Course description in terms of learning outcomes: This course covers the fabrication, design, function, and applications of nanosensors. We will read seminal articles on nanosensors and nanotechnology, discuss their implications, and current applications. Students will be familiar with foundational ideas and a representative set of foundational and modern experiments in nanoscience by the end of the course.

Instructor: David Thompson, 936 294 3270, david.thompson@shsu.edu
Tentative Office Hours MTW: 11-12, T: 3-4
Feel free to email or phone or with questions or to schedule alternate meeting times.

Lecture Location: Chemistry and Forensic Science (CFS) 102

Required Calculator: TI 84 or similar scientific graphing calculator

Text: Selected Articles and Monographs

Blackboard Login Page: https://blackboard.shsu.edu/webapps/login/

Grading: Your grade will be based upon your performance on:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Preparation for and participation in lecture discussions</td>
<td>100</td>
</tr>
<tr>
<td>Presentation</td>
<td>300</td>
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<tr>
<td>Planning Paper</td>
<td>300</td>
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<tr>
<td>Exams</td>
<td>300</td>
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<tr>
<td>Total</td>
<td>1000</td>
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Lecture Preparation and Participation (100 pts): Each lecture is worth 2.5 pts: 1 point for participating with at least one salient content related comment or question per lecture, 1.5 points for demonstrating familiarity with the assigned reading for that day.

Presentation: (300 points)
Content Goals: Present a summary of the results of 4 articles related to nanosensing. Three must be research papers published in the last 4 years. The remaining article can be older research paper, or a chapters from a book. All 4 articles should share a focus. They should (a) be the work of one research group, or (b) all share one author spanning graduate school, post doc and first career position, or (c) be linked via citations, or (d) should share a specific topic. Each presenter must present four unique articles with a unique focus. (Focus and articles cannot be shared between presentations.)

In the talk you should

1. Discuss at least one historical experiment (preferably more than 20 years old) that helped to lay the foundation for the science discussed in your talk.
2. Prepare an exceptionally clear and deep exposition of one scientific concept or instrument or experiment (not your own) that you were not familiar with at the beginning of this seminar. The goal is to ensure that fellow students are able to leave your talk having deepened their scientific knowledge in at least one significant way. This concept or experiment must be approved by the instructor as being sufficiently significant and sophisticated and novel to be worthy of exposition. Additionally, the explanation that is crafted must be approved for accuracy and clarity prior to the talk. The speakers should be prepared to answer challenging questions on this topic.
4. Each paper should contribute at least one figure to your talk. This should be accompanied by a clear explanation of the figure and its relevance.
5. Prepare at least one slide showing an equation. Relate it clearly to the material you are presenting. The equation should not simply be presented. It must have sufficient explanation to clearly teach the audience how it applies and why it is useful.
6. Prepare at least one slide showing chemical formula’s and reactions.
7. Describe a specific experiment that you would like to see carried out to extend either your own work or the work reported in one of the papers you discuss in your talk.

8. Acknowledge your sources on the slides relevant to them. Acknowledge general help on an acknowledgement slide.

Talk Delivery Goals:
The delivery should include:
1. At least 30 and no more than 55 minutes of material.
2. Good eye contact with the audience. Over the course of the talk you should try to make eye contact with every member of the audience.
3. Loud and clear diction. Someone sitting in the back of the room should be able to clearly hear what you are saying.
4. At least one teaching aid: e.g. a demonstration, a physical object that is shown to the audience, an audience activity…
5. An introduction, conclusion and one other section in the middle of the talk (each lasting at least 3 minutes) in which the speaker speaks directly to the audience without any aids. In at least one of these the speaker should move out from behind the podium or desk as they speak directly to the audience. This helps to draw the audience to the speaker, so that they identify the speaker with the talk. (Especially for young scientists it is important that people notice you and remember who you are. Speaking without aids focuses the audiences attention on you. It also gives you very good practice speaking coherently and confidently.)

Planning Essay (300points):
The planning essay is a 4000 word essay that will form the foundation of the presentation outlined above. (Note: 4000 words = 100 words per minute x 40 minutes.) The second goal of the planning essay is to serve as an example of how one might begin to write a review paper. (The paper cannot be read verbatim in the talk. However by the time you get to the talk, the writing will have made you so familiar with the material that this should not be a problem.) The paper should be formatted according to the rules required by the journal Analytical Chemistry.

http://pubs.acs.org/page/ancham/submission/index.html

At the end of every two weeks at the beginning of the term you should will submit a 2000 word summary of each paper, and 10 powerpoint slides based on that paper. In the weeks after that you should strive to edit and rewrite this document to distill out an effective communication of the work you have studied. The final planning essay will be due one week before your presentations.

Planning paper and presentation due dates:
Jan 25: Select topic. Find and read a review article and/or a chapter in a text related to your topic. The goals of this reading should be (1) general learning and (2) identification of two literature articles, a historical experiment, a scientific concept and an equation that you can role into your talk. Craft a 1000 word essay (20 pts) and 10 accompanying slide(s) and story line (20 pts) for this paper.
Feb 8: Select and read article 2. Craft a 1000 word essay (20 points) and 10 accompanying slide(s) (20 pts) for article 2. Peer Review essay & slides of a class mate (10pts).
Feb 22: Select and read article 3. Craft a 1000 word essay (20 pts) and 10 accompanying slide(s) (20 pts) for article 3. Peer Review essay & slides of a class mate (10pts).
Mar 8: Select and read article 4. Craft a 1000 word essay (15 pts) and 10 accompanying slide(s) (15 pts) for article 4. Peer Review essay & slides of a class mate (10pts).
Mar 22: Peer Review essay & slides of a class mate (10pts).
Apr 5: Rough draft of talk (60 pts) and paper (60 pts) due.
Apr 25 (Sunday): Final draft of paper (160 pts) due.
Apr 26-30 Final presentations (160 pts): presentation times will be assigned by drawing of lots.

Midterm Exams (300points): There will be two midterm exams, each worth 150 points and each focusing on a specific set of foundational ideas related to nanoscience.

Potential Revisions of the Course Requirements:
Course requirements are negotiable within the first 3 weeks of the course. If you would like to see them revised please contact me with specific well reasoned proposals within this time period.
Accommodation: Any student with a disability that affects his/her academic functioning should contact the Services for Students with Disabilities (SSD) at the SHSU Counseling Center (Lee Drain North Annex, telephone 936-294-1720, TDD 936-294-3786) to apply for accommodations. In the event that accommodations are approved by SSD, the student is advised to schedule an appointment with the course instructor in order to present his/her accommodation forms and discuss the arrangements for the accommodations.

Collaboration: In general I encourage you to work with others. Collaboration will enable you to get much more out of the class than if you work alone.

The following Sam Houston State University Policies are designed to strengthen community and learning and are fully applicable in this Nanosensors course (Chemistry 585)

ACADEMIC DISHONESTY:
All students are expected to engage in all academic pursuits in a manner that is above reproach. Students are expected to maintain honesty and integrity in the academic experiences both in and out of the classroom. Any student found guilty of dishonesty in any phase of academic work will be subject to disciplinary action. The University and its official representatives may initiate disciplinary proceedings against a student accused of any form of academic dishonesty including but not limited to, cheating on an examination or other academic work which is to be submitted, plagiarism, collusion and the abuse of resource materials. For a complete listing of the university policy, see: http://www.shsu.edu/administrative/faculty/sectionb.html#dishonesty

STUDENT ABSENCES ON RELIGIOUS HOLY DAYS POLICY:
Section 51.911(b) of the Texas Education Code requires that an institution of higher education excuse a student from attending classes or other required activities, including examinations, for the observance of a religious holy day, including travel for that purpose. Section 51.911 (a) (2) defines a religious holy day as: “a holy day observed by a religion whose places of worship are exempt from property taxation under Section 11.20….” A student whose absence is excused under this subsection may not be penalized for that absence and shall be allowed to take an examination or complete an assignment from which the student is excused within a reasonable time after the absence.

University policy 861001 provides the procedures to be followed by the student and instructor. A student desiring to absent himself/herself from a scheduled class in order to observe (a) religious holy day(s) shall present to each instructor involved a written statement concerning the religious holy day(s). The instructor will complete a form notifying the student of a reasonable timeframe in which the missed assignments and/or examinations are to be completed. For a complete listing of the university policy, see: http://www.shsu.edu/~vaf_www/aps/documents/861001.pdf

STUDENTS WITH DISABILITIES POLICY:
It is the policy of Sam Houston State University that individuals otherwise qualified shall not be excluded, solely by reason of their disability, from participation in any academic program of the university. Further, they shall not be denied the benefits of these programs nor shall they be subjected to discrimination. Students with disabilities that might affect their academic performance are expected to visit with the Office of Services for Students with Disabilities located in the Counseling Center. They should then make arrangements with their individual instructors so that appropriate strategies can be considered and helpful procedures can be developed to ensure that participation and achievement opportunities are not impaired.

SHSU adheres to all applicable federal, state, and local laws, regulations, and guidelines with respect to providing reasonable accommodations for students with disabilities. If you have a disability that may affect adversely your work in this class, then I encourage you to register with the SHSU Counseling Center and to talk with me about how I can best help you. All disclosures of disabilities will be kept strictly confidential. NOTE: No accommodation can be made until you register with the Counseling Center. For a complete listing of the university policy, see: http://www.shsu.edu/~vaf_www/aps/811006.pdf

VISITORS IN THE CLASSROOM:
Only registered students may attend class. Exceptions can be made on a case-by-case basis by the professor. In all cases, visitors must not present a disruption to the class by their attendance. Students wishing to audit a class must apply to do so through the Registrar's Office.
Tentative Class Schedule for CH585 (Spring 2010)

**Introduction**

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
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<tbody>
<tr>
<td>W Jan 13</td>
<td>L1</td>
<td>Introduction to the course and nanosensors</td>
</tr>
<tr>
<td>F Jan 15</td>
<td>L2</td>
<td>The observations of Faraday</td>
</tr>
<tr>
<td>M Jan 18</td>
<td></td>
<td>Martin Luther King Holiday</td>
</tr>
<tr>
<td>W Jan 20</td>
<td>L3</td>
<td>Raman Spectroscopy &amp; Surface Enhanced Raman Sensing</td>
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**Unit I: 2-Dimensional Ensemble Nanosensors, illustrated by a 2-D surface enhanced Raman sensor**

Nanoparticle formation & organization

1. **Synthesis** – A bottom up approach
   a. Nanosphere Synthesis
      - F Jan 22: L4 – Stober, microemulsion, Ostwald ripening
      - M Jan 25*: L5 – Electrical - Zeta potential Measurement, steric hindrance, aggregation kinetics, Particle stability,
      - W Jan 27: L6 - Thermodynamic Considerations including Solvation ideas
   b. Nanoparticle Separation
      - F Jan 22: L7 – Rate Zonal Centrifugation
      - M Feb 1: L8 – Chromatography & electrophoresis

2. **Lithography** – A top down approach
   a. Metal Vapor Deposition
      - W Feb 3: L9 - Vacuum Pumps, Piezoelectric Pressure & mass transducers
   b. Lithography
      - F Feb 5: L10 Nanosphere Lithography and Evaporation-induced-self-assembly
   c. Influence of the substrate on order in 2-D crystals
      - M Feb 8*: L11 UV Lithography
      - W Feb 10: L12 Nanoimprint Lithography
      - F Feb 12: L13 Scratch, Dig Characterization and implications for device construction.

Nanoparticle Functionalization

1. How much surface area is there to cover?
   - M Feb 15: L14 Langmuir
   - W Feb 17: L15 Brunauer, Emmett and Teller
   - F Feb 19: L16 Cryogenic Sorptometry

2. L17 Self assembled monolayers
   - M Feb 22*: L18 Layer-by-Layer Gas Phase Deposition / antibody coupling

3. L19 Surface Enhanced Raman Spectroscopy
   - F Feb 26: L21 Exam (Langmuir, Brunauer Emmett and Teller)

**Other examples of 2-D ensemble nanosensors:**

- M Mar 1: (I will be away at the Pittcon Conference on this day)
  - L21 Exam (Langmuir, Brunauer Emmett and Teller)
- W Mar 3: (I will be away at the Pittcon Conference on this day)
  - L22 Presentation and Paper Peer Review Workday

F Mar 5: L23 LSPR
Unit II: Single Particle tracking and Sensing

**M Mar 8** (I will be away at the SOT Conference on this day)
- L24 Presentation and Paper Peer Review Workday

**W Mar 10**
- L25 Alivisatos

**F Mar 12**
- L26 Mirkin + DNA aggregates/ Nitrate sensor

**Mar 15-19** Spring Break – No Class

**M Mar 22**
- L27 Background for Brownian Motion I

**W Mar 24**
- L28 Einstein + Brownian Motion

**F Mar 26**
- L29 Perrin + Brownian Motion II

**M Mar 29**
- L30 Van Blaaderen

**W Mar 31**
- L31 Xie + silver nanoparticle tracking

**F Apr 2**
- L32 Zhang

**M Apr 5**
- L33 Bustamonte Laser tweezers

**W Apr 7**
- L34 Cantillevers? MagMOONs McNaughton

**F Apr 9**
- L35 Exam (Brownian Movement, Einstein, Perrin, Stokes)

Unit III – Survey of other creative ideas and experiments related to nanosensing

**M Apr 12**
- L36 Nanoparticle toxicity and the ethics of nanodevice development

**W Apr 14**
- L37 Nanocavity based sensors

**F Apr 16**
- L38 Optical I - Near field optodes PEBBLEs Kopelman

**M Apr 19**

**W Apr 21**
- L40 Magnetic nanoparticles Hybrid sensors - TERS

**F Apr 23**
- L41 Feynman (Plenty of Room at the bottom), Drexel (Engines of creation) and Smalley (Response to Drexel in three letters)

**Su Apr 25**
- **final versions of planning papers are due**

**M Apr 26**
- L42 Oral Presentations

**W Apr 28**
- L43 Oral Presentations

**F Apr 30**
- L44 Oral Presentations

**M May 3**
- L45 Oral Presentations

**W May 5**
- L46 Oral Presentations

End of Semester

*Deadlines related to planning paper or oral presentations*