Physics 3000: Physics of Device Materials  
Fall 2016

Monday, Wednesday, Friday. Slot 9. 4:00 pm – 4:50 pm. Room EN-1054.

PR: Physics 1051

Course description on department web page:  
http://www.mun.ca/physics/undergraduates/syllabus/p3000.php

Instructor: Prof. Mykhaylo Evstigneev. Rm C3025. Phone 864-2474. Email mevstigneev@mun.ca.

Office Hours: The instructor is available at most times outside of class except for Thursdays. Students are encouraged to contact the instructor to confirm availability for a meeting.

Course web page: See D2L

Text

Recommended supplementary texts:  
Semiconductor Devices Physics and Technology by S.M. Sze.

Evaluation
Loncapa assignments 10%  
Written assignments 5%  
Mid-term exam 1 20%  
Mid-term exam 2 20%  
Final Exam 45%  
No supplementary exam

Assignments (approximately 6)  
Due approximately every two weeks, starting near the end of September. Assignments are to be turned in during class on the due date.

Mid-term tests: Early October and mid-November.

Missed work: Students who cannot complete assignments or mid-term tests need to consult the University Calendar, Section 6.7.5 Exemptions from Parts of the Evaluation, and speak to the instructor.

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Important general information from the University
Student Code of Conduct: http://www.mun.ca/student/conduct/  
Final Examinations: http://www.mun.ca/regoff/calendar/sectionNo=REGS-0628  
Academic Misconduct: http://www.mun.ca/regoff/calendar/sectionNo=REGS-0748  
Accommodations for Students with Disabilities: http://www.mun.ca/blundon/accommodations/
**Tentative Outline**

<table>
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<tr>
<th>Topic</th>
<th>Chapters</th>
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| Crystal structure of solids:  
  *Semiconductor materials, types of solids.*  
  Space lattices, atomic bonding.  
  Imperfections and impurities in solids, growth of semiconductor materials, device fabrication techniques. | 1.1-1.7  | 3                  |
| Electrons in solids:  
  *Principles of quantum mechanics, energy quantization and probability concepts.*  
  *Energy band theory.*  
  *Density of states function, statistical mechanics, Fermi-Dirac distribution, Fermi energy, Maxwell-Boltzmann approximation.* | 2.1-2.5  | 3                  |
| Semiconductors in equilibrium:  
  *Charge carriers in Semiconductors.*  
  Dopant atoms and energy levels, carrier distribution in extrinsic semiconductors.  
  Statistics of donors and acceptors.  
  Carrier concentrations: effects of doping.  
  Position of the Fermi level: effects of doping and temperature. | 3.1-3.6  | 5                  |
| Carrier transport and excess carrier phenomena:  
  *Carrier drift.*  
  *Carrier diffusion, graded impurity distribution.*  
  *Carrier generation and recombination, Hall effect.* | 4.1-4.5  | 3                  |
| The pn junction and metal-semiconductor contact:  
  *Basic structure of a pn junction.*  
  *pn junction under zero applied bias.*  
  *pn junction under reverse applied bias.*  
  *Metal-semiconductor contact: rectifying junction, forward bias.*  
  *Metal semiconductor ohmic contacts.* | 5.1-5.6  | 5                  |
| Metal-oxide-semiconductor field effect transistor:  
  *The MOS field-effect transistor action.*  
  *The two terminal MOS capacitor.*  
  *Potential differences in a MOS capacitor.*  
  *Capacitance-voltage characteristics.*  
  *The basic MOSFET operation; MOSFET scaling, non-ideal effects.* | 6.1-6.5, 7.1-7.2 | 6                  |
| Other devices:  
  *The pn and Schottky barrier junctions.*  
  *The bipolar transistor.*  
  *Microelectromechanical systems.*  
  *Optical absorption.*  
  *Solar cells.*  
  *Photodetectors.*  
  *Light-emitting diodes.*  
  *Laser diodes.* | 9.1, 10.1, 11.5, 12.1-12.5 | 8                  |