



# ENGG\*4180 Biomedical Engineering Design IV

01

Fall 2020

Section(s): C01

School of Engineering

Credit Weight: 1.00

Version 1.00 - September 09, 2020

---

## 1 Course Details

### 1.1 Calendar Description

This is the capstone design course for the Biomedical Engineering program. Teams normally of 3-4 students apply engineering analysis and design principles to a biomedical engineering problem. A completely specified solution at the level of preliminary or final design is required, including assessment of socio-economic and environmental impact. This is a small group design that requires reports and a poster presentation to a professional standard. Ethics and legal case studies relevant to professional engineering practice are presented during the lectures. Only students currently registered in ENGG\*4000 will be permitted to select this course.

**Pre-Requisites:**

**Restrictions:**

All 1000 and 2000 level core courses and ENGG\*4000  
Registration in semester 8 (last semester) of the BENG program and in a maximum of 3.25 credits registration. Students must have a minimum cumulative average of 60% or higher in ALL ENGG courses. Restriction waiver requests are handled by the Director, School of Engineering, or designate.

### 1.2 Course Description

This is the capstone design course for the Engineering program. Teams of normally 3-4 students apply engineering analysis and design principles to an engineering problem in their discipline. A completely specified solution at the level of preliminary or final design is required, including assessment of socio-economic and environmental impact. This is a small group design that requires reports and a poster presentation to a professional standard. Ethics and legal case studies relevant to professional engineering practice are presented during the lectures.

## 1.3 Timetable

Lectures: See webadvisor for times, Courselink for Teams or Zoom information

Poster Presentation: Design Day - TBD (online)

## 1.4 Final Exam

The exam is currently scheduled for 08:30AM - 10:30AM 2020/12/15

Exam time and location is subject to change. Please see WebAdvisor for the latest information.

---

# 2 Instructional Support

## 2.1 Instructional Support Team

Course Co-ordinator:	Julie Vale
Email:	<a href="mailto:jvale@uoguelph.ca">jvale@uoguelph.ca</a>
Telephone:	+1-519-824-4120 x54863
Office:	THRN 2340

## 2.2 Teaching Assistants

Teaching Assistant:	Waleed Hilal
Email:	<a href="mailto:whilal@uoguelph.ca">whilal@uoguelph.ca</a>

---

# 3 Learning Resources

## 3.1 Required Resources

### Course Website (Website)

<https://courselink.uoguelph.ca>

Course material, news, announcements, and grades will be posted to the **ENGG\*41X** Courselink site. You are responsible for checking the site regularly. As per University regulations, all students are required to check their <[mail.uoguelph.ca](mailto:mail.uoguelph.ca)> e-mail account regularly; e-mail is the official route of communication between the University and students.

### Law for Professional Engineers (Textbook)

Marston, D.L. **Law for Professional Engineers (Fifth Edition)**. McGraw-Hill Ryerson. Toronto. ISBN 978-1-260-13590-9

**Canadian Professional Engineering and Geoscience (Textbook)**

Andrews, G.C., Shaw, McPhee **Canadian Professional Engineering and Geoscience, Practice and Ethics (Sixth Edition)**, Nelson, ISBN 13: 978-0-17-676467-8

**3.2 Recommended Resources****Practical Law of Architecture, Engineering and Geoscience (Textbook)**

Samuels, B. M and Sanders, D. R. (2011) **Practical Law of Architecture, Engineering and Geoscience**, Pearson, ISBN 978-0-13-700408-9

**3.3 Additional Resources****Other Resources (Other)**

**Lecture:** Notes are available in Courselink.

**Memos and reflections:** Download the requirements according to the schedule given in this handout and posted on Courselink.

**Projects:** Download the assignments according to the schedule given in this handout and posted on Courselink.

**School:** Students are encouraged to design and build components or prototypes of devices if possible. Facilities of the School machine shop, access to all undergraduate laboratories and associated instruments and equipment are available subject to approval. The need for, and costs of, materials, special services or use of other facilities should be foreseen. Small grants may be available to purchase materials or components which are essential to the project but cannot be sourced within the School. **Requests must be made to the instructor using the posted Supplies\_Tech Request Form and/or Equipment Request Form, specifying the exact nature of the service required.** The sooner these requests have been submitted the better. The funds available depend upon the School's budget, and are not guaranteed.

**4 Learning Outcomes**

The goal is to prepare students to deal with open-ended, multi-faceted design problems similar to those that they will encounter as working professionals.

**4.1 Course Learning Outcomes**

By the end of this course, you should be able to:

1. Apply their academic knowledge to work on a complex engineering problem identified in ENGG\*4000.
2. Collect and analyze information and synthesize solutions taking into account significant technological, commercial, social and environmental factors.
3. Apply design principles to a complex engineering problem.

4. Summarize and communicate the design solution, including project management, economic, social, and environmental factors.
5. Exhibit effective teamwork and leadership skills at all stages of the project
6. Explain the responsibilities of engineers to society and demonstrate the expectations in professional practice through class discussions, report submission and the final exam.
7. Demonstrate life long learning values consistent with what is expected of a Professional Engineer

## 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome
1	Knowledge Base	1
1.1	Recall, describe and apply fundamental mathematical principles and concepts	1
1.2	Recall, describe and apply fundamental principles and concepts in natural science	1
1.3	Recall, describe and apply fundamental engineering principles and concepts	1
1.4	Recall, describe and apply program-specific engineering principles and concepts	1
2	Problem Analysis	1, 2
2.1	Formulate a problem statement in engineering and non-engineering terminology	1, 2
2.2	Identify, organize and justify appropriate information, including assumptions	1, 2
2.3	Construct a conceptual framework and select an appropriate solution approach	1, 2
2.4	Execute an engineering solution	1, 2
2.5	Critique and appraise solution approach and results	1, 2
3	Investigation	1, 2
3.1	Propose a working hypothesis	1, 2
3.2	Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system)	1, 2

#	Outcome	Learning Outcome
3.3	Analyze and interpret experimental data	1, 2
3.4	Assess validity of conclusions within limitations of data and methodologies	1, 2
4	Design	3
4.1	Describe design process used to develop design solution	3
4.2	Construct design-specific problem statements including the definition of criteria and constraints	3
4.3	Create a variety of engineering design solutions	3
4.4	Evaluate alternative design solutions based on problem definition	3
4.5	Develop and refine an engineering design solution, through techniques such as iteration, simulation and/or prototyping	3
5	Use of Engineering Tools	1, 2
5.1	Select appropriate engineering tools from various alternatives	1, 2
5.2	Demonstrate proficiency in the application of selected engineering tools	1, 2
5.3	Recognize limitations of selected engineering tools	1, 2
6	Individual & Teamwork	5
6.1	Describe principles of team dynamics and leadership	5
6.2	Understand all members' roles and responsibilities within a team	5
6.3	Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude	5
6.4	Apply strategies to mitigate and/or resolve conflicts	5
6.5	Demonstrate leadership through, for example, influencing team vision and process, promoting a positive team culture, and inspiring team members to excel	5
7	Communication Skills	4
7.1	Identify key message(s) and intended audience in verbal or written communication as both sender and receiver	4
7.2	Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode	4

#	Outcome	Learning Outcome
7.3	Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience	4
7.4	Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references	4
7.5	Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions	4
8	Professionalism	5, 6
8.1	Demonstrate an understanding of what it means to be a professional engineer and distinguish between legislated and non-legislated professions	6
8.2	Effectively describe engineering law and its impact on professional engineering practice	6
8.3	Demonstrate professional behaviour	5, 6
9	Impact of Engineering on Society and the Environment	2, 4
9.1	Analyze the safety, social, environmental, and legal aspects of engineering activity	2, 4
9.2	Evaluate the uncertainties and risks associated with engineering activities	4
9.3	Anticipate the positive and negative impacts of introducing innovative technologies to solve engineering problems	4
10	Ethics & Equity	6
10.1	Summarize ethical theories and equity, diversity, and inclusivity principles	6
10.2	Determine an ethical course of action by applying ethical theories and the PEO Code of Ethics	6
10.3	Demonstrate values consistent with good ethical practice, including equity, diversity, and inclusivity	6
11	Economics and Project Management	4
11.1	Apply project management techniques and manage resources within identified constraints	4

#	Outcome	Learning Outcome
11.2	Identify risk and change management techniques, in the context of effective project management	4
11.3	Estimate economic impact and feasibility of an engineering project or design using techniques such as cost benefit analysis over the life of the project or design	4
12	Life Long Learning	7
12.1	Identify personal career goals and opportunities for professional development	7
12.2	Self-assess skills relative to career goals and SOE defined learning outcomes	7
12.3	Demonstrate capability for continuous knowledge and skill development in a changing world	7

## 5 Teaching and Learning Activities

### Course Format

Classes are scheduled for each week on Monday. In addition to classroom time, where active learning is being promoted, it is expected that each team member will spend an average of 15 to 20 h per week on the design project over the semester, as this course is equivalent to two regular senior engineering science courses. The active learning component will require group discussions and presentations on material related to the lecture material.

Students work in teams of three or four persons. Smaller (or larger) groups are only considered by the course coordinator under extraordinary circumstances, and approval is conditional on availability of sufficient resources. Inter-disciplinary groups are encouraged if a particular problem has sufficient scope to provide appropriate experience to all team members. ***It is expected that the selection of the team, the project and the faculty advisor was arranged during ENGG4000.***

Teams are encouraged to communicate virtually. If a face-to-face meeting is required, students are encouraged to use the design studios scattered throughout the Engineering Complex. Access to these rooms is not guaranteed - contact your faculty advisor.

Each team is advised by a School faculty member responsible for helping to delineate the terms of reference for the project, providing guidance where necessary, and evaluating all written reports. The projects are self-administered: each team must carry out planning and

execution of the project on its own. Accordingly, team members are required to keep a log book on the activities each individual completes. ***Team members and their faculty advisor should discuss and record concerns about the group's progress at the interim report stage and take appropriate action.*** The respective log books will be reviewed in deciding the appropriate action.

The following is a planned schedule of lectures, which is subject to change.

## 5.1 Lecture

**Topics:** Intellectual property

**Topics:** History of the profession

Iron Ring, Quebec Bridge, Self Regulation, the Seal

**Topics:** Introduction to Normative Ethics and Social Justice

**Topics:** Engineering Code of Ethics and definitions of Professional Misconduct

Intro to case studies

**Topics:** Key issues in Engineering Ethics

Whistleblowing and Conflict of Interest

**Topics:** Introduction to Canadian Law

Common Law, the Constitution, and the Charter

**Topics:** Introduction to Tort Law

Unintentional Tort, Negligence, and Duty of Care

**Topics:** Tort

Professional duty of care, Duty to warn

**Topics:** Introduction to Contract law

Five elements, Contract A&B



**Topics:** Contract interpretation

**Topics:** Completing Contracts

Rescinding, Discharge, and Breach

**Topics:** (Time permitting) Intersections of Law and Ethics

Environmental Ethics and Workplace Health and Safety

## 5.2 Other Important Dates

Please see the University of Guelph schedule of important dates:

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c03/c03-fallsem.shtml>

## 5.3 Student Design Activity and Milestones

<b>Week No.</b>	<b>Task</b>
1	Confirm terms of reference and schedule faculty advisor meeting times.
2 - 6	Analyze and research problem, develop design alternatives, evaluate and specify prime contender. Before Friday Oct. 23, 2020, 17:00 h., submit hard copy of interim report to faculty advisor (if requested) and post electronic copy to Dropbox. Electronic Distribution of Contribution (DOC) completed in Courselink
7 - 11	Develop final design/prototype, evaluate and refine.
12	Prepare design report, present findings with the poster and complete Exit Survey. (i) Poster presentation - Design Day, Thursday December 3, 2020. Online. <b>Note! Attendance of all group members at the final poster presentation and evaluation is a course requirement.</b> (ii) Friday December 4, 2020, 09:00 h, submit hard copy of final report to faculty advisor (if required) and post electronic copy to Dropbox. Electronic DOC completed in Courselink (iii) Before Friday December 4, 2020, 12 midnight, complete the confidential on-line Exit Survey. Further details in Courselink.

---

## 6 Assessments

### 6.1 Marking Schemes & Distributions

**Ethics and Law and the associated examinations are crucial components of this course and of an Engineering education.** In the event that a student fails the combination of law and ethics exams, the course grade will be calculated using Scheme B. Otherwise, the course grade will be calculated using Scheme A.

Name	Scheme A (%)	Scheme B (%)
Interim Report	18	0
Final Report	40	0
Poster Presentation	10	0
Proposal memo	0	0
Reflection 1	2	0
Reflection 2	2	0
Interim memo	2	0
Reflection 3	2	0
Reflection 4	2	0
Final Memo	2	0
Ethics Exam	10	50
Law Exam	10	50
Exit Survey	0	0
Total	100	100

## 6.2 Assessment Details

### Interim Report (18%)

**Date:** Fri, Oct 23, 5:00 PM

**Learning Outcome:** 1, 2, 3, 4, 5

Failure to submit a distribution of contribution (DOC details available on Courselink) will result in an incomplete grade for this component of the course.

### Final Report (40%)

**Date:** Fri, Dec 4, 11:00 PM

**Learning Outcome:** 1, 2, 3, 4, 5, 6, 7, 7

Failure to submit a distribution of contribution (DOC details available on Courselink) will result in an incomplete grade for this component of the course.

### Poster Presentation (10%)

**Date:** Thu, Dec 3

**Learning Outcome:** 4, 5

### Reflection 1 (2%)

**Date:** Fri, Sep 25, 11:00 PM

**Learning Outcome:** 4, 5, 7, 7, 7

**Proposal memo (0%)**

**Date:** Mon, Sep 14, 11:00 PM

**Learning Outcome:** 4, 5, 7, 7, 7

**Reflection 2 (2%)**

**Date:** Fri, Oct 9, 11:00 PM

**Learning Outcome:** 4, 5, 6, 7, 7, 7

**Interim memo (2%)**

**Date:** Fri, Oct 23, 11:00 PM

**Learning Outcome:** 4, 5, 7, 7, 7

**Reflection 3 (2%)**

**Date:** Fri, Nov 6, 11:00 PM

**Learning Outcome:** 6

**Reflection 4 (2%)**

**Date:** Fri, Nov 27, 11:00 PM

**Learning Outcome:** 6

**Final Memo (2%)**

**Date:** Fri, Dec 6, 11:00 PM

**Learning Outcome:** 4, 5

**Ethics Exam (10%)**

**Learning Outcome:** 6

**Date:** 1hr duration

There will be **two** Ethics tests (see Courselink for more information). The grade on the Ethics exam will be the **maximum** of Test 1 and Test 2. Students can choose to skip either Test 1 or Test 2 with no consequence. No accommodation will be provided for students who miss Test 1 (in this case, the ethics exam grade will be comprised entirely of Test 2)

- **Test 1:** a 1hr midterm. Schedule is TBD, pending approval from central scheduling.
- **Test 2:** 1hr duration. The *second* hour of the final exam slot (see webadvisor for times/dates)

**Law Exam (10%)**

**Learning Outcome:** 6

**Date:** 1hr duration. The *first* hour of the 2hr final exam slot (see webadvisor for dates/times)

**Exit Survey (0%)**

**Date:** Sat, Nov 30, 9:00 AM

A component of Life-Long Learning Graduate Attribute assessment is the School's Exit Survey. This Exit Survey provides valuable insight into student development and

expectations as they enter the workforce. **Information provided to the School through the Exit Survey is confidential.**  
**Failure to complete the Exit Survey will result in an Incomplete Grade for the entire course.**

---

## 7 Course Statements

### 7.1 Course Grading Policies

**Missed Assessments:** If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

**Accommodation of Religious Obligations:** If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

**Passing grade:** In order to pass the course, students must obtain an overall grade of 50% or higher on the aggregate of all the course work outlined in Section 6 Assessment. Please note the alternate grading scheme outlined in Section 6 in the event that a student fails the exams.

**Late Reports:** There will be no extension of the deadlines for submissions, except for serious health or compassionate reasons, with the appropriate documentation. Just like the consulting world where projects are not awarded if the proposals are late, a grade of zero will be given for late submissions.

**Certification:** Students must write their PEO SMP (Student Membership Program) number on all submitted work. This signifies that the SOE Code of Ethics was adhered to. For group projects, students must also state that they contributed to the group effort in an equitable manner.

**Logbook:** Each student should keep a logbook detailing the activities performed that are related to the course. It should include record of all group and individual activities, lecture notes, meeting minutes, work distribution, design notes, calculations, planning, decisions, sketches and all relevant information. The logbook should be signed off by other members of the group on a regular basis. The logbook will be reviewed by the instructor, course coordinator, faculty advisor and TA from time to time.

### 7.2 Course Specific Lab and Machine Shop Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. ENGG\*41X0 does not have a laboratory component for the lecture portion for the course. However, for the project component, some student teams may be in the shop and or in the lab to build and test their prototype or final design. When in the shop and the lab, students must adhere to the applicable safety requirements and regulations. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

### **7.3 Photo, Video, Media Consent**

Photos and videos will be taken throughout the semester for the purpose of communicating to the public about the engineering program at UofG. These pictures and videos may include poster presentations and showcasing of prototypes on Design Day. The final memo will also be included in a compendium and on the university's website, which will be made accessible to the public.

Please follow the link to the university's website to download the consent form:

<https://news.uoguelph.ca/guides/brand-guide/imagery/copyright-and-consent/>

The completed consent form should be submitted individually to the Courselink dropbox.

## **8 School of Engineering Statements**

### **8.1 Instructor's Role and Responsibility to Students**

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

### **8.2 Students' Learning Responsibilities**

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

### **8.3 Lab Safety**

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking

all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

## 9 University Statements

### 9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

### 9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

### 9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

### 9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

## 9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website  
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website  
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

## 9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community—faculty, staff, and students—to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct  
<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

## 9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

## 9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars  
<https://www.uoguelph.ca/academics/calendars>

## 9.9 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings and academic schedules. Any such changes will be announced via CourseLink and/or class email. All University-wide decisions will be posted on the COVID-19 website (<https://news.uoguelph.ca/2019-novel-coronavirus-information/>) and circulated by email.

## 9.10 Illness

The University will not normally require verification of illness (doctor's notes) for fall 2020 or winter 2021 semester courses. However, requests for Academic Consideration may still require medical documentation as appropriate.

---