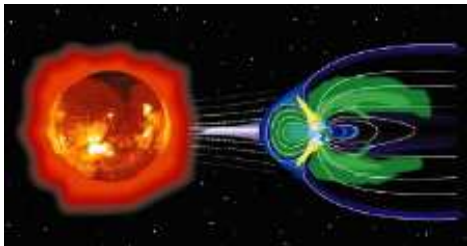


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# Materials and Thermal Analysis for Space Applications

York University  
Space Engineering  
ENG 3330

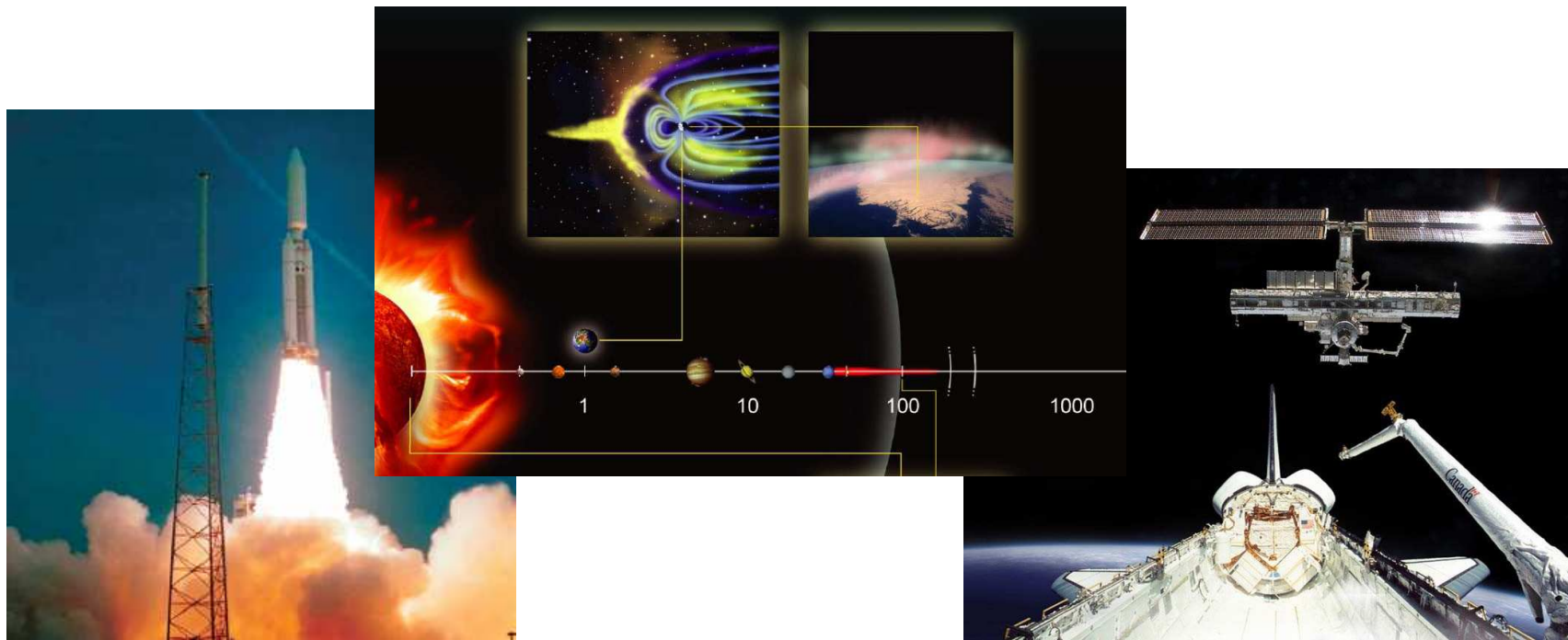


H. Chesser  
(CSEB 1012U)

# COURSE OBJECTIVE

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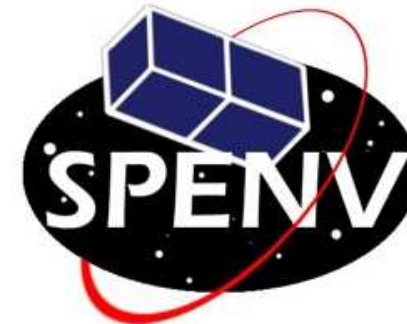
- Builds on materials concepts from ENG 2000
- Adds the requirements/constraints of the Launch and Space Environments
- Materials focus – no solar pressure, drag, etc



# COURSE FORMAT, CONTENT

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- Three hour lecture each week
- Assignments are intended to reinforce concepts and get you to practice skills
- Project work – more open-ended in nature, gets you to apply your knowledge and skill
  - Projects assigned based on SSETI Swarm project
  - Class will be part of the SPENV (Space environment effects) team
- Final exam to check retention of material



<http://www.sseti.net/>

# NX5 WORKSHOPS

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- Some of the assignment and project work will involve you running structural and thermal analyses
- This year we have switched to NX5 software for pre and post processing both FEM (structural) and FD (thermal) models
- There will be a set of 4 workshops to give you some hands-on experience with NX5
- Software is accessible in Eng Labs, CSEB and on personal machines via VPN (see course web site for instructions on VPN access)

# COURSE SCHEDULE & OUTLINE

Week	Date	Topic	Assignment
1	04-Mar	<b>Introduction</b> Materials, Spacecraft Subsystems, Solid Mechanics Review	Assignment 1 Due 18-Mar
2	11-Mar	<b>The Launch Event &amp; Effects</b> Launch Vehicles Intro, Loads, Vibration, Material – Young’s Modulus, Strength, Toughness, Material Failure Criterion, Composite Materials	
		<b>NX Workshop 1</b>	
3	18-Mar	<b>NX Workshop 2</b>	
		<b>Thermal Environment &amp; Effects</b> Solar UV Radiation, Orbital thermal environment, Specific Heat, Conductivity, Thermo-optical properties, Temperature Cycling and Heat Exchange, UV Degradation	
4	25-Mar	<b>NX Workshop 3</b>	Assignment 2 Due 01-Apr
		<b>Quiz 1</b>	
5	01-Apr	<b>NX Workshop 4</b>	
			Project A Due 15-Apr
6	08-Apr		

# COURSE OUTLINE (Cont'd)

Week	Date	Topic	Assignment
7	15-Apr	<b>Vacuum Environment &amp; Effects</b> Outgassing, Contamination, Mechanisms, Vacuum Tribology	Assignment 3 Due 22-Apr
8	22-Apr	<b>Neutral Environment &amp; Effects</b> Near Earth atmosphere, Aerodynamic Drag, Sputtering, Atomic Oxygen Attack, Spacecraft Glow, Micrometeoroids	
9	29-Apr	<b>Magnetic/ Plasma Environment &amp; Effects</b> Solar, Geo-Magnetic Fields, Basic Plasma Physics, Debye Shielding, Plasma Oscillations, Single Particle Motion  <b>Quiz 2</b>	Assignment 4 Due 06-May
10	06-May	<b>Radiation Environment and Effects</b> Space radiation environment, radiation sources and models, damage mechanisms, shielding, analysis tools and methods, design guidelines, hardness assurance and mitigation techniques	
11	13-May	<b>Review/Tour</b>	Project B Due: 13-May

# COURSE DETAILS

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<b>Course Work</b>	<b>Weighting</b>
Assignments, Projects	40%
Quizzes (2)	20%
Exam	40%

Assignment due dates given – submission via Moodle web site preferred

# References

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- **Required:**

- Pisacane, V, “The Space Environment and Its Effect on Space Systems”, AIAA, 2008, ISBN 978156347926. Also on 2 hour reserve in the Steacie library TL 1489 P57 2008.
- Callister, “Materials Science and Engineering: An Introduction”, sixth edition, TA 403 C23 2003 (ENG 2000 textbook)

- **Reading List:**

- "The Space Environment: Implications for Spacecraft Design", Revised and Expanded Edition, Tribble, Alan C., Princeton University Press, ISBN 0-691-10299-6, TL 1489 T75 2003, 2 hour reserve in Steacie
- "Materials Selection in Mechanical Design", 3rd edition, Ashby, Michael, F., Elsevier, ISBN 0-7506-6168-2, TA 403.6 A74 2005, 2 hour reserve in Steacie
- “Satellite Thermal Control Handbook”, Gilmore, D.G., editor, Aerospace Corp., TL 900 S595 2002 VOL. 1, also available from library as an e-book
- “Spacecraft Structures and Mechanisms From Concept to Launch”, Sarafin, T.P. editor, Microcosm/Kluwer, 1997
- “Spacecraft Structures”, Wijker, J., Springer, ISBN 978-3-540-75552-4, TL 875 W55 2008

- **Web resources** – register (free) with both these:

- Space Environment Information System (SPENVIS)  
<http://www.spennis.oma.be/spennis/>
- Matweb site - <http://www.matweb.com/>

