presented two weeks before the planned date.

The thesis committee gives a formal evaluation to the student with the note Pass (P) or Failure (N) which will be shown on the term report.

The student is notified of the conclusions of the committee in the days following the examination.

2.7 PROGRESS OF THE STUDIES AND FINANCIAL SUPPORT PLAN

In order to allow for the program committee to follow the advance of the studies of the graduate students, we have set milestones in the progress of the studies, which aim at financially encouraging those who show reasonable progression in their graduate studies. For more details, see the document “Financial assistance and support to success” at Appendix B.

2.8 METHODS OF RESEARCH AND ANALYSIS OF INFORMATION

All master students must follow the course GMC-7053 *Méthodes de recherche et analyse de l'information* (methods of research and analysis of information) at their first registration session. The doctoral students who have not already taken it are invited to follow this course in their first or second registration session. This course on research methodology aims to make the students independent in research, in organization and ethical use of information and to develop a critical mind regarding information sources and the world of scientific edition.

Preliminary activities will allow the students to discuss different subjects during practical workshops such as: Introduction to research and Université Laval study regulations, research methodology, writing the dissertation, the thesis or scientific articles. He will follow a 15 hours training given by the library at Université Laval on research and evaluation of information.

The student will create his *Plan de collaboratio* (collaboration plan) for the master degree or their manuscript for the second qualification examination (*Examen oral* GMC-8000).

2.9 MECHANICAL ENGINEERING SEMINAR FOR STUDENTS TO MASTER'S DEGREE

Every Master's student must include the course [GMC-7042](#) *Séminaire de génie mécanique* (seminar) in his program. The purpose of this course is to initiate the graduate student to the effective communication of results. Registration must be done at the end of his studies program.

The requirements for this course are as follows:

- To follow a two hours workshop on how prepare and give an oral presentation. To prove his presence at a given workshop, the student must ask the person responsible for this workshop to sign the form in Appendix C.
- Attend, during his entire program, a minimum of eight (8) conferences, including at least four (4) in the course [GMC-7042](#). To prove his presence at a given conference, the student must ask a professor attending the conference to sign the form in Appendix C. He hands over this document to the program direction when he presents his seminar.
- Give a seminar about his research subject (20 minutes for presentation and 5 minutes to answer questions) at his next-to-last or last semester of registration to the master's program.

2.10 MASTER'S DISSERTATION AND PH. D. THESIS

Before undertaking the writing of his master's dissertation or doctoral thesis, the student should consult the Faculty of graduate and postdoctoral studies (FESP) website in *Rédiger votre mémoire ou these* : <https://www.fesp.ulaval.ca/etudiants-actuels/rediger-votre-memoire-ou-these> (in French).

This new tool aims at providing the necessary information needed throughout the student's program. It is a unique reference regarding graduate studies.

For consistency, it is obligatory to follow the presentation rules established by the Faculty of graduate and postdoctoral studies, especially regarding the title page patterns, the layout and the character size. You will be able to consult these presentation rules at the section "Règles de présentation de la FESP" on the website.

2.11 WRITING IN THE ENGLISH LANGUAGE

The writing of the dissertation or thesis is in the French language. However, the Regulation on studies, articles 49 and 98, gives the program direction the right to authorize the writing of parts or all of a dissertation or thesis in a language other than French. The student must obtain, on the recommendation of his supervisor, the approval of the program direction prior to writing.

2.12 MANUSCRIPT-BASED MASTER'S DISSERTATION OR THESIS

The Faculty of graduate and postdoctoral studies (FESP) specifies that it is the student and his supervisor who decide whether to make use of the writing of a manuscript-based (article-based) thesis (thesis composed of articles or including articles). The department of Mechanical Engineering allows this approach.

Reference criteria suggested by the program committee of Mechanical Engineering

The main body of the dissertation or thesis may include one or more articles, published or unpublished, respecting the following criteria :

Doctorate

Minimum number of papers as a primary author (guide: 75 % of the content from the student) Minimal state : submitted	3
Minimum number of papers published or accepted (with a letter from the editor) among the 3 required	1
Quality of the journals where the articles were or will be published	Recognized journals in the field of the student. Articles published in high level conferences will also be accepted.

Master

Minimum number of papers as a primary author (guide: 75 % of the content from the student) Minimal state : writing completed	2
Minimum number of papers ready to be submitted among the 2 required	1
Quality of the journals where the articles were or will be published	Recognized journals in the field of the student. Articles published in high level conferences will also be accepted.

The FESP specifies that even when the program direction requires the insertion of published papers it cannot unduly delay the evaluation of a student if the publication or acceptance for publication is delayed. Publication of a paper should not prevent its insertion in the thesis or restrict the future dissemination of it.

Authorization

The manuscripts of papers published by the candidate during his studies which relate to his research project will be integrated into the main body of the dissertation or thesis so that it is considered during the evaluation. The structure of the dissertation or thesis must therefore be organized according to these insertions.

From the moment the student and his supervisor consider the writing of a manuscript-based dissertation or thesis, an authorization to proceed must be requested in writing to the program direction, along with a writing outline.

Structure of a manuscript-based dissertation or thesis

FESP requirements.

The dissertation or thesis must be more than a collection of manuscripts. It must keep its usual structure in which papers are inserted, among other parts of the dissertation or thesis, to form a non-repetitive cohesive unit.

The text and presentation of each paper must be adapted accordingly, which requires eliminating unnecessary sections and presenting the papers in a manuscript form and not as reprints or photocopies of publications.

Each paper, when inserted into the dissertation or thesis, forms a separate chapter. Papers must have been prepared and published during the graduate studies, as part of the research project undertaken for graduation.

Including papers in a dissertation or thesis must be done in strict compliance with copyright.

The presentation rules for insertion of articles are given by the FESP (see *Particularités de la rédaction par articles ou par insertion d'articles* on the web site of the FESP).

Requirements of the 2nd and 3rd cycles program committee in Mechanical Engineering

The introduction and conclusion should be written to bring out the consistency of the approach. The program committee suggests including the following items:

-
- Abstracts in the French and English languages
 - Table of contents
 - Nomenclature (if applicable)
 - Introduction and summary (foreword, problematic, objectives...)
 - Literature review for the whole project
 - Explanations on the integration of all the papers in a scientifically cohesive unit and on the main contributions
 - A methodology (sub) chapter which explains the experimental approach and apparatus or the numerical method and preliminary tests, unless they are explicitly described in the papers
 - Papers (one per chapter)
 - Title, introduction, abstract in the French language (and in the English language if the paper is written in English and allowed by the program direction)
 - The paper itself
 - General conclusion and prospects
 - Appendices
-

For more details:

General: <https://www.fesp.ulaval.ca/> (in French)

“Rédiger votre mémoire ou votre thèse”

<https://www.fesp.ulaval.ca/etudiants-actuels/rediger-votre-memoire-ou-these>

“Rédaction dans une langue autre que le français”

“ Règles de présentation de la FESP”

“ Contenu et règles particulières des parties ”

<https://www.fesp.ulaval.ca/particularites-redaction-par-articles>

“Diffusion et publication d'un mémoire ou d'une thèse”

“Politique relative à l'intégrité scientifique”

2.13 FAST-TRACK TO A PH. D.

2.13.1 Fast-track to a PH. D.

When the research subject of a master student is of large-scope, fast-track to the Ph. D. allows to be admitted to the doctoral studies without writing the master's dissertation. Some requirements must be met and the fast-track must be approved by the supervisor and the program director.

Requirements of the Regulation on studies (article 195):

- have the approval of his supervisor;
- complete the master's degree courses (courses, seminars);
- demonstrate that the research project has sufficient extent and originality to be a thesis, in the opinion of the supervisor and the program direction;
- demonstrate that you possess the skills required to undertake and complete a Ph. D. degree, by a written and oral presentation of the state of advancement of your research project.

The ability to oral and written communication is an oimportant criterion for the fast-track to be approved (presentation of seminars, conferences, papers, etc.)

The requirements of the Ph. D. program shall be fully completed afterwards. A course followed for the master's degree cannot count for the Ph. D. degree (one course cannot be included in two programs, except for courses in an integrated transition).

Request for a fast-track to a Ph. D. program must be submitted to the program direction along with a file containing the relevant information to make a decision: description of the master's research and Ph. D. research to realize, connection between the two projects, justification of the project extent, courses to take, approval of the supervisor.

In the case of fast-track passage, the master's degree can be obtained once all the courses and exams of the doctoral program are completed.

2.13.2 Integrated transition from master MM-GMC to doctorate (new)

With the integrated transition, the student can choose up to 9 credits courses that will count in the two programs. The objective is to allow students who demonstrated capacities to advance more quickly to superior grades to do so. At the opposite to the fast-track, the master must be fully fulfilled, including the master's thesis (dépôt du mémoire de maîtrise).

Method :

Minimal Registration Period	After the first session of Master Program is completed.
Minimal Cumulative Average	Integrated transition: 3,5/4,33 at Bachelor Degree level or equivalent for non-Canadians, and meeting the requirements at the Master level.
Other Admission Criteria	Acceptance from the future research supervisor. Targeted courses already selected.
Admissible Courses	All the GMC and GIN courses from the 7000 section or equivalent.
Number of Credits from Passing Grade	9 credits maximum.
Validity Period	The third grade courses contribute to the doctorate program as planned by agreement up to 5 years after having been completed successfully. After that, their contribution must be evaluated again by the Doctorate Program Director.
Process to request integrated transition	The request for integrated transition must be submitted to the program direction along with a file that includes elements pertinent to render a decision. The elements required are: University transcript, a letter of approval from the Research Director, and the targeted courses for the integrated transition. The form <i>Autorisation d'inscription au passage intégré REG-365-IN</i> must be completed with this information.

Note : A course that have contributed an integrated transition between a 1st cycle and a 2nd cycle program cannot be used in an integrated transition between the master and the doctorate programs.

IMPORTANT : Ce formulaire doit être rempli avant l'ajout du Passage intégré au dossier de l'étudiant. La version originale doit être déposée au dossier facultaire du programme actuel et une copie doit être remise au programme subséquent, à l'étudiant et à la FESP. Toute modification au choix d'activités prévues doit être approuvée par les deux directions de programme, suivant la même procédure.

IDENTIFICATION DE L'ÉTUDIANTE OU DE L'ÉTUDIANT

Nom	Prénom(s)	NI				
<table border="1"> <tr> <td>Programme actuel</td> <td></td> </tr> <tr> <td>Code du programme</td> <td>Titre du programme</td> </tr> </table>			Programme actuel		Code du programme	Titre du programme
Programme actuel						
Code du programme	Titre du programme					
<table border="1"> <tr> <td>Programme subséquent</td> <td></td> </tr> <tr> <td>Code du programme</td> <td>Titre du programme</td> </tr> </table>			Programme subséquent		Code du programme	Titre du programme
Programme subséquent						
Code du programme	Titre du programme					

SCOLARITÉ AUTORISÉE (cours du cycle subséquent uniquement)

Note : Les crédits du programme subséquent ne seront pas pris en compte dans le calcul de la moyenne du programme actuel. La direction de programme doit s'assurer que l'étudiant aura une place dans les cours faisant l'objet du passage intégré.

		Demande initiale <input type="checkbox"/>		Modification <input type="checkbox"/>	
Matière – Numéro	Titre de l'activité	Crédits	Cycle	Session d'inscription	
Total					

AUTORISATION DE LA DIRECTION DU PROGRAMME ACTUEL

Nom de la directrice/du directeur du programme		
Signature	Date	
	aaaa	mm jj

AUTORISATION DE LA DIRECTION DU PROGRAMME SUBSÉQUENT

J'atteste que l'entente entre les programmes offrant ce passage intégré a été dûment approuvée par le comité institutionnel responsable. Conformément à cette entente, les cours de cycles supérieurs contribuent au programme subséquent _____ années après avoir été réussis. Au-delà de cette période, leur contribution devra être à nouveau évaluée par le directeur du programme.

Nom de la directrice/du directeur du programme		
Signature	Date	
	aaaa	mm jj

SIGNATURE DE L'ÉTUDIANTE OU DE L'ÉTUDIANT

Signature	Date	
	aaaa	mm jj

2.14 EVALUATION JURY OF THE DISSERTATION OR THESIS

To have more information on the process of evaluation, see the detailed procedure on the web site of the FESP : : <https://www.fesp.ulaval.ca/etudiants-actuels/soumettre-a-evaluation> and <https://www.fesp.ulaval.ca/evaluation-du-memoire-ou-de-la-these> .

The dissertation and thesis are evaluated by a jury appointed by the FESP. The jury for master's dissertation or thesis must be designated before the initial submission. Jury members make an individual judgment on the submitted document and are not allowed to communicate with each other to compare their assessments. The pooling of the examiners' reports determines the jury's decision.

An evaluation jury consists of ex officio examiners (the supervisor and co-supervisor) and examiners appointed on an ad hoc basis, qualified according to their expertise in the field and to whom it is necessary to take an external view on the work of the student. The jury of a dissertation includes a minimum of three examiners; the jury of a thesis a minimum of four examiners, one of which is completely independent of Université Laval. In both cases, when there is a co-supervisor, it is recommended to add a supplementary examiner. In such a case, there will be four examiners for the dissertation and five for the thesis.

When the research supervisor assumes the responsibility of the program direction, the vice-dean for studies of his faculty will take the place of him.

If there has been a pre-reading, the pre-reader is usually but not necessarily a member of the jury.

Evaluation of the dissertation or the thesis

The first step in the process of evaluation is the designation of the jury : the jury is 1) suggested by the supervisor to the program director by transmitting by email the form *Désignation du jury d'évaluation d'un mémoire*; 2) recommended, after verifications, by the program director to the FESP; 3) designated by the FESP.

Jury of the dissertation

The ad hoc designation of an examiner (*regard extérieur* – external point of view) must respect the following conditions:

- the approached person holds a master's degree in the pertinent domain (or a related domain);
- he or she has not been engaged with the student in any conflict of interest, proven or potential, that may interfere with the objectivity of the evaluation.

The jury must include an examiner who is able to take an external view of the dissertation and who has not participated or actively collaborated in the student's work (for example, by contributing to one of the articles included in the dissertation).

Jury of the thesis

The ad hoc designation of an examiner (external view and external examiner) respects the following conditions:

- the approached person holds a doctorate's degree (Ph. D.) in the pertinent domain (or a related domain);
- she or he has not been engaged with the student in any conflict of interest, proven or potential, that may interfere with the objectivity of the evaluation: she or he has not participated or actively collaborated in the student's work (for example, by contributing to one of the articles included in the thesis).

The jury must include an external examiner, completely independent, who doesn't have any employment link or any association with Université Laval (the associate professor, whether or not empowered to co-supervise students, is therefore not eligible).

Initial submission

After the initial submission

2.15 AT THE TIME OF INITIAL SUBMISSION (MASTER'S AND PH. D.)

You will find more complete information and forms on the following website:
<https://www.fesp.ulaval.ca/etudiants-actuels/soumettre-a-evaluation> (in French)

At the time of initial submission, the student must be registered at the current session in the program for which he is applying for a degree (or be pursuing the research). Then follow these steps:

The student must bring the following documents to the academic management agent of his program, at the "Secrétariat des études" (studies secretariat) (room PLT-3120, cyclesup.gmc@gmc.ulaval.ca). The secretariat will transfer them to FESP after having entered the data into Banner.

- A copy of the title page of the dissertation or thesis. For consistency, it is mandatory to follow the model of title page, notably for layout and font size. See: <https://www.fesp.ulaval.ca/etudiants-actuels/rediger-votre-memoire-ou-these>. Afterwards, the student should ensure that the title of the dissertation or thesis registered on his school report, in Capsule, is similar to the title of the document he will deposit to the FESP and ask for correction if necessary.
- "*Déclaration de l'étudiant - éthique de la recherche (form VRR-101)*"

To be transmitted to the programs direction :

- "*Désignation du jury d'évaluation d'un mémoire*" ou "*Désignation du jury d'évaluation d'une thèse*". The document must be completed by research supervisor in collaboration with the student.

Once completed, the supervisor records the date and sends the document by e-mail to the program director. The programs direction receive the suggestion, validate it and transmit his recommendation to the FESP that will appoint the jury.

1. When the dissertation or the thesis is complete and perfect, the student request the opening of his “*dossier d’évaluation*” by writing to the FESP at evaluation@fesp.ulaval.ca using his official Université Laval e-mail. The e-mail must have the following information:
 Object: Initial deposit – (dissertation or thesis) of - first name – and - name
 Body of the message:
 - NAME, first name - NI
 - Program (Master’s or PH. D. + branch of research)
 - NAME, first name of research supervisor
 - NAME, first name of co-supervisor, if appropriate
 - Title of manuscript
 - Number of pages
2. Transmit an electronic copy of the thesis or the dissertation using preferably OneDrive (see instructions under “*Votre manuscrit*”) or attached to the opening request at evaluation@fesp.ulaval.ca. The original and a PDF version must be transmitted. The name of the files must include your First Name-Name-NI.
3. The manuscript must be accompanied by the following forms filled and signed :
 “*Licence non exclusive de diffusion pour mémoire et thèse (FESP-102)*” for the Bibliothèque nationale, signed by the student;
 “*Fiche d’information sur le document rédigé en Word ou ODT ou LaTeX (DOC)*”.
4. As applicable to his situation, the student also encloses the following form(s):
 “*Autorisation de rédiger dans une langue autre que le français (FES-101)*”, if appropriate;
 “*Autorisation de diffusion par le(s) coauteur(s) d’un article inséré dans le mémoire ou la thèse (FES-100)*”, one form for each paper cosigned and inserted in the dissertation or thesis (if appropriate);
 “*FES-106 Demande de restriction de diffusion*” (up to 12 months¹) if appropriate, signed by the student and approved by supervisor;
 “*Agreement related to the confidentiality of an essay, a dissertation a thesis*”, if appropriate.

Note: Forms in italics are available on the intranet of the website: <https://www.gmc.ulaval.ca>

¹ After the first 12 months, if the diffusion restriction must be extended, see the information on the following link : <https://www.fesp.ulaval.ca/etudiants-actuels/diffusion-des-resultats-de-recherche>

2.16 PREPARE THE PH. D. THESIS DEFENSE

Prior to the defense, a defense certificate must be issued by the FESP.

Requirements:

- all evaluation reports are entered;
- the student's supervisor must have forwarded to the program direction the information regarding the location and time of the defense and the composition of the jury, identifying the external examiner;
- the program direction must have sent this information to the FESP via the Banner system and agreed that the defense should take place, depending on the evaluation reports.

The student and his supervisor are responsible to book rooms for the defense and jury deliberations. Room reservations for the Alexandre-Vachon Building and the Adrien-Pouliot Building are made through *Module de réservation de locaux (MRL)* under "Demandes de réservations".

INFORMATIONS DIVERSES – SOUTENANCE DE THÈSE
Réservation des locaux

*Pavillon Vachon :	Salle du Conseil 1039-B Salles de cours 2820, 2830, 2840, 3820, 3850 Contact : Mme Guylaine St-Pierre, poste 3345 ou locaux@fsg.ulaval.ca
*Pavillon Pouliot :	Salle 3370 Contact : Mme Guylaine St-Pierre, poste 3345 ou locaux@fsg.ulaval.ca Salle 3355 pour les délibérations du jury Contact : Via Pixel ou Mme Catherine Lévesque, poste 6786
**Pavillon Pouliot :	Salle de vidéoconférence facultaire 1138-H Inscription d'une combinaison comptable valide pour réserver 15 personnes autour de la table + environ 15 personnes
Pavillon Casault :	Salle du Conseil (salle 3632) et salle 3865 pour les délibérations du jury Contact : Mme Lyne Pressé, poste 6362
Pavillon Marchand :	Amphithéâtre Hydro-Québec (salle 1210, 80 places) et salle 2125 ou 3125 pour les délibérations du jury Forfait soutenance (4 heures et moins) : 60,00 \$ interne*** Frais supplémentaire de 30,00 \$ pour modification de la salle Contact : Mme Micheline Girard, poste 3933
Pavillon COPL :	Auditorium (salle 1168, 80 places) et salle pour les délibérations du jury Contact : Mme Michelle Bernier, poste 3817 Mme Cinthia Ricard-Côté, poste 12348
Environnement (Jardin Van Hende)	Salle 1240 (80 places) et salle 1147-Z (16 places) pour les délibérations du jury Tarif 1240 : 92,00 \$ journée, 62,00 \$ demi-journée*** Tarif 1147-Z : 74,00 \$ journée, 49,00 \$ demi-journée*** Contact : Mme Janet Rodrigue, poste 3145 Mme Josée Vaillancourt, poste 3742
Pavillon Gene-H. Kruger:	Salle 2320 et 2330 (84 places, possibilité 134 places) Salle 2320 ou 2330 : 93,00 \$ journée, 62,00 \$ demi-journée*** Salle 2320 et 2330 : 174,00 \$ journée, 116,00 \$ demi-journée*** Contact : Bureau des événements campus, poste 2740 ou info@bec.ulaval.ca GHK-2376, salle de 20 places pour délibérations du jury Tarif : 61,00 \$ pour une demi-journée (combinaison comptable)*** Contact : Mme Caroline Trahan, poste 2438

* Prendre note que les réservations de salles pour le pavillon Vachon et le pavillon Pouliot se font sur Pixel à l'aide de l'outil « Réservation ». Pour connaître les salles de cours disponibles, utiliser l'outil « Recherche plage horaire – cours » qui se trouve dans le menu « Outils administratifs ». Pour de l'aide ou de l'information supplémentaire, communiquez avec Madame Guylaine St-Pierre, poste 3345 ou à locaux@fsg.ulaval.ca

**Pour la salle de vidéoconférence HD, il y a des frais de réservation (fournir une combinaison comptable, grille tarifaire disponible à <https://www.fsg.ulaval.ca/services/salle-de-visioconference/>). Un test de compatibilité devra être effectué avec le correspondant. Contacter à cet effet un technicien à l'adresse aide@fsg.ulaval.ca pour l'organisation plusieurs jours à l'avance.

*** Les tarifs mentionnés sont sujets à changement sans préavis.

2.17 FINAL SUBMISSION (MASTER'S AND PH. D.)

Banner now allows the program direction to approve the final submission.

All deposits must be done with an electronic copy. For more information, see “Transmission de documents à la FESP”: <https://www.fesp.ulaval.ca/etudiants-actuels/soumettre-a-evaluation>

The steps at the Department of Mechanical Engineering are as follows:

- The student makes the requested corrections in the evaluation reports and the defense report if necessary.
- The person(s) designated to verify if the corrections have been made send to the program direction by email the approval to proceed to the final submission.
- The student indicates whether the title has changed since the initial submission.
- The program director or the student supervisor will inform the student by written communication that the final submission has been approved. Mrs France Normand will also be informed so that she can authorized the payment of the possible amount of money from the financial support plan for this step.

For the master's program, the final submission will be authorized by the FESP who will send to the student the attestation required. For the Ph. D. program, the FESP would have already sent the attestation to the student when the results of the defense were recorded into the system

The final submission of the dissertation or thesis is done by the student at the FESP secretariat, after having obtained an agreement from the program director. This final step starts the process of graduation.

The process that will be followed by the FESP until graduation is detailed on the following link: <https://www.fesp.ulaval.ca/etudiants-actuels/soumettre-a-evaluation>

3. GENERAL INFORMATION

3.1 THE DEPARTMENT OF MECHANICAL ENGINEERING

The Department of Mechanical Engineering is the administrative unit responsible for the 2nd and 3rd cycles programs in Mechanical Engineering. The department head is currently:

Yves St-Amant, ing., Ph. D.
 Adrien-Pouliot Building, Room 1504-C
 Phone: 418 656-2131 ext. 407920
 Email: directeur@gmc.ulaval.ca

The student will be in regular contact with his supervisor, co-supervisors and the person responsible for the program committee.

Besides those, you might occasionally have business to do with the following people:

Fonction	Nom	Local	Téléphone
Administrative manager	Johanne Pouliot	PLT-1314-A	418 656-2131 ext. 402420
Responsible practices and research work	Boris Mayer St-Onge	PLT-3306-E	418 656-2131 ext. 404856
Data processing	aide@fsg.ulaval.ca	PLT-3708	418 656-2131 ext. 404651
Responsible practices and research work	Marc-André Plourde-Campagna ing.	PLT-1357	418 656-2131 ext. 404831
Electronic technician	André Chamberland	PLT-1340-C	418 656-2131 ext. 408454
Electronic technician	Michel Dominique	PLT-1340-C	418 656-2131 ext. 408454
Administrative technician	France Normand	PLT-1504	418 656-2131 ext. 403837
Secretary	Sylvie Latendresse / Carole Forcier	PLT-1504	418 656-2131 ext. 404859
Agent of academic management	Vanessa Boutin	PLT- 3120	418 656-2131 ext. 403997

To contact the academic secretary (“agente de gestion des études”) by email, please use the following email: cyclesup.GMC@gmc.ulaval.ca

3.2 THE ASSOCIATION OF GRADUATE STUDENTS

Since 1986, graduate students in Mechanical Engineering are formally represented by their association: “l'Association des étudiantes et étudiants diplômés en génie mécanique (AEDEGM)”. The primary objective of this association is to protect and promote the educational, social and economic interests of its members. Furthermore, it represents the latter in relations with the department, the faculty, the university, the other associations and any other organization. In order to contact the association, you may leave a note in its mail box no. 44 in the hallway PLT-1314 or contact the person responsible for the association at the following email address: aedegm@asso.ulaval.ca.

3.3 TEACHING ASSISTANCE

In 2008, a collective labor agreement was signed by Université Laval and the SARE, the “Syndicat des auxiliaires de recherche et d'enseignement” (union of research and teaching assistants). Since then, a student who wishes to find remunerated employment as a research or teaching assistant (tutorial classes, laboratory assistant, marking of examinations) must refer to the postings on the website of the “Service de placement de l'Université Laval” (Placement Service): <http://www.spla.ulaval.ca>.

As of Summer 2018, all positions of teaching assistant available requiring more than 75 hours of work during the semester are posted on the web site of the “Service de placement de l'Université Laval” (placement service) and the student may apply for the position if he meets the requirements. For contracts that require less than 75 hours during the semester, the professors of the Department of Mechanical Engineering can directly recruit the students who will assist them in their course. In this case, Mrs Sylvie Latendresse / Carole Forcier, secretary of the Department of Mechanical Engineering, is responsible for the teaching assistant work contracts. In order to fill these positions, she might communicate these job opportunities to the graduate students by email to learn about their interest for these positions. To have his contract prepared, the student must fill out the form “Demande de travail” (work request) along with the professor for whom he will work. The form should be signed by both the student and the professor and given back to Mrs Sylvie Latendresse / Carole Forcier who will validate the information and prepare the contract.

During the fall and winter semesters, the graduate student must be registered for full-time studies at Université Laval or another acknowledged university in order to work as a teaching assistant. During the summer semester, the student does not have to be registered for the current semester as long as he was registered for full-time studies during the previous winter semester.

The contracts regarding the supervision of examinations are separate from the teaching assistant contracts. At the beginning of every semester, Mrs Sylvie Latendresse / Carole Forcier, who is responsible for the contracts, will contact the graduate students by email in order to inquire for their interest in supervising examinations. The contracts are then attributed depending on the availability of the interested students and the professors' needs. A global contract will be prepared for each student at the end of each semester and will include every hour spent supervising examinations during the semester.

An international student who does not have immigration status but who owns a residence or study permit valid for the duration of the work contract must obtain a social insurance number to obtain an employment contract. To obtain a social insurance number, the document “Contrat d’emploi” is prepared by the secretariat of the Department of Mechanical Engineering. The student must report to a Service Canada office with the following documents: his passport, his residence or study permit, a full time postsecondary registration proof and the document “Contrat d’emploi”. A social insurance number is then rapidly issued for the duration of his residence or study permit. Upon receipt of his social insurance number, the student must go to the secretariat of the Department of Mechanical Engineering with the document providing his social insurance number and his residence or study permit. The secretary will then make copies of the documents which will be used for the preparation of the contract and be kept in the student’s file.

Payroll checks are issued every two weeks and must be deposited directly in the student’s bank account. To do so, the student must complete the form “[Dépôt direct de votre bourse ou autre paiement](#)”, also available at the secretariat of the Mechanical Engineering Department. The student must then send the form, along with a sample cheque, to the “Vice-rectorat aux ressources humaines, Direction des services au personnel”. If the student use the direct deposit, he will have the possibility of consulting his pay slip by using the self-service Peoplesoft RH. The student may also complete the appropriate section in his self-service Peoplesoft RH page to register for direct deposit. If the student doesn’t register for direct deposit, his payroll checks will be posted by the Service of human resources-to the address registered in his student file.

The student may go to the secretariat of the Department of Mechanical Engineering located at room PLT-1504 to meet with the director of the Department of Mechanical Engineering, M. Yves St-Amant, or to obtain information from the employees of the department:

- Mrs Sylvie Latendresse / Carole Forcier for a meeting with the head of the department, teaching assistancy and supervision of examination contracts;
- Mrs France Normand for academic scholarships, the grants related to the program milestones, research assistant contracts, petty cash expenses, or purchase requests.

To obtain information about his academic file, the student must contact the staff of the “Secrétariat des études” (studies secretariat) located at room PLT-3120 in the Adrien-Pouliot Building.

Security in the laboratories

Every student who has a work contract to teach or assist in a laboratory must attend the mandatory “SIMDUT” (WHMIS) training (information on dangerous products) This bilingual training is now available online. You can find more information about this course and [procedure](#) to register on the site of the “[Service de sécurité et de prévention \(SSP\)](#)”.

In addition, for those who work with lasers, it is mandatory to take the “[Laser training](#)” given by Université Laval and to have an eye exam every 3 years. The contact person is Madame Annie Mercier, poste 14882, Annie.Mercier@ssp.ulaval.ca.

3.4 WORKSPACE, KEYS, BORROWED MATERIAL

Upon his arrival at the Department of Mechanical Engineering, the new student must meet with the administrative manager, Mrs Johanne Pouliot, who will provide the student with a workspace and a work table. To obtain the room key where his workspace is located, the student must ask Mrs Johanne Pouliot (room 1314-A) or Mrs France Normand (room 1504). To obtain a key, the student must give a \$ 20 deposit that will be refunded when the key is returned.

Following the final submission of his master's dissertation or Ph. D. thesis, the student must return all keys in his possession to Mrs Johanne Pouliot or Mrs France Normand. He must also return to his supervisor any books or objects that he borrowed during his studies. He must sort his computer data and talk to his research group about the transfer of relevant data, if applicable. Note that VPN access will be disabled when the student is no longer registered and that the virtual mail box will remain active for a year.

Rules

The student will be granted a workspace only during the semesters where he is registered for full-time studies (at least 12 credits).

The student who would like to move to another workspace must ask the administrative manager of the department. He must obtain the authorization prior to moving any personal belongings.

An agreement between two individuals is not considered valid until it has been authorized by the administrative manager of the department.

If a student wants to have a workspace for a second time, he must place a second request to the administrative manager of the department. The workspace that will be given may not be located at the same place as the workspace the student previously occupied.

3.5 MAIL AND E-MAIL

The mail is dropped off in the mail boxes located in the hallway PLT-1314. The student may find in his mail box personal messages coming from his supervisor, the person responsible for the program committee or any administrative services. It is imperative that every student checks his mail box on a regular basis for messages that are addressed to him.

In order to learn the lock combination of his mail box, the student should ask Mrs France Normand or Mrs Sylvie Latendresse / Carole Forcier at the secretariat of the Department of Mechanical Engineering.

Université Laval can reach you quickly, individually or in groups, at your email address (ulaval.ca). A unique e-mail system for all the students at Université Laval promotes effective communication.

Any instance of Université Laval (including the Departement of Mechanical Engineering) may rapidly reach the student personally or as part of a group using the student's Université Laval

email address. It is the student's responsibility to check his emails and to efficiently manage the content of his virtual mail box.

The advantages of this system are as follows:

- Possibility to use this service by using an email software or a WEB browser;
- Possibility to filter messages;
- Possibility to obtain WEB memory space to store documents.

3.6 POSTING OF GENERAL INFORMATION FOR GRADUATE STUDENTS

General information is posted on the board "**MAITRISE - DOCTORAT**" located in the main corridor in front of the secretariat of the Department of Mechanical Engineering and in the hallway PLT-1314 near the mail boxes. You can find there:

- Announcements for graduate courses;
- Conference announcements;
- Important session dates;
- Thesis defenses;
- Etc.

It is the student's responsibility to consult the documents that are posted on this board.

3.7 PHOTOCOPIES

Photocopies related to your research project usually are the responsibility of your research director. In order to make copies, you must have a [magnetic card](#) from the "Service de reprographie" (printing service). This card can be used with the copying machines that are located at different places throughout the Adrien-Pouliot Building.

3.8 LIBRARY

The [student card](#), the virtual identity card available in monPortail, will give access to the main library (Jean-Charles-Bonenfant Building) and to the scientific library (Alexandre-Vachon Building). Students can obtain information about the services offered by visiting the website of the [Library](#).

3.9 TEST-RIGS AND INSTRUMENTATION

Following an agreement with your supervisor, if you have to design, set-up or modify a test-rig, it is suggested that you first discuss your project with the department's designer, who will share his experience and will advise you in all aspects.

Usually, it is the student's responsibility to produce all technical drawings needed. However, the designer or the person in charge of the applied and research work ("responsable de travaux pratiques et de recherche") are always available for help.

Finished drawings have to be submitted to the designer for checking. He will then transmit the drawing to the workshop.

In the context of your research project, if you need instrumentation not available in your lab, check with the administrative manager in order to find out if it could be borrowed somewhere else in the Department of Mechanical Engineering. This step is essential before asking your supervisor to buy equipment.

For any question related to the use, design, repair or assembling of instrumentation, you can ask for advice and help from the electronics technicians at room PLT-1340-C or Mr. Marc-André Plourde-Campagna at room PLT-1357.

3.10 COMPUTER HARDWARES AND SOFTWARES FOR RESEARCH

The department's computers are located in rooms PLT-3303 and PLT-3305 of the Adrien-Pouliot Building.

If the student needs the support of a computer technician, he can go to the room PLT-3708 of the Adrien-Pouliot Building or submit a request via email: aide@fsg.ulaval.ca or by phone at 418 656-2131 ext. 4651

The student's supervisor must allow the student to use the computer resources of the department and the ones specific to the research group.

The development and growing needs for computer assisted design and engineering have a growing influence on the Department of Mechanical Engineering. High-tech computers and software are available for research and academic purposes. Université Laval also possesses central infrastructures able to conduct large scale numerical calculations.

A variety of computer systems are available for the graduate students in order to assist them in the achievement of their research objectives.

APPENDIX A – WRITING GUIDE FOR THE PHD ORAL EXAMINATION (GMC-8000) AND FOR THE MASTERS COLLABORATION PLAN

This document must be prepared by the student. It is important to have it revised by the director prior to send it to the thesis committee. It shows the most important scientific and organisational aspects of the research project. This plan must have a maximum of 15 pages for masters and 20 pages for PhD.

Studies and Research Plan

1. General informations:

- Student name, 1st registration session, identification number (NI), research director and co-director.

2. Description of the intended research project:

- Title of the research project;
- Introduction;
- The general context (environmental, economic, etc.) and the context specific to the research team of the student (pursuit of previous works, collaboration with private enterprises...);
- The review of relevant scientific documentation about the research subject. This review includes a first glimpse of relevant scientific documentation, including international publications and those of the research team;
- The research problematic arising from the literature review;
- The general and specific research objectives defined as precisely as possible;
- The research methodology, clarifying for example the research type, working hypothesis, dependent and independent variables, ways and methods to be used to do the research (test bench, equipment, software, etc.), relevant verification and validation elements, expected results;
- The main research steps: calendar and schedule in chart form including literature review, the research and dissertation or thesis writing;
- Conclusion.

3. Expected Student's Schedule and Steps:

- The course program of the student and expected deliverables: participation in seminars, symposia and conferences; publications;
- Requirements for the dissertation or the thesis (extent, format, details if it is a paper-based thesis, etc.) considering the rules specific to the program.

4. Special elements in relation with the methods of supervision, for example:

- Manner in which the collective supervision will be done, if any;
- Arrangements in the case of part-time work or a prolonged absence from the student or the supervisor.

5. Special research Framework, for example:

- If the subject is related to a granted or contractual research, specify the elements on intellectual property, ethics, confidentiality, and communications pertinent to the research.

6. Signatures (student, supervisor, co-supervisor)

**DEPARTEMENT DE GENIE MECANIQUE
PLAN DE COLLABORATION**

INFORMATIONS GÉNÉRALES	
Nom :	1 ^{re} inscription :
N ^o identification (NI) :	
Directeur de recherche :	Codirecteur :

ÉLABOREZ CHACUN DES ÉLÉMENTS SUIVANTS EN VOUS INSPIRANT DU GUIDE DE RÉDACTION.

DESCRIPTION DE LA RECHERCHE

RÉALISATIONS ATTENDUES DE L'ÉTUDIANTE OU DE L'ÉTUDIANT
PROGRAMME DE COURS ET PRODUCTIONS ATTENDUES
LES EXIGENCES RELATIVES AU DOCUMENT

LES ÉLÉMENTS SPÉCIAUX RELATIFS AUX MODALITÉS D'ENCADREMENT

LE CADRE DE LA RECHERCHE

SIGNATURES	
Étudiant :	Directeur de recherche :
Date :	Date :
IMPORTANT : Vous devez faire parvenir une copie du document à la direction de programme.	Codirecteur de recherche :
	Date :

APPENDIX B - FINANCIAL ASSISTANCE AND SUPPORT TO SUCCESS

SCHOLARSHIPS AND CONTRACTS

The main organisms that offer scholarships for graduate students are the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Fonds de recherche Nature et Technologies Québec (FRNTQ). The application forms are available online at the following addresses:

<http://www.frntq.gouv.qc.ca/> (FRNTQ)

<http://www.nserc-crsng.gc.ca> (CRSNG)

The application forms must be completed at the beginning of the fall semester. It is the responsibility of the candidates to be aware of the deadlines.

Other organization may grant a restricted number of scholarships to graduate students in Mechanical Engineering. The “Bureau des bourses et de l’aide financière” (Bursary and financial aid office), located in the Alphonse-Desjardins Building, gives a list of every scholarship available. The “Fondation de l’Université Laval” also offers very interesting scholarships to Ph. D. students every year. The student may find the information related to the scholarships online at the following address:

<http://www.bbafe.ulaval.ca>

The student may also find few scholarship announcements in front of the secretariat of the Faculty of Engineering and Sciences, located in the Alexandre-Vachon Building (room VCH-1033) as well as on the board located in front of the secretariat of the Department of Mechanical Engineering (room PLT-1504).

The Department of Mechanical Engineering does not offer any scholarship. However, the graduate student may receive a scholarship or a work contract directly from his or her supervisor. In this instance, the student must come to an agreement with the supervisor.

Finally, every semester, the Department of Mechanical Engineering offers a certain number of job opportunities as a teaching assistant. The positions requiring more than 75 hours of work during the semester are filled following postings made on the “Service de placement” (placement service) website (<http://www.spla.ulaval.ca>). For the shorter contracts, the student must come to an agreement with the professor directly. Such a position is not guaranteed for every graduate student.

The international student must also possess a valid residence or study permit issued by Citizenship and Immigration Canada (CIC). Information regarding the application process for such a permit is available at the “Bureau d’accueil des étudiants étrangers” (International students welcome office) located in the Alphonse-Desjardins Building at room 2344. You can also find information on the website of the “Bureau de la vie étudiante” (Student life office): <http://www.bve.ulaval.ca/>.

MANAGEMENT GUIDE OF THE FINANCIAL SUPPORT TO SUCCESS

1) Context and information regarding financial support to success

In 2011-2012, following the approbation of the board, major revisions were made to the management of the funds allocated to support master's degree and PhD students financially. The faculties now have the obligation to follow unique plans of funds allocation to master's degree and PhD students in all their programs. These unique allocation plans were established based on the objectives to increase the rate of degrees awarded, decrease the duration of studies and provide support to students.

2) Rules and management of plans to be applied by the departments

a) Admissibility

- Budgets must be used in accordance with the allocation plan rules;
- Only students registered full time are eligible;
- It is not possible to pay an amount to a student jointly supervised not physically present at Université Laval without a study permit and a social insurance number;
- Students accepted in their program before the summer semester of 2012 are considered in transition.

o Master's degree students

- A student may receive a maximum of \$ 650 from the faculty support funds, which is managed by the department of mechanical engineering, for the duration of his program since his acceptance ("Volet 2 maitrise");
- A student may also receive, once in the duration of his program, a bonus of \$ 1000 rewarding the excellence of his work. This depends on funds availability ("Volet 3").

o PhD students

- A student from Quebec and the student from abroad with a scholarship may receive a maximum of \$ 3500 and a foreign student who benefit from an exemption of marked up school fees may receive a maximum of \$ 5500 from the faculty support funds, which is managed by the department of mechanical engineering, for the duration of his program since his acceptance. ("Volet 1"); student from Quebec, France and granted by their country are eligible to an amount of \$ 1000 for each of the two first sessions (managed by the BBAF);
- Merit bonus according to achieved milestones ("Volet 2"); max \$ 4500;
- A student may also receive once a bonus of \$ 1000 rewarding the excellence of his work, according to categories, with the possibility of 3 bonus in the duration of his program This bonus is managed by the parity committee of the faculty and depends on funds availability ("Volet 3").

b) Management measures

- The parity committee managing the financial support to success funds is responsible to distribute funds received by the faculty for the support plans;
- Every department is required to debrief the parity committee regarding funds distribution to ensure follow up by the committee.

3) Implementation of support to success plans

a) Master's degree and PhD

- The first semester of registration corresponds to the first semester of the support plan (Ex : First registration at the fall semester 2020 corresponds to semester 1 of the support plan);
- Progression through the support plan is evaluated in reference to the first semester of registration, no matter if the student is not registered full time during the following semesters. (Ex: If the student is registered for the first time for the fall semester 2020 but isn't registered for the winter semester 2021 and registers again for the summer semester 2021, the latter semester will correspond to semester 3 of the plan).

Student eligibility

- To be eligible to receive a payment, a student must be registered full time.
(*Full time definition: 12 course credits or 7 research credits. If a student is registered for less than 7 research credits, the total number of credits for a semester must be higher or equal to 12 (research credits + course credits \geq 12)*);
- In the activity table presented at the end of this document, the semester related to a given milestone indicates the maximum number of semesters allowed to complete the milestone. (Ex.: Semester 3: a student will be eligible to payment if he successfully completed the milestone before or during his 3rd semester);
- A student is only eligible to one payment following completion of a given milestone for the duration of his program;
- The department grants payments to students following the plan only for the identified milestones;
- Payments for bonuses to excellence are managed by the departments. These bonuses will be offered according on funds availability and the funds will be established by the parity committee.

Particularity for PhD foreign students

Following the support plan of the Faculty, a foreign students who benefits from an exemption of Université Laval's marked up school fees is eligible to receive a scholarship of \$ 2000 (\$ 1000 at the beginning of the first two semesters).

A verification will be made with the Scholarship and financial support bureau (BBAF) to ascertain that the student benefits from an exemption of Université Laval's marked up school fees (verification with the technician in charge: phone extension #3673 or by email at BBAF@BBAF.ulaval.ca)

If a student benefits from an exemption of Université Laval's marked up school fees, he will not receive the \$ 2000 scholarship from the BBAF but may receive it through the support plan of the faculty, provided that:

- the student registers for the first time to a PhD program (including accelerated transition from master's degree to PhD but excluding a program change or the case of a student resuming studies in a PhD program);
- the student remains registered full time for the first two consecutive semesters of his PhD program.

A student may obtain more information regarding the exemption of Université Laval's marked up school fees at:

http://www.bbaf.ulaval.ca/cms/site/bbaf/home/bourses_etudes/etudiants_etrangers/exemption_droits_scolaire_supplementaires

Note: French students and students receiving a scholarship from their country receive the \$ 2000 scholarship through the BBAF. This \$ 2000 scholarship will therefore not be paid by the support plan.

The amounts awarded as funds to support master's and doctorate are subject to obtaining the annual budgets and may change.

Procedure for applying for the financial support to success plan

To obtain a financial support to success plan, the student must access **Capsule** and select «Activités de formation à la recherche» and «Soumettre une demande de bourse» depending on his studies program. Subsequently, he selects the financial support to success plan by clicking on the "Demander" button. Then the student must confirm and submit his demand.

After that, for the Diffusion items (volet 2), the student will have to send the form and the documents requested to the program direction for authorization and send them to Mrs. France Normand to the secretariat of the department.

Soutien financier : mai 2020 – avril 2021

Plan de soutien à la réussite – Maîtrise **✓** Volet 2 maîtrise

Session	Jalon	Génie mécanique	Montant
S01 À S06 inclusivement	Activité évaluée	Dépôt initial	650 \$
Total maximum			650 \$

Plan de soutien financier à la réussite – Doctorat

Bourse de soutien ✓ Volet 1 doctorat			
Session	Jalon	Détail Génie mécanique	Montant
S01			1000 \$
S02			1000 \$
S03	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
S04	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
S05	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
S06	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
S07	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
S08	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
S09	Bourse de soutien	Respect plan de collaboration + approbation du directeur de recherche	500 \$
<i>Sous-total</i>			<i>5500 \$</i>
Bourses au mérite ✓ Volet 2 doctorat			
Admissible une seule fois pour chacun des jalons pendant le programme			
S01 à S02	Épreuve I	Réussite de l'examen écrit GMC-8002	750 \$
S01 à S03	Épreuve II	Réussite de l'examen doctorat oral GMC- 8000	1000 \$
S01 à S13	Diffusion	Publication, premier auteur	750 \$
S01 à S12	Diffusion	Communication scientifique. Être premier auteur et présentateur	1000 \$
max S13	Prime à la diplomation	Dépôt initial (1500 \$ si dépôt avant la fin de la session S12)	1000 \$
<i>Sous-total</i>			<i>4500 \$</i>
Total maximum			10 000 \$

Voir note (a)
Voir note (a)
Voir note (b)

*À noter qu'en cas de bonification financière ponctuelle pendant une année financière, celle-ci n'est pas considérée dans le calcul du montant maximum.

Autres montants possibles suivant la disponibilité annuelle des fonds – Primes à l'excellence **✓** Volet 3 maîtrise et doctorat

Session	Jalon	Les primes à l'excellence sont attribuées par concours. Voici quelques suggestions pour montrer l'excellence d'un dossier :	Montant maximum
	Prime pour examen doctoral	Communication orale GMC-8001 avant fin S6 ou rapport d'avancement avant fin S9	1000 \$
	Prime pour publication	Prix spécial, exemple : un article d'une qualité exceptionnelle	
	Prime pour présentation	Prix spécial, exemple : le meilleur article étudiant dans une conférence	
Total	<i>L'étudiant à la maîtrise est admissible une seule fois durant son programme (1000 \$), l'étudiant au doctorat est admissible une fois par catégorie avec possibilité de 3 primes pendant son programme.</i>		3000 \$

- (a) Pour les étudiants québécois, français et boursiers de leur pays, ces bourses sont versées par le Bureau des bourses et aide financière (BBAF).
Pour les étudiants étrangers qui bénéficient du programme d'exonération des droits de scolarité supplémentaires de l'U. Laval, ces montants sont payés par le fonds de soutien facultaire.
- (b) Le plan de collaboration peut correspondre au document de l'examen oral.

PLAN DE SOUTIEN FINANCIER À LA RÉUSSITE BOURSE DE SOUTIEN FACULTAIRE

Instructions soutien facultaire, volet 1 à 3

Vous trouverez en document attaché un formulaire à remplir. Dans un souci constant de simplifier les processus, ce formulaire a été conçu de telle sorte que vous puissiez l'utiliser pour les trois volets du plan de soutien financier à la réussite (1- Bourses de soutien pour le respect du plan de collaboration, 2- Bourses au mérite, 3- Bourses d'excellence).

Soutien pour le respect du plan de collaboration (Volet 1)

Les bourses de soutien de 1000 \$ sont destinées aux étudiants étrangers inscrits au doctorat qui bénéficient du programme d'exonération des droits de scolarité majorés de l'Université Laval, ces montants sont payés par le fonds de soutien facultaire aux deux premières sessions d'inscription. Pour les étudiants québécois, français et boursiers de leur pays, ces bourses sont versées par le Bureau des bourses et aide financière (BBAF) et les étudiants n'ont rien à faire à ce sujet.

Les bourses de soutien de 500 \$ pour le respect du plan de collaboration sont destinées aux étudiants inscrits aux sessions S3 à S9 de leur programme d'études dont le progrès est satisfaisant pour la session donnée. Les demandes de bourses peuvent être demandées en tout temps durant la session après la date d'abandon sans échec avec remboursement.

[Pour demander cette bourse, ne pas utiliser le formulaire, faire la demande dans Capsule.](#)

Bourses au mérite à la maîtrise ou au doctorat (Volet 2)

Les étudiants sont admissibles une seule fois pour chacun des jalons pendant leur programme. Les étudiants peuvent soumettre leur demande de bourse en tout temps.

[Pour demander une bourse au mérite, faire la demande dans Capsule.](#) Pour les items Diffusion, veuillez en plus remplir le volet 2 du formulaire, auquel vous joindrez un document attestant de la diffusion. Le formulaire sera signé par votre directrice ou directeur de recherche et la direction de programme, puis apportez le document à Mme France Normand au secrétariat du Département de génie mécanique.

Bourses d'excellence annuelles départementales (volet 3)

Cette demande de bourse se fait dans le cadre du plan de soutien financier facultaire, habituellement vers la fin de la session hiver. (Notez que la Faculté des sciences et de génie décide annuellement d'allouer des bourses ou non selon la disponibilité des budgets). Ce programme s'adresse autant aux étudiants à la maîtrise qu'à ceux du doctorat. Le comité de programme de 2^e et 3^e cycles de génie mécanique est responsable de gérer ce concours. Les éléments de justification principaux considérés sont les résultats à la communication orale au doctorat GMC-8001 (avant fin S6) ou au rapport d'avancement au doctorat (avant fin S9), ainsi qu'un article de journal ou de conférence exceptionnel, attesté par exemple par un concours du meilleur article étudiant lors d'une conférence. Le classement se fait sur la base de l'excellence des éléments de justification (par exemple examen doctoral, publication et présentation), de votre dossier scolaire et du mérite selon votre directeur ou votre directrice de recherche.

Instructions :

- [Veuillez remplir le volet 3 du formulaire attaché, incluant votre justification;](#)
- Annexe une lettre d'appui de votre directrice ou directeur de recherche;
- Présentez les documents justificatifs de l'excellence (preuve de meilleur article, etc.);
- Apportez les candidatures à Mme France Normand au secrétariat du Département de génie mécanique.

FORMULAIRE – BOURSE DE SOUTIEN FACULTAIRE

Nom :		Prénom :						
Numéro d'identification (NI) (9 chiffres) :			Session d'admission :			Date actuelle :		
Adresse courriel :								
Programme d'étude :	MM-GMC Sans concentration		MM-GMC concentration GIN		D-GMC Sans concentration		D-GMC concentration GIN	
Titre du projet de recherche :								
Nom du directeur ou de la directrice de recherche :								
VOLET 1 – SOUTIEN POUR LE RESPECT DU PLAN DE COLLABORATION					1000 \$ S1 ET S2 500 \$ S3 A S9			
L'étudiant présente un rapport d'au plus une page à annexer au présent formulaire, sur l'avancement de son projet doctoral durant la session.								
L'étudiant doit rappeler ses objectifs pour la session et décrire succinctement les progrès réalisés en vue de les atteindre. Il indique également les scientifiques reliés au programme d'études (présentations à des conférences, publications, etc.). L'étudiant terminera son rapport en présentant un échéancier pour la session suivante.								
COMMENTAIRES DU DIRECTEUR OU DE LA DIRECTRICE DE RECHERCHE								
Est-ce que le progrès de l'étudiant est satisfaisant pour la session précédente?					<input type="checkbox"/>	Oui	<input type="checkbox"/>	Non
Expliquez les écarts par rapport aux objectifs :								
VOLET 2 - BOURSES AU MÉRITE À LA MAÎTRISE ET AU DOCTORAT (Soumettre en tout temps)					750 \$ ou \$1000 (EN FONCTION DU JALON, VOIR PLAN DE SOUTIEN FINANCIER)			
Jalon visé :					Date d'obtention :			
VOLET 3 - BOURSES D'EXCELLENCE DÉPARTEMENTALES (soumettre avant date butoir)					1 000 \$			
Moyenne cumulative :								
Description sommaire des éléments du dossier :								
SIGNATURE DU DIRECTEUR OU DE LA DIRECTRICE DE L'ÉTUDIANT								
_____				_____				
Date				Directeur				
SIGNATURE DE LA DIRECTION DE PROGRAMME								
_____				_____				
Date				Directeur de programme				

RAPPORT D'AVANCEMENT PROGRAMME DE DOCTORAT EN GÉNIE MÉCANIQUE

À compléter par l'étudiant et son directeur de recherche au cours de la 9 ^e session depuis sa première inscription au programme				
Nom :	Prénom :	Matricule :		
Titre de la thèse :				
<div style="border-bottom: 1px solid black; margin-bottom: 5px;"></div> Signature				
PARTIE I - RAPPORT DE L'ÉTUDIANT				
L'étudiant présente son rapport, d'au plus deux pages à annexer au présent formulaire, sur l'avancement de son projet doctoral depuis sa dernière communication orale GMC- 8001.				
L'étudiant doit brièvement rappeler les objectifs de son projet et décrire succinctement les progrès récemment réalisés ainsi que les activités scientifiques reliées au programme d'études (présentations à des conférences, publications, etc.). L'étudiant terminera son rapport d'avancement en décrivant l'échéancier prévu en vue du dépôt initial de sa thèse.				
PARTIE II - COMMENTAIRES DU DIRECTEUR DE RECHERCHE				
1. Quelle est la fréquence de vos rencontres avec l'étudiant?	<input type="checkbox"/>	Chaque semaine	<input type="checkbox"/>	Une fois par mois
2. Quand prévoyez-vous le dépôt de la thèse?	Date :			
3. Quelle est votre évaluation globale du progrès de l'étudiant au cours de la dernière année?	<input type="checkbox"/>	Excellent	<input type="checkbox"/>	Très bon
	<input type="checkbox"/>	Bon	<input type="checkbox"/>	Faible
Expliquez : <div style="text-align: center; margin-top: 20px;"> <div style="border-bottom: 1px solid black; width: 80%; margin: 0 auto;"></div> Directeur de recherche </div> <div style="display: flex; justify-content: space-around; margin-top: 20px;"> <div style="border-bottom: 1px solid black; width: 30%;"></div> <div style="border-bottom: 1px solid black; width: 40%;"></div> </div>				
Date	Signature			
PARTIE III - COMMENTAIRES DU DIRECTEUR DU PROGRAMME DE 2 ^E ET 3 ^E CYCLE				
<input type="checkbox"/> Rapport pleinement satisfaisant				
<input type="checkbox"/> Rapport non satisfaisant (indiquez quelle action a été ou sera prise afin de remédier à la situation et joindre toute documentation pertinente)				
<div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="border-bottom: 1px solid black; width: 45%;"></div> <div style="border-bottom: 1px solid black; width: 45%;"></div> </div>				
Date	Directeur de programme de 2 ^e et 3 ^e cycle			

APPENDIX C1 - GMC-7053 + GMC-7047
MÉTHODES DE RECHERCHE ET ANALYSE DE L'INFORMATION

Preuve d'assistance à des ateliers

NOM : _____ NI : _____

1	Titre de l'atelier : Introduction à la recherche	
	Nom du professeur :	
	Signature d'un professeur :	Date :
2	Titre de l'atelier : Méthodologie de la recherche	
	Nom du professeur :	
	Signature d'un professeur :	Date :
3	Titre de l'atelier : Plan de collaboration et Description détaillée de la recherche	
	Nom du professeur :	
	Signature d'un professeur :	Date :
4	Titre de l'atelier : Rédaction d'un article scientifique	
	Nom du professeur :	
	Signature d'un professeur :	Date :
5	Titre de l'atelier : Rédiger un mémoire ou une thèse	
	Nom du professeur :	
	Signature d'un professeur :	Date :

APPENDIX C2 - GMC-7042 SÉMINAIRE DE GÉNIE MÉCANIQUE
Preuve d'assistance à des séminaires

NOM : _____ **NI :** _____

Atelier	Titre de l'atelier : Éléments-clés d'une présentation orale	
	Nom du professeur :	
	Signature d'un professeur :	Date :

1	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :

2	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :

3	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :

4	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :

5	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :
6	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :
7	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :
8	Nom du conférencier :	
	Titre de la conférence	
	Nom d'un professeur témoin :	
	Signature du professeur :	Date :

APPENDIX D - GUIDE FOR THE DOCTORAL WRITTEN QUALIFICATION EXAMINATION

Mathematics

Subject A) Basic notions: Ordinary differential equations, Laplace transform, Linear algebra, Vector calculus, Complex numbers (mandatory)

One section to choose from the following three: (Yvan Maciel)

Subject B) Partial differential equations

Subject C) Numerical methods

Subject D) Probability and statistics

Fields of studies and subjects:

1. Fluid mechanics (Guy Dumas)
2. Energetics
 - Subject 1) Thermodynamics (Alain De Champlain)
 - Subject 2) Heat transfer (Louis Gosselin)
3. Applied mechanics
 - Subject 1) Resistance of materials (Marie-Laure Dano)
 - Subject 2) Machine elements (André Bégin-Drolet)
4. Dynamics and vibrations
 - Subject 1) Dynamics (Benoît Lévesque)
 - Subject 2) Vibrations (Yves St-Amant)
5. Control systems and mechatronics
 - Sujet 1) Control systems (Alexandre-Campeau-Lecours)
 - Sujet 2) Mechatronics (Alexandre Campeau-Lecours)
6. Materials and fabrication (Alain Curodeau)
7. Industrial production (Mustapha Nour El Fath)
 - Subject 1) Production management (industrial engineering)
 - Subject 2) Operations research (industrial engineering)

MATHEMATICS

The content of the mathematical exam is covered in various chapters of the “Kreyszig” (the reference of this book may be found at the end of this section). The content is divided into four sections:

- A. Basic notions: Ordinary differential equations, Laplace transform, Linear algebra, Vector calculus, Complex numbers;
- B. Partial differential equations, Special functions;
- C. Numerical methods;
- D. Probability and statistics.

Section A is mandatory. The student must also choose another section, the most appropriate for his thesis subject, among the three that are left (B, C or D). This section must be chosen in advance with his thesis committee.

Subject A (one and a half hour examination)

Ordinary differential equations	Chap. 1.1 to 1.4 and 2.1 to 2.8
Laplace transform	Sec. 6.1 to 6.5
Linear algebra: matrices, vectors, determinants	Sec. 7.1 to 7.5, 7.7, 7.8 and 8.1 to 8.3
Vector calculus	Chap. 9
Complex numbers	Sec. 13.1 and 13.2

Subject B (one and a half hour examination)

Sturm-Liouville problems, Orthogonal expansions	Sec. 11.5, 11.6
Partial differential equations	Sec. 12.1 to 12.9

Subject C (one and a half hour examination)

Numerical methods; solutions of equations, integration and differentiation	Chap. 19.1 to 19.3, 19.5
Numerical methods in linear algebra	Sec. 20.1 to 20.5
Numerical methods for differential equations	Chap. 21

Subject D (one and a half hour examination)

Probability theory, data analysis	Chap. 22
Mathematical statistics	Chap. 23

BIBLIOGRAPHY

Kreyszig, E., 2011, *Advanced Engineering Mathematics*, 10th edition, John Wiley & Sons, ISBN 978-0-470-45836-5

Field 1: Fluid mechanics
(three hour examination)

Fluid statics	Sec. 2.6, 2.11 2,12
Elementary fluid dynamics – The Bernoulli equation	Chap. 3
Fluid kinematics	Sec. 4.1, 4.2
Finite control volume analysis:	Sec. 5.1, 5.2, 5.3
Differential analysis of fluid flow:	Sec. 6.1, 6.2, 6.3, 6.4, 6.8, 6.9
Similitude, dimensional analysis, theory of models	Chap. 7
Viscous flow in pipes and flowrate measurement	Chap. 8
General characteristics of external flows	Sec. 9.1, 9.2
Friction and pressure drag	Sec. 9.3
Bearing	Sec. 9.4
Isentropic flows of a perfect gas	Sec. 11.1 to 11.4
Normal shock waves	Sec. 11.5.3

BIBLIOGRAPHY

Munson, B.R., et al., 2013, *Fundamentals of Fluid Mechanics*, 7th Ed., Wiley

Field 2: Energetics**Subject 1: Thermodynamics (one and a half hour examination)**

Basics	Chap. 1
Work and heat	Chap. 2
Properties of pure substances	Chap. 3
First Law: Closed systems	Chap. 4
First Law: Open systems	Chap. 5
Second Law and entropy	Chap. 6 and 7
Piston engines	Sec. 9.1 to 9.7
Gas turbines	Sec. 9.8 to 9.11
Steam engines	Sec. 10.1 to 10.6
Refrigeration	Sec. 11.1 to 11.6
Combustion	Sec. 15.1 to 15.5

BIBLIOGRAPHY

Çengel, Yunus A., Boles, Michael A., 2006, *Thermodynamics, An Engineering Approach*, 5th edition, Éditions The McGraw-Hill Companies Inc., ISBN 0-07-288495-9 (book only) ou ISBN 0-07-310768-9 (book + CD)

Subject 2: Heat transfer (one and a half hour examination)

Introduction to heat transfer	Sec. 1.1 to 1.6
Introduction to conduction	Sec. 2.1 to 2.4
One-dimensional, steady-state conduction	Sec. 3.1 to 3.6
Transient conduction	Sec. 5.1 to 5.7
Introduction to convection	Sec. 6.1 to 6.7
External flow	Sec. 7.1 to 7.6
Internal flow	Sec. 8.1 to 8.5
Heat exchangers	Sec. 11.1 to 11.6
Radiation: processes and properties	Sec. 12.1 to 12.9
Radiation exchange between surfaces	Sec. 13.1 to 13.3

BIBLIOGRAPHY

Bergman, T.L., Lavine, A.S., Incropera, F.P. and Dewitt, D.P., 2011, *Fundamentals of Heat and Mass Transfer*, 7th Ed., Wiley

Field 3: Applied mechanics**Subject 1: Resistance of materials (one and a half hour examination)**

Axially loaded members	Sec. 4.1, 4.2, 4.4, 4.6
Stress transformation	Sec. 9.1 to 9.5
Strain transformation	Sec. 10.1 to 10.3, 10.5
Generalized Hooke's law	Sec. 10.6
Bending	
Shear and moment diagrams	Sec. 6.1, 6.2
Strain and stress	Sec. 6.3 to 6.5, 7.1 to 7.3
Deflection	Sec. 12.1, 12.2, 12.5 to 12.7, 12.9
Torsion	Sec. 5.1 to 5.5
Combined loading	Sec. 8.1, 8.2
Buckling of column	Sec. 13.1 to 13.3

Note: Section numbers correspond to the 9th edition of the book. They may correspond to different numbers for previous editions.

BIBLIOGRAPHY

Hibbeler, R.C., 2014, *Mechanics of materials*, 9th edition, Pearson Prentice Hall

Subject 2: Machine elements (one and a half hour examination)

Mohr circle representation and Stress concentration	Sec. 4.8 to 4.13
Failure theories, ductile material	Sec. 6.1 to 6.11
Fatigue	Sec. 8.1 to 8.12, 8.17
Power screw	Sec. 10.3 and 10.4
Bolts	Sec. 10.7 to 10.10
Welding	Sec. 11.4 to 11.6
Rolling-element bearings	Chap. 14
Spur gears	Sec.15.1 to 15.13

BIBLIOGRAPHY

Juvinall, R.C., Marshek, K.M., 2006, *Fundamentals of Machine Component Design*, Wiley, 4th edition

Field 4: Dynamics and vibrations**Subject 1: Dynamics (one and a half hour examination)**

Kinematics of rigid bodies in the plane and in 3D	Chap. 5 and 7
Rotation	Sec. 5.2 and 7.3
Absolute motion	Sec. 5.3, 7.2, 7.4, 7.5, 7.6
Relative velocity	Sec. 5.4
Instantaneous center of zero velocity	Sec. 5.5
Relative acceleration	Sec. 5.6
Motion relative to rotating axes	Sec. 5.7
Kinetics of bodies in the plane and in 3-D	Chap. 6 and 7
Equations of motion	Sec. 6.2 and 6.5
Translation	Sec. 6.3
Rotation about a fixed point	Sec. 6.4 and 7.5
Work-energy relations	Sec. 6.6 and 7.8
Impulse – momentum	Sec. 6.8, 6.9, 7.7, 7.9
Gyroscopic effect	Sec. 7.10, 7.11

BIBLIOGRAPHY

Meriam, J.L., Kraige, L.G., *Engineering Mechanics*, Vol. 2, Dynamics, 3rd edition, John Wiley & Sons.

Subject 2: Vibrations (one and a half hour examination)

Harmonic motion, periodic motion, terminology	Chap. 1
Free vibrations of a system with one degree of freedom Natural frequencies, Newton's method, Energy method, Rayleigh's method, Method of virtual work, damping, Logarithmic decrement.	Chap. 2
Forced vibrations of a system with one degree of freedom Excitations by force, by unbalance and by support motion, Insulation, Viscous damping equivalent, Structural damping, Sensors for measuring vibrations, Transient vibrations, Arbitrary excitations (method of the convolution integral and Laplace's method).	Chap. 3, 4
Systems with two or more degrees of freedom Normal modes; Free and forced vibrations, Coordinate coupling, Dynamic absorber, Vibration absorber, Stiffness and flexibility influence coefficient methods, Orthogonality of normal modes and decoupling differential equations, Modal damping, Normal mode summation	Chap. 5, 6

BIBLIOGRAPHY

Thompson, W.T., *Theory of Vibration and Applications*, 3rd, 4th or 5th edition, Prentice Hall

Field 5: Control systems and mechatronics**Subject 1: Control systems (one and a half hour examination)**

Introduction to control systems	Chap. 1
Mathematical modeling of control systems	Chap. 2
Mathematical modeling of Mechanical and electrical systems	Chap. 3
Transient and steady-state response analysis	Chap. 5
Control Systems Analysis and Design by the Root-Locus Method	Chap. 6
Control Systems Analysis and Design by the Frequency-Response Method	Chap. 7
PID Controllers and Modified PID Controllers	Chap. 8

Ogata, K., 2010, « *Modern Control Engineering* », 5th Edition. Pearson

Subject 2: Mechatronics (one and a half hour examination)

Binary numbers	Chap. 3 sec. 3.1 et 3.2
Basic Circuit Analysis and Passive Components	Chap. 9
Semiconductors	Chap. 10
Operational Amplifiers	Chap. 11
Sensors	Chap. 13
Permanent Magnet Brushed DC Motor Characteristics	Chap. 22

Carrier, J. E., Ohline, R. M., & Kenny, T. W., 2011, « *Introduction to mechatronic design* ». Prentice Hall

Field 6: Materials and fabrication
(three hour examination)

Structure and behavior of materials during transformation	Chap. 2, 3, 10
Processes of transformation by casting and solidification of metals	Chap. 5
Forming of metals	Chap. 6, 11
Working metal sheets	Chap. 7
Cutting metals	Chap. 8, 9

BIBLIOGRAPHY

Kalpakjian, S., 1997, *Manufacturing Processes for Engineering Materials*, 3rd edition.

Field 7: Industrial production**Subject 1: Production Management, Industrial engineering (three hour examination)****Theme 1: The Process of Product Development**

The house of quality, simultaneous engineering, product improvement strategies, product life cycle, dead point analysis.

- * *Chapter 4*

Theme 2: Demand Prediction

Methods of prediction evaluation (MSE, MFE, MAPE), chronological series, characteristics (tendency, season, cycle, noise), mobile averages, exponential smoothing, double exponential smoothing, regressions.

- * *Chapter 3*

Theme 3: The Material Requirements Planning

The major strategies (smoothing, just-in-time, mixt), the systems ERP, MRP II and MRP, capacity requirements.

- * *Chapter 14*

Theme 4: Scheduling of Operations

GANTT Diagram, Johnson's rule, learning curve, just-in-time, basic rules of scheduling (FIFO, SPT, EDD...).

- * *Chapter 16*

Theme 5: Project Management

The critical path method (modelling and resolution), PERT (modelling and resolution), factors for success.

- * *Chapter 17*

Theme 6: Quality Management and Control

Quality management programs (ISO, QS, HACCP...), statistical quality control, control charts, sampling, cause & effect diagrams, quality circles.

- * *Chapter 10*

Theme 7: Arrangement and Localization of Installations

Generic types of factory arrangements: by product, functional, group, network, holographic, fractal and fix; evaluation of arrangement plans, line balancing, work organization (standard times), and, localization decisions, localization of new units in the network.

- * *Chapter 6 and 8*

BIBLIOGRAPHY

Stevenson et Benedetti C., 2012, « *La gestion des opérations* », 3^e édition, Chenelière Mc Graw-Hill

Subject 2 : Operations research, Industrial engineering (three hours examination)**Theme 1: Graph and Network Theory**

Shortest path, maximum flow, minimum cost flow, minimum spanning tree, problem modelling and resolution.

- * [1] *Théorie des graphes et des réseaux* or [2] *Chap. 8* or [3] *Chap. 8*

Theme 2: Linear Programming

Graphic resolution method, simplex method, Big M method and the Two Phase method, revised simplex method

- * [1] *La programmation linéaire* or [2] *Chap. 4* or [3] *Chap. 3 and 4*

Theme 3: Duality and Sensibility

Dual formulation, reduced prices and dual variables, sensitivity study

- * [1] *Théorie de la dualité et analyse de sensibilité* or [2] *Chap. 6* or [3] *Chap. 5*

Theme 4: Mixed-integer linear programming

Formulation of mixed-integer linear programs, resolution via Branch and Bound, cut generation

- * [1] *Programmation en nombres entiers et Notions avancées d'optimisation* or [2] *Chap. 13 and 14* or [3] *Chap. 9*

Theme 5: Classic optimization

Problem classification, problem with or without constraints, convexity and concavity, local or global optimum

- * [1] *la modélisation et la programmation linéaire* or [2] *Chap. 1* or [3] *Chap. 3*

Thème 6 : Transportation Model

Formulation, basic solution using minimum-cost and northwest corner methods, resolution via the transportation Simplex Method, modelling and solving assignment problems

- * [3] *Chap. 7*

BIBLIOGRAPHY

[1] Notes de cours *GIN-2110 Optimisation des systèmes et des réseaux*

[2] Lundgren J., Rönnqvist M., Värbrand P., 2010, *Optimization*, Studentlitteratur

[3] Winston, Wayne L, *Operations Research, Applications and Algorithms*, Fourth Edition
