IAT 336 – Materials and Design
2008/2009 Academic Year
SYLLABUS

Start Date:	September 2, 2008			**End Date:**	December 10/2008		
Total Hours:	231	**Total Weeks:**	13	**Term/Level:**	3	**Units:**	3
Prerequisites: IAT 233- Spatial Design							
Course No. **IAT 336**	**Course Name** **Materials in Design**			**Office Hours:**	**Ken Zupan: Room 14-575** **Tuesdays 10:30-12:30 (by appt.)** **Telephone: 778-782-8179**		
Instructor: **T/A**	**Ken Zupan** **Jinsil Seo** **Nathan Cheng**			**Contact:**	kfz@sfu.ca **jinsils@sfu.ca** **nathancheng@hotmail.lcom**		

Schedule:
Lecture: Mondays 9:30-10:30 AM, Room 3090
Labs: D101 Mondays 10:20-12:20, Room 3350
D102 Tuesdays 8:30-10:20 Room 3350
D103 Tuesdays 13:30-15:20 Room 3350

Course Description:
The aim of this 13-week course is to develop a methodology for selecting materials and processes that is design-oriented. This course provides students with an understanding of materials choices in designing interactive objects and environments. The range of available materials and manufacturing processes is vast, but all choices must respond to the requirements posed by the particular artifact being designed. The course thus aims first at understanding the criteria that affect material choices in design such as:

(1) Physical properties of materials
(2) The design process
(3) Human factors/interaction
(4) Social aspect of Materials (connotation)
(5) Natural Forces that act on materials
(6) Manipulation and the affordances of materials
(7) Manufacturing/Fabrication Methods
(8) Environmental factors
(9) New advances/trends in material science.

Course Objectives/Goals:
In this course, students will:

- Understand the physical properties of various types of materials used in product design. E.g. polymers, metals, ceramics etc.
- Research, specify and justify material choices within that class
- Gain an understanding of the design process and its relation to material selection

- Understand the relevance of human factors when designing with materials e.g. weight, texture, scale of object
- Study the social connotations and perceptions connected with various materials. e.g. steel=durability, longevity
- Research the natural, physical forces that act on materials e.g. torsion, compression and other strains.
- Gain basic knowledge of manufacturing processes to enhance their designs
- Study the breadth of issues affecting material choices in design including the social responsibility of the designer.
- Understand how material choices affect the performance of designs (affordances)

Course Outcomes:
After completing this course, students will be able to:

- Gain an understanding of the relationship between the design process and material selection
- Understand the social responsibility of a designer when selecting and working with materials
- Understand how the choice of materials affects the performance of designs (affordances)
- Distinguish the physical properties and forces that act upon different materials
- Apply the prescribed manufacturing processes for different materials.
- Understand the social and cultural perceptions ascribed to different materials.

Course Plan/Topics*:
*(Due to scheduling conflicts e.g. stat holidays, guest speaker conflicts, instructor may alter course plan slightly over duration of course. Students will be notified beforehand)

1. Introduction:

(a.) Designers lack knowledge of materials science.
(i) Engineers vs. Designers (deductive vs. inductive reasoning)

(b.) What is form?
(i) The relationship of form, function and behaviour in materials
(ii)Form after function- the evolution of product design

(c.) The Design Process
(i) Description of the design process
(ii) Where does material selection fit in the design process?
(iii) Conceptualizing and evaluation skills.

2. Criteria for Material Selection:

(a.) Idioms: Each material is unique and has its own characteristics.

(b.) Four Step Material Selection Technique for designers: Analysis, Synthesis, Similarity, Inspiration.

3. Individual Criteria

(a.) Interaction:
(i) What do we mean by interaction (utility)?
(ii)The role of interaction/functionality in product design
(iii)Interaction qualities: embodiment, tactility/feel, size/scale, weight.

(b.) Materials and Meaning (Connotation)

(i) Aesthetic- the emotional connection to material and form
  (1.) Emotional feedback
  (2.) Exploring historical political and social connotations to materials
  (3.) Cost/value perceptions
  (4.) Craft vs. Mass-production/perceptions of quality
  (5.) Disposability and product attachment

(c.) Forces that Act on Materials (Material Limits)

(i.) Gravitational Forces

(ii.) Natural Elements (atmospheric)
  (1.) Light
  (2.) Wind
  (3.) Water (liquid, solid)
  (4.) Light (ultra-violet)
  (5.) Temperature

(iii.) Stresses and Strains:
  (1.) Tension
  (2.) Compression
  (3.) Bending
  (4.) Torsion

(iv.) Chemical Corrosion:
  (1.) Liquid corrosion acting on various materials (e.g. rust, solvents)

(d.) Engineering

(1.) Design materials and their Properties
  (i.) Metals
  (ii) Ceramics
  (iii) Glasses
  (iv) Polymers

(2.) Three Physical States of Material
  (i) Gas
  (ii) Liquid
  (iii) Solid

(3.) Structures
  (i) Grain structures of materials

(4.) Mechanical Properties of materials (Alterable)
  (i) Hardness
  (ii) Brittleness
  (iii) Ductility
  (iv) Elasticity
  (v) Elongation
  (vi) Plastic

(5.) Physical Properties (not easily altered)
  (i) Opacity/Transparency
  (ii) Colour/Pigment

(iii) Density
(iv) Electrical Conductivity
(v) Thermal Conductivity (heat)
(vi) Thermal Expansion
(vii) Magnetism
(viii) Melting Point
(ix) Corrosion Resistance

(6.) Manufacturing Methods
(i) Metals: Forging, casting
(ii) Plastics: Injection molding, vacuum forming, rotational molding
(iii) Wood: Bending techniques, finishing

(7.) Fabrication Methods
(i) Joining
(ii) Shaping
(iii) Trimming

(E.) Trends (New Materials)

(1.) Materials in Research e.g. Nanotechology
(2.) Early commercialization of new materials
(3.) Materials in combination
(4.) Materials found in unexpected places- unique designs

(F.) Affordances/Creativity with materials

(1.) Evolution of form through use
(2.) How do you get certain shapes?
(3.) Haptics: How do you create various textures/feels?
(4.) How do you increase the strength of materials?
e.g. structure
(5.) The aesthetics of joints- how to use material fabrication
to enhance designs.
(6.) How do you repair the material?

Delivery Method:
Lectures and tutorials

Grading:

- 20% quizzes (in-class)
- 20% exams (one mid-term, one final)
- 30% Assignments (in-class and take home)
- 30% Final Project (TBA)

Texts, Resources & Materials

Required: The Art and Science of Material Selection in Product Design by Michael Ashby, Kara Johnson, Butterworth, Heinnemann.

Reference: Physical Computing, Dan O'Sullivan and Tom Igoe, Heinneman

Recommended Materials*:

One x-acto knife with #11 blades or knife with retractable blades
One rubber cutting board (letter size or larger)
Metal ruler (12" or longer)
One newsprint or white bond pad of paper (11 X 17")
Two regular pencils
Two soft-lead pencils (2B and 4B)
One fine tip black felt marker
One white eraser (e.g. Faber-Castell or Staedtler)
Spraymount (3M) to be used in vented areas only!)
CDs or DVDs for archiving your work.

*(These are the minimum materials needed for your class. Some of the projects will require specialized materials but we will notify you in advance.)

SIAT Academic Honesty Statement:

Academic dishonesty is a serious academic offence that will result in a severe academic penalty.The SFU policy on academic honesty is stated in the Code of Academic Honesty (T 10.02). This is available at http://www.sfu.ca/policies/teaching/t10-02.htm

All students are responsible for familiarizing themselves with these policies. Ignorance of these standards will not preclude the imposition of penalties.

Plagiarism is the most common form of academic dishonesty arising in the context of students fulfilling their academic responsibilities.
It involves using another author's words without proper attribution. Plagiarism includes self-plagiarism, which involves submitting substantively the same work for academic evaluation more than once.

The following acts will be treated as instances of plagiarism:

- Submitting, in fulfillment of course requirements, a paper or other work, or part thereof, that has been written, produced or researched by another person.
- Submitting, in fulfillment of course requirements, a paper, other work or part thereof, that has previously been submitted for the same or for a different course, even where the work is authored by the student concerned.
- Quoting or paraphrasing material in a paper or other work, submitted in fulfillment of course requirements, that has been authored or produced by another, without acknowledging the reference by proper citation.
- Representing in any way, another's ideas or expressions as one's own in a paper or other work submitted in fulfillment of course requirements.

Other forms of academic dishonesty include:

- Cheating on an examination.
- Falsifying material subject to academic evaluation.
- The use of any unapproved aids or the unapproved sharing of material during an examination.
- The unauthorized possession or use of an examination or assignment.
- Using or attempting to use other students' answers.
- Providing answers to other students.
- Failing to take reasonable measures to protect answers from use by other students in assignments, projects or examinations.
- Submitting identical or virtually identical assignments by students who studied together.
- Impersonating a candidate in an examination or availing oneself of the results of such impersonation.
- Submitting false information, records, laboratory results, documents, transcripts or other academic credentials

- Stealing or destroying the work of another student.
- Inappropriately depriving others of the opportunity to have access to the academic resources of the library.
- The inappropriate use of technology in course work, assignments or examinations.

The above list is not meant to be exhaustive. It was compiled with reference to SFU policy T10.02 and various SFU departmental policy statements with particular reference to the policy interpretation of the Department of Political Science which is available at http://www.sfu.ca/polysci/undergrad/ug_plag_pol.html.

University procedures and penalties for acts of academic dishonesty are detailed in the policy T 10.03 at http://www.sfu.ca/policies/teaching/t10-03.htm.

This statement aims to facilitate the understanding and implementation of SFU Policy and Procedures as stated in T 10.02 and T 10.03, which will always prevail in the event that a contradiction arises.

Lesson Plans

Week of/ Number	Learning Topics/Material Covered	Reference/ Reading	Lab/Assignment	DUE DATE
1	(1) **Introduction and Orientation** - Overview of Course - Designers lack knowledge of Materials Sciences -Deductive vs. Inductive Reasoning. -What is form? The relationship between form and materials -Form after function: the evolution of product design	TBA	**Lecture:** -Lab rules -Drawing Tutorial **Observation Exercise:** Observe structures and consumer products. Prepare a commentary with sketches detailing: (individual exercise) (1) The material that has been used (2) The forms it has allowed. (3) The perceptions its use has allowed.	TBA
2	(1) **The Design Process** -Description of the design process -Where does the material selection fit in the design process? -Conceptual & evaluation skills (2) **Criteria for Material Selection:** -Idioms: Each material is unique and has its own -Four Step Materials Selection Process	TBA	**Product Dissection** Exercise (In-Class)	TBA

Week of/ Number	Learning Topics/Material Covered	Reference/ Reading	Assignment	Due Date
3	**Interaction & Human Factors theory** (1) Interaction: What do we mean by interaction. The way users manipulate objects. Intro to tangible action theory (2) Introduction to human-factors theory. Human dimensions including anthropometric theory 7 application, joint motion measurements, children weight and structural body dimensions. (3) The role of interaction/functionality in product design. (4) Interaction qualities: embodiment, tactile feel, scale, weight	TBA	**Human Factors Evaluation:** Bodystorming Demo (lighting product)	TBA
4.	**Materials and Meaning** (1) Emotional feedback - individual - social - cultural/historical (3) Cost/value perceptions (4) Craft vs. Mass-production/ perception of quality (5) Disposability/sustainability (6) Substitution of materials	TBA	**Lab: Materials Association Exercise** Take Home Assignment: Consumer Product using Mood Board	TBA

Week of/ Number	Learning Topics/Material Covered	Reference/ Reading	Lab/ Assignment	Due Date
5.	**Stresses and Strains:** **1. What are stresses and strains?** (a) Tension (b) Compression (c.) Shearing (d) Torsion (Torque)	TBA	**Tinkering Tutorial:** **Tinkering Exercise:** Using low –fidelity materials e.g. foam, card, rubber bands, model the four stresses and strains in abstract form.	TBA
6.	**Engineering Properties** **(1) Major Classes of Design Materials.** (a.) Metals (b.) Ceramics (c.) Glass (d.) Polymers (e.) Organics (e.g. wood) (f.) Fabrics **(2) The Three Physical States** (a.) Gas (b.) Liquid (c.) Solid **Mid-Term Quiz**	TBA	**Electronic Prototyping/** LED and Styrene Bending Exercise	TBA
7.	**(1) Physical Properties (not alterable)** (a.) Opacity/Transparency (b.) Colour/Pigment (c.) Density (d.) Electrical Conductivity (e.) Thermal Conductivity (f.) Magnetism (g.) Melting Point (h.) Corrosion Resistance	TBA	**Casting Tutorial and Exercise (In-Class)** In this exercise, students will create a casting of a figure using cold casting and wax sculpting. **Create Teams: Final Project Assignment TBA**	TBA

Week of/ Number	Learning Topics/Material Covered	Reference/ Reading	Assignment	Due Date
8.	**Manufacturing Methods**: (1.) Metals: Forging, casting, stamping etc. (2.) Plastics: Injection molding, vacuum forming, rotational molding. (3.) Wood: Bending techniques, finishing techniques	TBA	**Solidworks Tutorial** **Evolution of Materials & Design.** Create a poster of a product showing the evolution of a product TBA using the following material criteria: material, connotation, function, fabrication from different time periods.	TBA
9.	**1. Fabrication Methods:** (a.) Joining (b.) Shaping (c.) Trimming **2. Surface Treatment of Mtls.** (a.) Sandblasting (b.) Anodizing (Aluminum)	TBA	**Solidworks Tutorial**	TBA
10.	**1. New Trends in Design Materials:** (a.) Materials in Research e.g. nano-technology (b.) Early commercialization of new materials (c.) Design material inspiration found in unexpected places	TBA	**SolidWorks Tutorial** POSTER CRITIQUE	TBA
11.	**Natural Forces that Act on Materials (Materials Limits)** **(1) Gravitational Forces** **(2) Natural Elements** (a.) Light (b.) Wind (c.) Water (solid/liquid) (d.) Light (Ultra-Violet) (e.) Temperature **(3) Chemical Corrosion** (a) Rust, solvents **(4) Wear**	TBA	**SolidWorks** Work on FINAL Project	TBA

Week of/ Number	Learning Topics/Material Covered	Reference/ Reading	Assignment	Due Date
12.	**Affordances/Creativity** 1. Evolution of form through use 2. How do you get certain shapes? 3. How do you create various textures/feels? 4. How do you increase the strength of materials? 5. The aesthetics of joints-how to use material fabrication to enhance designs. 6. How do you repair the material?	TBA	**Electronic Prototyping Tutorial/ Open Lab to work on Final Projects**	TBA
13.	**Review: Final Quiz**	TBA	**Open Lab: Students will work on final projects.**	TBA
14.	**Final Exam: Presentations of Projects**	TBA		TBA

\