SFU FACULTY OF GRADUATE STUDIES

FACULTY OF
GRADUATE STUDIES

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SFU.CA/GRADUATE-STUDIES

S.26-156

MEMORANDUM

ATTENTION	Senate	DATE	October 15, 2026
FROM	Mary O'Brien, Chair of Senate Graduate Studies Committee (SGSC)		
RE:	New Courses		

For information:
Acting under delegated authority at its meeting of October 6, 2026, SGSC approved the following new courses, effective **Fall 2027**:

Faculty of Science
Department of Physics

1) New Course: PHYS 715: Quantum Mechanics
2) New Course: PHYS 721: Electromagnetic Waves
3) New Course: PHYS 745: Statistical Physics
4) New Course: PHYS 765: Solid State Physics

Senators wishing to consult a more detailed report of curriculum revisions may do so on the Senate webpage at https://www.sfu.ca/senate/documents.html.

SFU

MEMO

Faculty of Science

ATTENTION: Senate Graduate Studies Committee

FROM: Vance Williams, Associate Dean Graduate Studies, Faculty of Science

RE: FoS submission for SGSC

DATE: August 5, 2026

Dear SGSC,

The following curriculum changes have been approved by the Faculty of Science and are being submitted to the Senate Graduate Studies committee for approval.

~~The following Program changes are being proposed:~~
~~**PHYS M.Sc. Program**~~
~~**BISC Master's in Pest Management**~~
~~**BISC Ph.D. Program**~~
~~**MBB Ph.D. Program**~~

The following new courses are being proposed:
PHYS 715: Quantum Mechanics
PHYS 721: Electromagnetic Waves
PHYS 745: Statistical Physics
PHYS 765: Solid State Physics

~~The following course changes are being proposed:~~
~~**BISC 800: Skills for a Successful Scientist**~~
~~**BISC 879: Special Topics III**~~
~~**PHYS 810: Advanced Quantum Mechanics**~~
~~**PHYS 813: Advanced Mechanics**~~
~~**PHYS 816: Quantum Information Science**~~
~~**PHYS 821: Advanced Electromagnetism I**~~
~~**PHYS 822: Advanced Electromagnetism II**~~
~~**PHYS 841: Statistical Mechanics**~~
~~**PHYS 846: Nonlinear Physics**~~
~~**PHYS 847: Biological and Soft-Matter Physics**~~
~~**PHYS 849: Topics in Nanophysics**~~
~~**PHYS 855: Modern Optics**~~
~~**PHYS 861: Introduction to Solid State Physics**~~
~~**PHYS 871: Introduction to Elementary Particle Physics**~~
~~**PHYS 890: General Relativity and Gravitation**~~
~~**PHYS 891: Cosmology**~~

Enclosed are the documents in support of these changes.

Sincerely



Vance Williams
Associate Dean Graduate Studies, Faculty of Science

SFU GRADUATE STUDIES

NEW GRADUATE COURSE PROPOSAL

Course Subject (eg. PSYC) PHYS	**Number (eg. 810)** 715	**Units (eg. 4)** 3

Course title (max. 100 characters): Quantum Mechanics

Short title (for enrollment/transcript, max. 30 characters): Quantum Mechanics

Course description for SFU Calendar (course descriptions should be brief and should never begin with phrases such as "This course will..." or "The purpose of this course is..." If the grading basis is satisfactory/unsatisfactory include this in the description. Max. 50 words)

Wave mechanics in three dimensions; orbital angular momentum and spherical harmonics; central potentials, hydrogen atom; time-independent perturbation theory, Stark effect, Zeeman effect; identical particles, helium atom; scattering, Born approximation; time-dependent perturbation theory, interaction picture.

Rationale for introduction of this course (if more space is required, add a separate page)

Some of our students enter the graduate program without a sufficiently strong background in Quantum Mechanics. We would like them to increase their knowledge in this core area through coursework, thereby providing the necessary knowledge base for graduate studies and for success in our 800-level quantum mechanics courses. To do so, we are cross-listing the existing fourth-year course (Phys 415) and adapting it for graduate students.

Term of initial offering (eg. Fall 2019)	Fall 2027	**Course delivery** (eg. 3 hrs/week for 13 weeks)	3 hrs/week for 13 weeks
Frequency of offerings/year	1	**Estimated enrollment per offering**	3

EQUIVALENT COURSES

Courses that replicates the content of this course to such an extent that students should not receive credit for both courses. Please select the one that is most relevant.

☐ **SEQUENTIAL COURSE** [is not hard coded in the student information management system (SIMS).] Students who have taken (place relevant course(s) in the blank below (ex: STAT 603)) first may not then take this course for further credit.	☐ **ONE-WAY EQUIVALENCY** [is not hard coded in SIMS.] (Place relevant course(s) in the blank below (ex: STAT 603)) will be accepted in lieu of this course.	☑ **TWO-WAY EQUIVALENCY** [is hard coded and enforced by SIMS.] Students with credit for (place relevant course(s) in the blank below (ex: STAT 603)) may not take this course for further credit.
		PHYS 415

Does the partner academic unit agree that this is a two-way equivalency? ☐ YES ☐ NO

Please also have the partner academic unit submit a course change form to update the course equivalency for their course(s).

Prerequisite and/or Corequisite

Criminal record check required? ☐ Yes (if yes is selected, add this as prerequisite)

Additional course fees? ☐ Yes ☑ No

Campus where course will be taught ☑ Burnaby ☐ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

Course Components * ☑ Lecture ☐ Seminar ☐ Lab ☐ Capstone ☐ Practicum ☐ Online ☐ Other: _____

Grading Basis ☑ Letter grades ☐ Satisfactory/ Unsatisfactory ☐ In Progress / Complete

* See important definitions on the curriculum website.

Repeat for credit? ☐ Yes ☑ No	**Total completions allowed?** 1	**Repeat within a term?** ☐ Yes ☑ No
Required course? ☐ Yes ☑ No	**Final exam required?** ☑ Yes ☐ No	

Combined with an undergraduate course? ☑ Yes ☐ No If yes, identify which undergraduate course and the additional course requirements for graduate students. Please include a copy of the undergraduate course outline and fill out the Equivalent Courses section above.

PHYS 415. Graduate students will have additional course requirements, such as additional / more involved problem set questions, exam questions, and/or an independent project. The choice among these advanced requirements is at the discretion of the instructor.

RESOURCES

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

Faculty member(s) who will normally teach this course

Malcolm Kennett, Igor Herbut, Levon Pogosian, John Bechhoefer, Andrei Frolov

Additional faculty members, space, and/or specialized equipment required in order to offer this course

N/A

CONTACT PERSON

Academic Unit / Program	Name (typically, Graduate Program Chair)	Email
Physics	Eldon Emberly	physgchr@sfu.ca

ACADEMIC UNIT APPROVAL

☑ A course outline / syllabus is included

Non-departmentalized faculties need not sign

Graduate Program Committee Nancy Forde	**Signature** Nancy Forde Digitally signed by Nancy Forde Date: 2026.07.08 22:49:37 -07'00'	**Date** 8 July 2026
Department Chair LEVON POGOSIAN	**Signature** Levon Pogosian Digitally signed by Levon Pogosian Date: 2026.07.09 23:28:44 +04'00'	**Date** 9 JULY 2026

FACULTY APPROVAL

The course form and outline must be sent by FGSC to the chairs of each FGSC (fgsc-list@sfu.ca) to check for an overlap in content

Overlap check done? ☑ YES

This approval indicates that all the necessary course content and overlap concerns have been resolved. The Faculty/Academic Unit commits to providing the necessary resources.

Faculty Graduate Studies Committee Vance Williams	**Signature** Vance Williams Digitally signed by Vance Williams Date: 2026.07.19 19:55:42 -07'00'	**Date** July 19, 2026

A library review will be conducted. If additional funds are necessary, Graduate Studies will contact the academic unit prior to SGSC.

SENATE GRADUATE STUDIES COMMITTEE APPROVAL

Senate Graduate Studies Committee Mary O'Brien	**Signature** Mary Anne O'Brien	**Date** October 15, 2026

ADMINISTRATIVE SECTION (for Graduate Studies office only)

Library Check: _____
Course Attribute: _____
Course Attribute Value: _____
Instruction Mode: _____
Attendance Type: _____

If different from regular units:
Academic Progress Units: _____
Financial Aid Progress Units: _____

PHYS 715 QUANTUM III (3)

CALENDAR DESCRIPTION:

Wave mechanics in three dimensions; orbital angular momentum and spherical harmonics; central potentials, hydrogen atom; time-independent perturbation theory, Stark effect, Zeeman effect; identical particles, helium atom; scattering, Born approximation; time-dependent perturbation theory, interaction picture. Quantitative.

COURSE DETAILS: Understand foundations of quantum mechanics. Successfully attacking theoretical problems in quantum mechanics and establishing the major physical conclusion. The topics to be covered this semester will overlap most of the material in Chaps 9-14 of Townsend's text.

Topics to be covered in the textbook.

Ch9 Two body problem

Review classical and quantum mechanics

Symmetries: translation Ch6 and Ch9-2, time evolution Ch4, rotation Ch9-5

Rotational invariance Ch9-5, orbital angular momentum in position space Ch9-8, spherical harmonics, orbital angular momentumeigenfunction Ch9-9, and addition of angular momentum Ch9-9, Ch3, and Ch5

Two body problem: conservation of P (relative and CM coordinates) Ch9-3, conservation of J Ch9-5, commuting observables Ch9-6

Ch10 Bound states of central potential

Coulomb potential and Hydrogen atom Ch10-2

Laguerre polynomials and eigenfunctions and eigenvalues of Hydrogen atom Ch10-1 and Ch10-2

Energy level transition between principle quantum numbers Ch10-2

Ch11 Time independent perturbations

The energy levels of Hydrogen Ch11-6

Relativistic perturbations to the Hydrogen, L-S coupling Ch11-5, non degenerate perturbation theory Ch11-1.

Degenerate case Ch11-2, Stark Effect Ch11-3

Zeeman Effect Ch11-7

Paschen-Back limit Ch11-7

Dirac Equation – Fermions, half integer spin, positive and negative solution, particle and antiparticle (outside of the textbook).

Ch12 Identical Particles

Indistinguishable particles and symmetrization postulate Ch12-1 - Boson and Fermion, review of two electron system.

The Helium Atom Ch12-2 - excited states, para and ortho helium Ch12-2.

Multi-electron atoms and periodic table Ch12-3 - electronic configuration and L, S, and J Ch12-3, Covalent Bonding Ch12-4

Quantum systems beyond Hydrogen atom

Vibration and Rotation of a diatomic molecule Ch9-7

The finite spherical well and the Deuteron Ch10-3 with Ch6-9 and Ch6-10.

The infinite spherical well Ch10-4.

The 3-D Harmonic Oscillator Ch10-5.

Ch13 Scattering

Rutherford's experiment with alpha-particles, asymptotic wave functions and the differential cross section Ch13-1, probability densityCh6-10.

The Born approximation Ch13-2.

The Yukawa potential Ch13-3.

Partial wave expansion and phase shift analysis Ch13-4 and Ch13-5.

Ch14 Photons and Atoms

The Aharonov-Bohm effect Ch14-1.

Introduction of canonical momentum Ch14-2 and Ch14-4, second quantization Ch14-3.

Time dependent perturbation theory Ch14-5.

Schrodinger vs Heisenberg picture, interaction picture Ch14-5.

Fermi Golden Rule Ch14-6.

Spontaneous Emission Ch14-7.

Klein-Gordon equation – Bosons, more than one particle in a state with momentum

Grading

Midterm 20%

Final Exam 40%

Project 15%

Homework 25%

MATERIALS + SUPPLIES:

Required text: John S. Townsend, A modern approach to Quantum Mechanics.

Recommended reading lists: David J. Griffiths, Introduction to Quantum Mechanics; P. A. M. Dirac, The Principles of Quantum Mechanics.

SPRING 2026 - PHYS 415 D100

QUANTUM III (3)

Class Number: 6150 *Delivery Method: In Person*

COURSE TIMES + LOCATION:

Jan 5 – Apr 10, 2026: Mon, Wed, Fri, 10:30–11:20 a.m.
Burnaby

EXAM TIMES + LOCATION:

Apr 14, 2026
Tue, 3:30–6:30 p.m.
Burnaby

INSTRUCTOR:

Hoi-Kwan Lau
hoikwanl@sfu.ca

PREREQUISITES:

PHYS 385; either PHYS 384 or MATH 314. All prerequisite courses require a minimum grade of C-.

Description

CALENDAR DESCRIPTION:

Wave mechanics in three dimensions; orbital angular momentum and spherical harmonics; central potentials, hydrogen atom; time-independent perturbation theory, Stark effect, Zeeman effect; identical particles, helium atom; scattering, Born approximation; time-dependent perturbation theory, interaction picture. Quantitative.

COURSE DETAILS:

Understand foundations of quantum mechanics. Successfully attacking theoretical problems in quantum mechanics and establishing the major physical conclusion. The topics to be covered this semester will overlap most of the material in Chaps 9-14 of Townsend's text.

Topics to be covered in the textbook.

Ch9 Two body problem

- Review classical and quantum mechanics
- Symmetries: translation Ch6 and Ch9-2, time evolution Ch4, rotation Ch9-5
- Rotational invariance Ch9-5, orbital angular momentum in position space Ch9-8, spherical harmonics, orbital angular momentum eigenfunction Ch9-9, and addition of angular momentum Ch9-9, Ch3, and Ch5
- Two body problem: conservation of P (relative and CM coordinates) Ch9-3, conservation of J Ch9-5, commuting observables Ch9-6

Ch10 Bound states of central potential

- Coulomb potential and Hydrogen atom Ch10-2
- Laguerre polynomials and eigenfunctions and eigenvalues of Hydrogen atom Ch10-1 and Ch10-2

Energy level transition between principle quantum numbers Ch10-2

Ch11 Time independent perturbations

The energy levels of Hydrogen Ch11-6

Relativistic perturbations to the Hydrogen, L-S coupling Ch11-5, non degenerate perturbation theory Ch11-1.

Degenerate case Ch11-2, Stark Effect Ch11-3

Zeeman Effect Ch11-7

Paschen-Back limit Ch11-7

Dirac Equation – Fermions, half integer spin, positive and negative solution, particle and antiparticle (outside of the textbook).

Ch12 Identical Particles

Indistinguishable particles and symmetrization postulate Ch12-1 - Boson and Fermion, review of two electron system.

The Helium Atom Ch12-2 - excited states, para and ortho helium Ch12-2.

Multi-electron atoms and periodic table Ch12-3 - electronic configuration and L, S, and J Ch12-3, Covalent Bonding Ch12-4

----------Finish Coulomb potential and back to Ch9----------

Quantum systems beyond Hydrogen atom

Vibration and Rotation of a diatomic molecule Ch9-7

The finite spherical well and the Deuteron Ch10-3 with Ch6-9 and Ch6-10.

The infinite spherical well Ch10-4.

The 3-D Harmonic Oscillator Ch10-5.

Ch13 Scattering

Rutherford's experiment with alpha-particles, asymptotic wave functions and the differential cross section Ch13-1, probability density Ch6-10.

The Born approximation Ch13-2.

The Yukawa potential Ch13-3.

Partial wave expansion and phase shift analysis Ch13-4 and Ch13-5.

Ch14 Photons and Atoms

The Aharonov-Bohm effect Ch14-1.

Introduction of canonical momentum Ch14-2 and Ch14-4, second quantization Ch14-3.

Time dependent perturbation theory Ch14-5.

Schrodinger vs Heisenberg picture, interaction picture Ch14-5.

Fermi Golden Rule Ch14-6.

Spontaneous Emission Ch14-7.

Klein-Gordon equation – Bosons, more than one particle in a state with momentum P

Grading

Midterm	20%
Final Exam	40%
Homework	40%

Materials

MATERIALS + SUPPLIES:

Required text: John S. Townsend, A modern approach to Quantum Mechanics.

Recommended reading lists: David J. Griffiths, Introduction to Quantum Mechanics; P. A. M. Dirac, The Principles of Quantum Mechanics.

REQUIRED READING NOTES:

Your personalized Course Material list, including digital and physical textbooks, are available through the SFU Bookstore website by simply entering your Computing ID at: shop.sfu.ca/course-materials/my-personalized-course-materials.

DEPARTMENT UNDERGRADUATE NOTES:

Students who cannot write their exam during the course's scheduled exam time must request accommodation from their instructor in writing, clearly stating the reason for this request, within one week of the final exam schedule being posted.

REGISTRAR NOTES:

ACADEMIC INTEGRITY: YOUR WORK, YOUR SUCCESS

At SFU, you are expected to act honestly and responsibly in all your academic work. Cheating, plagiarism, or any other form of academic dishonesty harms your own learning, undermines the efforts of your classmates who pursue their studies honestly, and goes against the core values of the university.

To learn more about the academic disciplinary process and relevant academic supports, visit:

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SFU's Academic Integrity website, which includes helpful videos and tips in plain language: Academic Integrity at SFU

RELIGIOUS ACCOMMODATION

Students with a faith background who may need accommodations during the term are encouraged to assess their needs as soon as possible and review the Multifaith religious accommodations website. The page outlines ways they begin working toward an accommodation and

ensure solutions can be reached in a timely fashion.

SFU GRADUATE STUDIES

NEW GRADUATE COURSE PROPOSAL

Course Subject (eg. PSYC) PHYS	**Number (eg. 810)** 721	**Units (eg. 4)** 3

Course title (max. 100 characters): Electromagnetic Waves

Short title (for enrollment/transcript, max. 30 characters): Electromagnetic Waves

Course description for SFU Calendar (course descriptions should be brief and should never begin with phrases such as "This course will..." or "The purpose of this course is..." If the grading basis is satisfactory/unsatisfactory include this in the description. Max. 50 words)

Properties of electromagnetic waves and their interaction with matter. Transmission lines and waveguides; antennas, radiation and scattering; propagation of electromagnetic waves in free space and in matter; reflection and refraction at boundaries; polarization, interference and diffraction.

Rationale for introduction of this course (if more space is required, add a separate page)

Some of our students enter the graduate program without a sufficiently strong background in electromagnetism. We would like them to increase their knowledge in this core area through coursework, thereby providing the necessary knowledge base for graduate studies and for success in our 800-level electromagnetism courses. To do so, we are cross-listing the existing fourth-year course (Phys 421) and adapting it for graduate students.

Term of initial offering (eg. Fall 2019)	Fall 2027	**Course delivery** (eg. 3 hrs/week for 13 weeks)	3 hrs/week for 13 weeks
Frequency of offerings/year	1	**Estimated enrollment per offering**	3

EQUIVALENT COURSES

Courses that replicates the content of this course to such an extent that students should not receive credit for both courses. Please select the one that is most relevant.

☐ **SEQUENTIAL COURSE**	☐ **ONE-WAY EQUIVALENCY**	☑ **TWO-WAY EQUIVALENCY**
[is not hard coded in the student information management system (SIMS).] Students who have taken (place relevant course(s) in the blank below (ex: STAT 603)) first may not then take this course for further credit.	[is not hard coded in SIMS.] (Place relevant course(s) in the blank below (ex: STAT 603)) will be accepted in lieu of this course.	[is hard coded and enforced by SIMS.] Students with credit for (place relevant course(s) in the blank below (ex: STAT 603)) may not take this course for further credit.
		PHYS 421

Does the partner academic unit agree that this is a two-way equivalency? ☐ YES ☐ NO

Please also have the partner academic unit submit a course change form to update the course equivalency for their course(s).

Prerequisite and/or Corequisite

Criminal record check required? ☐ Yes (if yes is selected, add this as prerequisite)

Additional course fees? ☐ Yes ☑ No

Campus where course will be taught ☑ Burnaby ☐ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

Course Components * ☑ Lecture ☐ Seminar ☐ Lab ☐ Capstone ☐ Practicum ☐ Online ☐ Other: _____

Grading Basis ☑ Letter grades ☐ Satisfactory/ Unsatisfactory ☐ In Progress / Complete

* See important definitions on the curriculum website.

Repeat for credit? ☐ Yes ☑ No	**Total completions allowed?** 1	**Repeat within a term?** ☐ Yes ☑ No
Required course? ☐ Yes ☑ No	**Final exam required?** ☑ Yes ☐ No	

Combined with an undergraduate course? ☑ Yes ☐ No If yes, identify which undergraduate course and the additional course requirements for graduate students. Please include a copy of the undergraduate course outline and fill out the Equivalent Courses section above.

PHYS 421. Graduate students will have additional course requirements, such as additional / more involved problem set questions, exam questions, and/or an independent project. The choice among these advanced requirements is at the discretion of the instructor.

RESOURCES

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

Faculty member(s) who will normally teach this course

Eundeok Mun, Paul Haljan

Additional faculty members, space, and/or specialized equipment required in order to offer this course

N/A

CONTACT PERSON

Academic Unit / Program	**Name (typically, Graduate Program Chair)**	**Email**
Physics	Eldon Emberly	physgchr@sfu.ca

ACADEMIC UNIT APPROVAL

☑ A course outline / syllabus is included

Non-departmentalized faculties need not sign

Graduate Program Committee Nancy Forde	**Signature** Nancy Forde Digitally signed by Nancy Forde Date: 2026.07.08 22:50:11 -07'00'	**Date** 8 July 2026
Department Chair Levon Pogosian	**Signature** Levon Pogosian Digitally signed by Levon Pogosian Date: 2026.07.09 23:29:35 +04'00'	**Date** 9 July 2026

FACULTY APPROVAL

The course form and outline must be sent by FGSC to the chairs of each FGSC (fgsc-list@sfu.ca) to check for an overlap in content

Overlap check done? ☑ YES

This approval indicates that all the necessary course content and overlap concerns have been resolved. The Faculty/Academic Unit commits to providing the necessary resources.

Faculty Graduate Studies Committee Vance Williams	**Signature** Vance Williams Digitally signed by Vance Williams Date: 2026.07.19 19:59:28 -07'00'	**Date** July 19, 2026

A library review will be conducted. If additional funds are necessary, Graduate Studies will contact the academic unit prior to SGSC.

SENATE GRADUATE STUDIES COMMITTEE APPROVAL

Senate Graduate Studies Committee Mary O'Brien	**Signature** Mary Hea O'Brien	**Date** October 15, 2026

ADMINISTRATIVE SECTION (for Graduate Studies office only)

Library Check: _____
Course Attribute: _____
Course Attribute Value: _____
Instruction Mode: _____
Attendance Type: _____

If different from regular units:
Academic Progress Units: _____
Financial Aid Progress Units: _____

PHYS 721 ELECTROMAGNETIC WAVES (3)

Description

CALENDAR DESCRIPTION:

Properties of electromagnetic waves and their interaction with matter. Transmission lines and waveguides; antennas, radiation and scattering; propagation of electromagnetic waves in free space and in matter; reflection and refraction at boundaries; polarization, interference and diffraction. Quantitative.

COURSE DETAILS:

Course Outline (times are approximate) Week 1 Review of time-varying fields and Maxwell's equations Week 2,3 Conservation laws: charge, energy, momentum Week 4,5,6,7 Electromagnetic waves Week 8,9 Waveguides, transmission lines Week 10,11 Potentials and fields of charges in motion Week 12,13 Radiation and antennas

Grading

Homework, quizzes and tutorials 20%

Midterms (2x20) 40%

Project 15%

Final Exam 25%

MATERIALS + SUPPLIES:

Required Text: Intro to Electrodynamics 4th edition Author: Griffiths

FALL 2025 - PHYS 421 D100

ELECTROMAGNETIC WAVES (3)

Class Number: 4993 *Delivery Method: In Person*

COURSE TIMES + LOCATION:

Sep 3 – Dec 2, 2025: Mon, Wed, Fri, 9:30–10:20 a.m.
Burnaby

EXAM TIMES + LOCATION:

Dec 6, 2025
Sat, 3:30–6:30 p.m.
Burnaby

INSTRUCTOR:

Eundeok Mun
emun@sfu.ca

PREREQUISITES:

PHYS 321 (no substitution); PHYS 255 or ENSC 380; both with a minimum grade of C-.

Description

CALENDAR DESCRIPTION:

A continuation of PHYS 321: properties of electromagnetic waves and their interaction with matter. Transmission lines and waveguides; antennas, radiation and scattering; propagation of electromagnetic waves in free space and in matter; reflection and refraction at boundaries; polarization, interference and diffraction. Quantitative.

COURSE DETAILS:

Course Outline (times are approximate)

Week 1 Review of time-varying fields and Maxwell's equations

Week 2,3 Conservation laws: charge, energy, momentum

Week 4,5,6,7 Electromagnetic waves

Week 8,9 Waveguides, transmission lines

Week 10,11 Potentials and fields of charges in motion

Week 12,13 Radiation and antennas

Grading

Homework, quizzes and tutorials	20%
Midterms (2x20)	40%

Final Exam	40%

Materials

MATERIALS + SUPPLIES:

RequiredText:

Intro to Electrodynamics 4th edition
Author:Griffiths

REQUIRED READING NOTES:

Your personalized Course Material list, including digital and physical textbooks, are available through the SFU Bookstore website by simply entering your Computing ID at: shop.sfu.ca/course-materials/my-personalized-course-materials.

DEPARTMENT UNDERGRADUATE NOTES:

Students who cannot write their exam during the course's scheduled exam time must request accommodation from their instructor in writing, clearly stating the reason for this request, within one week of the final exam schedule being posted.

REGISTRAR NOTES:

ACADEMIC INTEGRITY: YOUR WORK, YOUR SUCCESS

At SFU, you are expected to act honestly and responsibly in all your academic work. Cheating, plagiarism, or any other form of academic dishonesty harms your own learning, undermines the efforts of your classmates who pursue their studies honestly, and goes against the core values of the university.

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SFU's Academic Integrity website, which includes helpful videos and tips in plain language: Academic Integrity at SFU

RELIGIOUS ACCOMMODATION

Students with a faith background who may need accommodations during the term are encouraged to assess their needs as soon as possible and review the Multifaith religious accommodations website. The page outlines ways they begin working toward an accommodation and ensure solutions can be reached in a timely fashion.

SFU GRADUATE STUDIES

NEW GRADUATE COURSE PROPOSAL

Course Subject (eg. PSYC) PHYS	**Number (eg. 810)** 745	**Units (eg. 4)** 3

Course title (max. 100 characters): Statistical Physics

Short title (for enrollment/transcript, max. 30 characters): Statistical Physics

Course description for SFU Calendar (course descriptions should be brief and should never begin with phrases such as "This course will..." or "The purpose of this course is..." If the grading basis is satisfactory/unsatisfactory include this in the description. Max. 50 words)

Postulates of statistical mechanics, partition functions, applications to gases, paramagnetism and equilibrium. Quantum statistics and applications.

Rationale for introduction of this course (if more space is required, add a separate page)

A few of our students enter the graduate program without a sufficiently strong background in statistical physics. We would like them to increase their knowledge in this core area through coursework, thereby providing the necessary knowledge base for graduate studies and for success in our 800-level statistical physics course. To do so, we are cross-listing the existing fourth-year course (Phys 445) and adapting it for graduate students.

Term of initial offering (eg. Fall 2019)	Fall 2027	**Course delivery** (eg. 3 hrs/week for 13 weeks)	3 hrs/week for 13 weeks
Frequency of offerings/year	1	**Estimated enrollment per offering**	3

EQUIVALENT COURSES

Courses that replicates the content of this course to such an extent that students should not receive credit for both courses. Please select the one that is most relevant.

☐ **SEQUENTIAL COURSE** [is not hard coded in the student information management system (SIMS).] Students who have taken (place relevant course(s) in the blank below (ex: STAT 603)) first may not then take this course for further credit.	☐ **ONE-WAY EQUIVALENCY** [is not hard coded in SIMS.] (Place relevant course(s) in the blank below (ex: STAT 603)) will be accepted in lieu of this course.	☑ **TWO-WAY EQUIVALENCY** [is hard coded and enforced by SIMS.] Students with credit for (place relevant course(s) in the blank below (ex: STAT 603)) may not take this course for further credit.
		PHYS 445

Does the partner academic unit agree that this is a two-way equivalency? ☐ YES ☐ NO

Please also have the partner academic unit submit a course change form to update the course equivalency for their course(s).

Prerequisite and/or Corequisite

Criminal record check required? ☐ Yes (if yes is selected, add this as prerequisite)

Additional course fees? ☐ Yes ☑ No

Campus where course will be taught ☑ Burnaby ☐ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

Course Components * ☑ Lecture ☐ Seminar ☐ Lab ☐ Capstone ☐ Practicum ☐ Online ☐ Other: _____

Grading Basis ☑ Letter grades ☐ Satisfactory/ Unsatisfactory ☐ In Progress / Complete

* See important definitions on the curriculum website.

Repeat for credit? ☐ Yes ☑ No	**Total completions allowed?** 1	**Repeat within a term?** ☐ Yes ☑ No
Required course? ☐ Yes ☑ No	**Final exam required?** ☑ Yes ☐ No	

Combined with an undergraduate course? ☑ Yes ☐ No If yes, identify which undergraduate course and the additional course requirements for graduate students. Please include a copy of the undergraduate course outline and fill out the Equivalent Courses section above.

PHYS 445. Graduate students will have additional course requirements, such as additional / more involved problem set questions, exam questions, and/or an independent project. The choice among these advanced requirements is at the discretion of the instructor.

RESOURCES

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

Faculty member(s) who will normally teach this course

Malcolm Kennett, Simon Watkins, David Broun, Jeffrey McGuirk

Additional faculty members, space, and/or specialized equipment required in order to offer this course

N/A

CONTACT PERSON

Academic Unit / Program	**Name (typically, Graduate Program Chair)**	**Email**
Physics	Eldon Emberly	physgchr@sfu.ca

ACADEMIC UNIT APPROVAL

☑ A course outline / syllabus is included

Non-departmentalized faculties need not sign

Graduate Program Committee Nancy Forde	**Signature** Nancy Forde Digitally signed by Nancy Forde Date: 2026.07.08 22:50:56 -07'00'	**Date** 8 July 2026
Department Chair Levon Pogosian	**Signature** Levon Pogosian Digitally signed by Levon Pogosian Date: 2026.07.09 23:30:09 +04'00'	**Date** 9 July 2026

FACULTY APPROVAL

The course form and outline must be sent by FGSC to the chairs of each FGSC (fgsc-list@sfu.ca) to check for an overlap in content

Overlap check done? ☑ YES

This approval indicates that all the necessary course content and overlap concerns have been resolved. The Faculty/Academic Unit commits to providing the necessary resources.

Faculty Graduate Studies Committee Vance Williams	**Signature** Vance Williams Digitally signed by Vance Williams Date: 2026.07.19 20:02:24 -07'00'	**Date** July 19, 2026

A library review will be conducted. If additional funds are necessary, Graduate Studies will contact the academic unit prior to SGSC.

SENATE GRADUATE STUDIES COMMITTEE APPROVAL

Senate Graduate Studies Committee Mary O'Brien	**Signature**	**Date** October 15, 2026

ADMINISTRATIVE SECTION (for Graduate Studies office only)

Library Check: _____
Course Attribute: _____
Course Attribute Value: _____
Instruction Mode: _____
Attendance Type: _____

If different from regular units:
Academic Progress Units: _____
Financial Aid Progress Units: _____

PHYS 745 STATISTICAL PHYSICS (3)

CALENDAR DESCRIPTION:

Postulates of statistical mechanics, partition functions, applications to gases, paramagnetism and equilibrium. Quantum statistics and applications. Quantitative.

COURSE DETAILS:

1. Introduction to Statistical Mechanics: probability, random walks and entropy
2. Ensembles: microcanonical, canonical and grand canonical ensembles, examples and connections to thermodynamics
3. Liouville's Theorem and Ergodicity
4. Kinetic Theory of gases
5. Quantum Statistical Mechanics: fermions and boson
6. Fermions: Fermi energy, Metals, White Dwarf Star
7. Bosons: photons, blackbody radiation, Bose Einstein Condensation and Superfluidity, phonons and Debye model
8. Ordering and phase transitions: Ising model, mean field theory, Landau theory

Grading

Problem Sets 40%

Midterm 15%

Project 15

Final Exam 30%

MATERIALS + SUPPLIES:

Required: *Essential Statistical Physics,* Kennett, M.P., Cambridge University Press.

SPRING 2026 - PHYS 445 D100

STATISTICAL PHYSICS (3)

Class Number: 6151 *Delivery Method: In Person*

COURSE TIMES + LOCATION:

Jan 5 – Apr 10, 2026: Mon, Wed, Fri, 9:30–10:20 a.m.
Burnaby

EXAM TIMES + LOCATION:

Apr 21, 2026
Tue, 12:00–3:00 p.m.
Burnaby

INSTRUCTOR:

Malcolm Kennett
malcolmk@sfu.ca
1 778 782-4826

PREREQUISITES:

PHYS 344 or CHEM 360, with a minimum grade of C-. Recommended: PHYS 385.

Description

CALENDAR DESCRIPTION:

Postulates of statistical mechanics, partition functions, applications to gases, paramagnetism and equilibrium. Quantum statistics and applications. Quantitative.

COURSE DETAILS:

1. Introduction to Statistical Mechanics: probability, random walks and entropy
2. Ensembles: microcanonical, canonical and grand canonical ensembles, examples and connections to thermodynamics
3. Liouville's Theorem and Ergodicity
4. Kinetic Theory of gases
5. Quantum Statistical Mechanics: fermions and boson
6. Fermions: Fermi energy, Metals, White Dwarf Star
7. Bosons: photons, blackbody radiation, Bose Einstein Condensation and Superfluidity, phonons and Debye model
8. Ordering and phase transitions: Ising model, mean field theory, Landau theory

Grading

Problem Sets	40%
Midterm	15%
Final Exam	45%

Materials

MATERIALS + SUPPLIES:

Required: *Essential Statistical Physics,* Kennett, M.P., Cambridge University Press.

REQUIRED READING NOTES:

Your personalized Course Material list, including digital and physical textbooks, are available through the SFU Bookstore website by simply entering your Computing ID at: shop.sfu.ca/course-materials/my-personalized-course-materials.

DEPARTMENT UNDERGRADUATE NOTES:

Students who cannot write their exam during the course's scheduled exam time must request accommodation from their instructor in writing, clearly stating the reason for this request, within one week of the final exam schedule being posted.

REGISTRAR NOTES:

ACADEMIC INTEGRITY: YOUR WORK, YOUR SUCCESS

At SFU, you are expected to act honestly and responsibly in all your academic work. Cheating, plagiarism, or any other form of academic dishonesty harms your own learning, undermines the efforts of your classmates who pursue their studies honestly, and goes against the core values of the university.

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SFU's Academic Integrity website, which includes helpful videos and tips in plain language: Academic Integrity at SFU

RELIGIOUS ACCOMMODATION

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SFU GRADUATE STUDIES

NEW GRADUATE COURSE PROPOSAL

Course Subject (eg. PSYC) PHYS	**Number (eg. 810)** 765	**Units (eg. 4)** 3

Course title (max. 100 characters): Solid State Physics

Short title (for enrollment/transcript, max. 30 characters): Solid State Physics

Course description for SFU Calendar (course descriptions should be brief and should never begin with phrases such as "This course will..." or "The purpose of this course is..." If the grading basis is satisfactory/unsatisfactory include this in the description. Max. 50 words)

Crystal structure, lattice vibrations and thermal properties of solids, free electron model, band theory, and applications.

Rationale for introduction of this course (if more space is required, add a separate page)

Some students enter the graduate program without having completed an undergraduate course in Solid State Physics. The proposed course provides the necessary knowledge base for graduate research in condensed matter physics and for success in our 800-level condensed matter physics courses. It is a cross-listed version of the existing fourth-year course (Phys 465) that is adapted for graduate students.

Term of initial offering (eg. Fall 2019)	Fall 2027	**Course delivery** (eg. 3 hrs/week for 13 weeks)	3 hrs/week for 13 weeks
Frequency of offerings/year	1	**Estimated enrollment per offering**	3

EQUIVALENT COURSES

Courses that replicates the content of this course to such an extent that students should not receive credit for both courses. Please select the one that is most relevant.

☐ **SEQUENTIAL COURSE** [is not hard coded in the student information management system (SIMS).] Students who have taken (place relevant course(s) in the blank below (ex: STAT 603)) first may not then take this course for further credit.	☐ **ONE-WAY EQUIVALENCY** [is not hard coded in SIMS.] (Place relevant course(s) in the blank below (ex: STAT 603)) will be accepted in lieu of this course.	☑ **TWO-WAY EQUIVALENCY** [is hard coded and enforced by SIMS.] Students with credit for (place relevant course(s) in the blank below (ex: STAT 603)) may not take this course for further credit.
		PHYS 465

Does the partner academic unit agree that this is a two-way equivalency? ☐ YES ☐ NO

Please also have the partner academic unit submit a course change form to update the course equivalency for their course(s).

Prerequisite and/or Corequisite

Criminal record check required? ☐ Yes (if yes is selected, add this as prerequisite)

Additional course fees? ☐ Yes ☑ No

Campus where course will be taught ☑ Burnaby ☐ Surrey ☐ Vancouver ☐ Great Northern Way ☐ Off campus

Course Components * ☑ Lecture ☐ Seminar ☐ Lab ☐ Capstone ☐ Practicum ☐ Online ☐ Other: _____

Grading Basis ☑ Letter grades ☐ Satisfactory/ Unsatisfactory ☐ In Progress / Complete

* See important definitions on the curriculum website.

Repeat for credit? ☐ Yes ☑ No	**Total completions allowed?** 1	**Repeat within a term?** ☐ Yes ☑ No
Required course? ☐ Yes ☑ No	**Final exam required?** ☑ Yes ☐ No	

Combined with an undergraduate course? ☑ Yes ☐ No If yes, identify which undergraduate course and the additional course requirements for graduate students. Please include a copy of the undergraduate course outline and fill out the Equivalent Courses section above.

PHYS 465. Graduate students will have additional course requirements, such as additional / more involved problem sets, questions, and/or an independent project. The choice among these advanced requirements is at the discretion of the instructor.

RESOURCES

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

Faculty member(s) who will normally teach this course

Malcolm Kennett, Simon Watkins, David Broun, Jeffrey McGuirk

Additional faculty members, space, and/or specialized equipment required in order to offer this course

N/A

CONTACT PERSON

Academic Unit / Program	**Name (typically, Graduate Program Chair)**	**Email**
Physics	Eldon Emberly	physgchr@sfu.ca

ACADEMIC UNIT APPROVAL

☑ A course outline / syllabus is included

Non-departmentalized faculties need not sign

Graduate Program Committee Nancy Forde	**Signature** Nancy Forde Digitally signed by Nancy Forde Date: 2026.07.08 22:51:33 -07'00'	**Date** 8 July 2026
Department Chair Levon Pogosian	**Signature** Levon Pogosian Digitally signed by Levon Pogosian Date: 2026.07.09 23:30:49 +04'00'	**Date** 9 July 2026

FACULTY APPROVAL

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Overlap check done? ☑ YES

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Faculty Graduate Studies Committee Vance Williams	**Signature** Vance Williams Digitally signed by Vance Williams Date: 2026.07.19 20:03:18 -07'00'	**Date** July 19, 2026

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SENATE GRADUATE STUDIES COMMITTEE APPROVAL

Senate Graduate Studies Committee Mary O'Brien	**Signature** Mary O'Brien	**Date** October 15, 2026

ADMINISTRATIVE SECTION (for Graduate Studies office only)

Library Check: _____
Course Attribute: _____
Course Attribute Value: _____
Instruction Mode: _____
Attendance Type: _____

If different from regular units:
Academic Progress Units: _____
Financial Aid Progress Units: _____

PHYS 765 SOLID STATE PHYSICS (3)

CALENDAR DESCRIPTION:

Crystal structure, lattice vibrations and thermal properties of solids, free electron model, band theory, and applications. Quantitative.

COURSE DETAILS:

Crystal Structure – Bravais lattice, Miller indices, reciprocal lattice, Brillouin zone, diffraction

Lattice Vibrations – harmonic approximation, phonons, lattice specific heat

Free-Electron Theory and Metals – Fermi surface, electronic specific heat, electrical and thermal conductivity

Band Theory of Solids – nearly-free electron model, tight-binding model, Bloch electrons, electronic band structure

Semiconductors and Insulators – band gaps, carriers, dopant impurities, effective mass, chemical potential, electrical conductivity

Superconductors – Meissner effect, vortex state, thermodynamics, specific heat, isotope effect

Grading

Homework 30%

Midterms 20%

Project 15%

Final Exam 35%

MATERIALS + SUPPLIES:

Required text:

1. S. Simon, The Oxford Solid State Basics ISBN:9780199680764

FALL 2025 - PHYS 465 D100

SOLID STATE PHYSICS (3)

Class Number: 5046 *Delivery Method: In Person*

COURSE TIMES + LOCATION:

Sep 3 – Dec 2, 2025: Mon, Wed, Fri, 11:30 a.m.–12:20 p.m.
Burnaby

EXAM TIMES + LOCATION:

Dec 12, 2025
Fri, 3:30–6:30 p.m.
Burnaby

INSTRUCTOR:

Simon Watkins
simonw@sfu.ca
1 778 782-5763

PREREQUISITES:

PHYS 385 or CHEM 364, with a minimum grade of C-.

Description

CALENDAR DESCRIPTION:

Crystal structure, lattice vibrations and thermal properties of solids, free electron model, band theory, and applications. Quantitative.

COURSE DETAILS:

Crystal Structure – Bravais lattice, Miller indices, reciprocal lattice, Brillouin zone, diffraction
Lattice Vibrations – harmonic approximation, phonons, lattice specific heat
Free-Electron Theory and Metals – Fermi surface, electronic specific heat, electrical and thermal conductivity
Band Theory of Solids – nearly-free electron model, tight-binding model, Bloch electrons, electronic band structure
Semiconductors and Insulators – band gaps, carriers, dopant impurities, effective mass, chemical potential, electrical conductivity
Superconductors – Meissner effect, vortex state, thermodynamics, specific heat, isotope effect

Grading

Homework	30%
Midterms	20%
Final Exam	50%

Materials

MATERIALS + SUPPLIES:

Required text:
1. S. Simon, The Oxford Solid State Basics ISBN:9780199680764

REQUIRED READING NOTES:

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