Western University
Department of Mechanical & Materials Engineering

MME 4493B – Functional Materials

COURSE OUTLINE – 2025-2026

CALENDAR DESCRIPTION: This course provides an introduction to solid state physics and its application to materials engineering. Technologies utilizing functional materials (those with useful innate responses to optical, electrical, chemical, etc. inputs), such as photovoltaics, batteries, and LEDs will be discussed.

COURSE INFORMATION:

Instructor: Prof. Eric Johlin

Email: ejohlin@uwo.ca

Lectures/tutorials/labs: None

CONSULTATION HOURS: Office hours will be announced after the term begins

PREREQUISITES: NMM 2276A/B, either MME 2260A/B or MSE 3301A/B.

ANTIREQUISITES: MME 4474A/B if taken in 2022-23, 2023-24, or 2024-25

ACCREDITATION UNITS: Engineering Science = 50%, Science = 50%

TOPICS:

Topics covered will include, but are not limited to:

1. Introduction to quantum mechanics
2. Wave properties of matter & Schrodinger's Equation
3. Hydrogen atom & periodic table
4. Atomic bonding & crystal structure
5. Electronic properties, semiconductors & metals
6. Optical & dielectric properties
7. Photovoltaics, batteries, & thermoelectrics
8. Nanomaterials & their functional properties

LEARNING OUTCOMES:

The Mechanical and Materials Engineering Program has been accredited by Canadian Engineering Accreditation Board (CEAB) of Engineers Canada. Accredited programs provide the academic requirements for licensure as a professional engineer in Canada. Western Engineering has defined indicators of the 12 Graduate Attributes (GAs) that the CEAB expects graduating engineering students to demonstrate. The connections between course learning outcomes and Western Engineering's GA Indicators are identified below.

Upon successful completion of this course, students will be able to:

1. Understand the origins of wave-particle duality, and quantum mechanics. and their need and implications to materials (KB2, KB4)
2. Apply the Schrodinger Equation to electrons in simple scenarios to gain understanding of atomic properties (KB2)
3. Gain baseline understanding of solid state physics, and its application to engineering materials and properties (KB2, KB4)
4. Analyse the origins of functional properties of engineering materials in a context of solid state physics (KB2, PA3)
5. Analyse real or synthesized data to extract useful material properties and relationships utilizing equations developed from first principles (I3)

CONTACT HOURS:

3 lecture hours, half course

TEXTBOOK:

All Optional:

Primary:

P.A. Cox "Introduction to Quantum Theory and Atomic Structure" Oxford Chemistry Primers, ISBN: 978-0198559160

P. Hoffmann "Solid State Physics: An Introduction" Wiley-VCH, ISBN: 978-3527408610

Additional:

S.A. Holgate "Understanding Solid State Physics" CRC Press, ISBN: 978-0750309721

R.P. Feynman "The Feynman Lectures on Physics" Basic Books. ISBN: 978-0465023820 (https://www.feynmanlectures.caltech.edu/index.html)

UNITS:

SI will be used

EVALUATION:

Take-home problem sets (3) 50%

PS #1:	Week 4
PS #2:	Week 7
PS #3:	Week 11

In-class quizzes (3) 50%

Quiz #1:	Week 5
Quiz #2:	Week 8
Quiz #3:	Final Exam Period

COURSE POLICIES: The following course-specific policies will be enforced throughout the course:

General

- Dates and other evaluation details are tentative and may be changed by the instructor. Notification will be sent through OWL
- There are multiple *suggested* references, but none of these are required; any required readings will be posted to OWL directly

Problem Sets

- Problem sets are done either individually or with a small group (1-3 students)
- These are considered learning activities with the majority of the mark based on effort
- If done in a group, everyone must submit their own version and list those they worked with
- Work handed in 1-24 hours late will receive a 20% penalty; over 24 hours late, a mark of zero will be applied.

Quizzes

- Quizzes will be short assessments in-class to assess and ensure understanding of the problem set material
- Quizzes will be closed note/book/etc., individual assessments
- Quiz 1 and 2 will take place in class
- The 3rd quiz will be scheduled during the final exam period to allow for testing over all the full class material
- All three quizzes are weighted equally, and will be generally be approximately one hour (including the 3rd quiz)
- A quiz missed without academic consideration will receive a mark of 0
- A quiz missed with academic consideration will be reweighted between the other quizzes

General Faculty / University Policies

The Faculty of Engineering and Western University have overarching policies that prescribe how undergraduate courses should run. The course-specific policies described above should be considered *in addition to* those overarching policies, or as course-specific interpretations of them. In the event of contradictions or confusion between course-specific policies above and general Faculty / University policies, please contact your course instructor for clarification.

Western Engineering's undergraduate polices can be found by navigating to:
https://www.eng.uwo.ca/undergraduate/academic-support-and-accommodations/policies.html

and then clicking the "*Engineering Undergraduate Policies framework*" link.

Important Links

- **WESTERN ACADEMIC CALENDAR**
- **ACADEMIC RIGHTS AND RESPONSIBILITIES**
- **ENGINEERING PROGRESSION REQUIREMENTS AND ACADEMIC REGULATIONS**
- **UNIVERSITY STUDENTS' COUNCIL (USC) - SERVICES**
- **IMPORTANT DATES AND DEADLINES**
- **ACADEMIC CONSIDERATION FOR MEDICAL ILLNESS - UNDERGRADUATE STUDENTS**
- **ACCOMMODATIONS FOR RELIGIOUS HOLIDAYS**
- **SCHEDULING OF ASSIGNMENTS, TESTS, AND EXAMINATIONS**

- **STUDENT FORMS**
- **OFFICE OF THE REGISTRAR**
- **RETENTION OF ELECTRONIC VERSION OF COURSE OUTLINES (SYLLABI)**
- **ACADEMIC APPEALS**
- **STUDENT ABSENCE PORTAL**

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Add Deadlines:

First term half course (i.e. "A" or "F")	September 13, 2024
Full courses and full-year half course (i.e. "E", "Y" or no suffix)	September 13, 2024
Second term half course (i.e. "B" or "G")	January 14, 2025

***Drop Deadlines*:**

First term half course without penalty (i.e. "A" or "F")	November 12, 2024
Full courses and full-year half courses without penalty (i.e. "E","Y" or no suffix)	December 2, 2024
Second term half or second term full course without penalty (i.e. "B" or "G")	March 7, 2025

Contact Information:

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