





FACULTY OF APPLIED SCIENCES

OFFICE OF THE DEAN

8888 University Drive, Burnaby, BC  
Canada V5A 1S6

TEL: 778.782.6775  
FAX: 778.782.5802

glaesser@sfu.ca  
www.fas.sfu.ca

MEMORANDUM

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ATTENTION Dr. Wade Parkhouse  
Dean, Graduate Studies

DATE August 31, 2014

FROM Dr. Uwe Glässer  
Faculty of Applied Sciences, Graduate  
Studies Committee

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RE: New Graduate Course Proposal in Mechatronic Systems Engineering (MSE 884)

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*The Faculty of Applied Sciences Graduate Studies Committee has unanimously approved by electronic vote on August 26, 2014 the new graduate course MSE 884 "Advanced Dynamics" proposed by the School of Mechatronic Systems Engineering.*

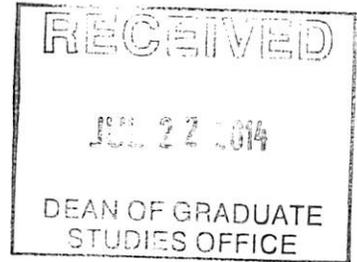
*The proposed course is a fundamental graduate level course in dynamics that will be taken by many graduate students in MSE (and possibly also in ENSC). The course was offered in 2013 as a Special Topics course. The required books are already available from the library.*

*An overlap check with the other SFU Faculties found that there are no concerns.*

*Would you please place this proposal on the agenda for the next SGSC meeting?*

cc: Dr. Martin Ester, Director, School of Computing Science  
Dr. Farid Golnaraghi, Director, School of Mechatronic Systems Engineering  
Dr. Kamal Gupta, Director, School of Engineering Science

*enclosures*



# New Graduate Course Proposal Form

## PROPOSED COURSE

Subject (eg. MAPH) <b>MSE</b>	Number (eg. 810) <b>884</b>	Units (eg. 4) <b>3</b>
Course Title (max 80 characters) <b>Advanced Dynamics</b>		
Short Title (appears on transcripts, max 25 characters) <b>Advanced Dynamics</b>		
Course Description for SFU Calendar <input checked="" type="checkbox"/> see attached document <input type="checkbox"/> Learning outcomes identified <b>Mechanical systems, generalized coordinates and configuration space, holonomic and nonholonomic constraints, virtual work, d'Alembert's principle and generalized forces, energy and momentum, Lagrange's equations, natural modes, principle coordinates and orthogonality, dissipation, impulsive motion, gyroscopic systems, velocity dependent potentials, Hamilton's principle and Hamilton's equations, phase space, introduction to special relativity.</b>		
Available Course Components: <input checked="" type="checkbox"/> Lecture <input type="checkbox"/> Seminar <input type="checkbox"/> Laboratory <input type="checkbox"/> Practicum <input type="checkbox"/> Online <input type="checkbox"/> _____		
Grading Basis <input checked="" type="checkbox"/> Letter grades <input type="checkbox"/> Satisfactory/Unsatisfactory <input type="checkbox"/> In Progress/Complete		This is a capstone course <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Prerequisites (if any) <input checked="" type="checkbox"/> see attached document (if more space is required) <b>MSE 280 (or ENSC 380) and MSE 380 (or ENSC 381) or equivalent courses</b>		
<input type="checkbox"/> This proposed course is combined with an undergrad course: Course number and units: _____		
Additional course requirements for graduate students <input type="checkbox"/> See attached document (if this space is insufficient)		
Campus at which course will be offered (check all that apply) <input type="checkbox"/> Burnaby <input type="checkbox"/> Vancouver <input checked="" type="checkbox"/> Surrey <input type="checkbox"/> GNW <input type="checkbox"/> _____		
Estimated enrolment <b>10</b>	Date of initial offering <b>Fall 2015</b>	Course delivery (eg. 3 hrs/week for 13 weeks) <b>3 hrs/week for 13 weeks</b>
<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Practicum work done in this class will involve children or vulnerable adults (If the "Yes" box is checked, all students will require criminal record checks)		
Justification <input type="checkbox"/> See attached document (if more space is required) <b>Graduate research in MSE often involves the analysis, modelling, simulation and control of complex mechanical systems. Typical methods of analysis (e.g. Newtonian) covered at the undergraduate level can be insufficient for this purpose in contrast with methods (e.g. Lagrangian) covered in this course</b>		

## RESOURCES

If additional resources are required to offer this course, the department proposing the course should be prepared to provide information on the source(s) of those additional resources.

Faculty member(s) who will normally teach this course <input checked="" type="checkbox"/> information about their competency to teach the course is appended <b>Dr Kevin Oldknow</b>
Number of additional faculty members required in order to offer this course <b>N/A</b>
Additional space required in order to offer this course <input type="checkbox"/> see attached document <b>N/A</b>
Additional specialized equipment required in order to offer this course <input type="checkbox"/> see attached document <b>N/A</b>
Additional Library resources required (append details) <input type="checkbox"/> Annually \$ _____ <input type="checkbox"/> One-time \$ _____ <b>N/A</b>

**PROPOSED COURSE** from first page

Program (eg. MAPH) <b>MSE</b>	Number (eg. 810) <b>884</b>	Units (eg. 4) <b>3</b>
Course title (max 80 characters) <b>Advanced Dynamics</b>		

**APPROVAL SIGNATURES**

When a department proposes a new course it must first be sent to the chairs of each faculty graduate program committee where there might be an overlap in course content. The chairs will indicate that overlap concerns have been dealt with by signing the appropriate space or via a separate memo or e-mail (attached to this form).

The new course proposal must also be sent to the Library for a report on library resources.

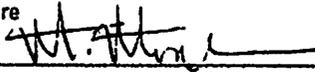
Once overlap concerns have been dealt with, signatures indicate approval by the department, home faculty and Senate Graduate Studies Committee.

**Other Faculties**

The signature(s) below indicate that the Dean(s) or designate of other Faculties affected by the proposed new course support(s) the approval of the new course.

Name of Faculty	Signature of Dean or Designate	Date

**Departmental Approval** (non-departmentalized faculties need not sign)

Department Graduate Program Committee <b>H. Moallem</b>	Signature 	Date <b>July 17, 2014</b>
Department Chair <b>Farid Golnaraghi</b>	Signature 	Date <b>7/18/14</b>

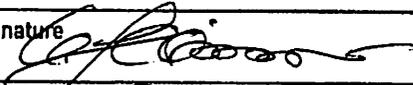
**Faculty Approval**

Faculty approval indicates that all the necessary course content and overlap concerns have been resolved, and that the Faculty/Department commits to providing the required Library funds and any other necessary resources.

Faculty Graduate Program Committee <b>Uwe Glässer</b>	Signature <b>See below</b>	Date <b>Aug 31 2014</b>
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**Senate Graduate Studies Committee Approval**

SGSC approval indicates that the Library report has been seen, and all resource issues dealt with. Once approved, new course proposals are sent to Senate for information.

Senate Graduate Studies Committee <b>UWE GLÄSSER</b> <b>WADE PARKHOUSE</b>	Signature  	Date <b>Aug. 31/2014</b> <b>Sept 18/14</b>
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**CONTACT**

Upon approval of the course, the Office of the Dean of Graduate Studies will consult with the department or school regarding other course attributes that may be required to enable the proper entry of the new course in the student record system.

Department / School / Program <b>MSE</b>	Contact name <b>Dr. Farid Golnaraghi</b>	Contact email <b>mfgolnar@sfu.ca</b>
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# Graduate Course Information Form

## Simon Fraser University Mechatronic Systems Engineering

**Date:** 9 May 2014

**Course number:** MSE 884

**Course title:** Advanced Dynamics

**Instructor:** Dr Kevin Oldknow

**Frequency of course offering:** Annual

### Course description:

Mechanical systems, generalized coordinates and configuration space, holonomic and nonholonomic constraints, virtual work, d'Alembert's principle and generalized forces, energy and momentum, Lagrange's equations, natural modes, principle coordinates and orthogonality, dissipation, impulsive motion, gyroscopic systems, velocity dependent potentials, Hamilton's principle and Hamilton's equations, phase space, introduction to special relativity.

### Syllabus:

#### 1. Introductory Concepts (2 weeks)

- The Mechanical System
- Generalized Coordinates
- Constrains
- Virtual Work
- Energy and Momentum

#### 2. Lagrange's Equations (3 weeks)

- Derivation of Lagrange's Equations
- Example Applications
- Integrals of Motion
- Small Oscillations
- Applications in Mechatronic Systems

3. Special Applications of Lagrange's Equations (3 weeks)

- Rayleigh's Dissipation Function
- Impulsive Motion
- Gyroscopic Systems
- Velocity-Dependent Potentials

4. Hamilton's Equations (3 weeks)

- Hamilton's Principle
- Hamilton's Equations
- Other Variational Principles
- Phase Space

5. Special Relativity (2 weeks)

- Introduction to Special Relativity
- Relativistic Kinematics
- Relativistic Dynamics
- Accelerated Systems

**Textbook:**

Classical Dynamics, Donald T. Greenwood, Dover Publications, 1997, ISBN: 0486696901

**Recommended readings:**

tbd

**Prerequisites:**

MSE 280 / ENSC 380: Linear Systems (or equivalent), MSE 380 / ENSC 381: Dynamic Systems Modelling and Simulation (or equivalent)

**Grading:**

Problem Sets	-
Project (Part 1)	20%
Project (Part 2)	20%
Mid-Term Exam	20%
Final Exam	40%
Component	Percentage

Two

A project (in ~~to~~ parts) will be incorporated in the course, requiring the analysis, modelling and simulation of nonlinear dynamic systems using the principles and techniques developed in the course, as well as comparison with results from physical systems (e.g. from the literature). One mid-term exam will be held during the term, as well as a final exam.

**Does the course have a project? Yes**

If yes, please provide details:

Students will be required to complete a comprehensive project in which systems involving significant continuous, nonlinear and potentially nonholonomic aspects must be analyzed, modelled and simulated with results compared to those obtained (e.g. in the literature) from physical systems.

**Teaching competency:**

Dr Oldknow is an expert in the area of dynamics, controls and wheel / rail systems. His research has included work in the areas of machining (and robotic) system dynamics and control, as well as large scale industrial research projects in the areas of rail vehicle dynamics and wheel / rail contact mechanics. He has published several papers in these areas, both in conference proceedings and refereed journals such as the International Journal of Machine Tools and Manufacture, Journal of Rail and Rapid Transit, IEEE Transactions on Mechatronics, and Wear. In addition, Dr Oldknow's academic work has been augmented by more than 10 years of industrial experience including extensive experience in dynamic systems modelling, control and industrial experiments.