

# Texas State Technical College Waco

## Course Syllabus

*Course Rubric & Number:* NANO 2455 (2-8-4)

*CIP Code:* 15.0304

*Course Title:* Nano Technology Systems

*Course Description:* Capstone course requiring a special lab project, from the areas of data storage, millipede, micro-nano actuators, tribological issues, thin films, crystallography, manufacturing strategies, Micro-Electronic Mechanical Systems (MEMS) and Nano-Electronic Mechanical Systems (NEMS) measurements. Requires a formal written, oral and visual proposal presentation.

*Prerequisites:* NANO 2405, NANO 2407

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*Department Chair:* Tommy Harper

*Date:* \_\_\_\_\_

*Approved by CIP Committee:*

*Date:* \_\_\_\_\_

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### **WECM Learning Outcomes:**

1. Identify customer (Instructor) requirements, from learning activity list.
2. Present project proposals in a formal written, oral and visual proposal presentation.
3. Document project progress in weekly written, oral and visual presentation.
4. Administer real time lab notebook.
5. Compile research for project.
6. Coordinate information on Standards International Organization (ISO 9000) for project.
7. Form problems to be solved.
8. Use Statistical Process Control (SPC) and total quality fundamentals to guide project.
9. Organize successful project plan.
10. Produce a time line for project completion.
11. Design project.
12. Develop drawings of project.
13. Create parts list and parts delivery time line.
14. Identify process flow.
15. Follow lab policy and procedures.
16. Monitor lab environmental conditions.
17. Verify gauge repeatability and reproducibility, (GR&R) of parts and system.
18. Verify components.
19. Collect parts from inventory.
20. Review assembly drawings.
21. Test, clean, and assemble project.
22. Test prototype.
23. Apply SPC to collected data.
24. Produce project according to time line.
25. Characterize project performance.
26. Verify customer concerns.
27. Package project.
28. Characterize packaged project performance.
29. Produce and defend final report in a formal written, oral and visual presentation.
30. Demonstrate and practice nano safety skills, both written and practical, while performing work in the laboratory environment.
31. List and describe various nanotechnology detectors and devices.
32. Review of safety skills, both written and practical, for the laboratory environment.

### **Resources:**

#### Textbook

- *Encyclopedia of Materials Characterization Tools/Equipment*, Brundle, Evans Jr. Watson, Manning Publishing, 1992.

#### Tools & Materials Students Purchase

Quantity	Item Description
1	64MB Jump Drive
1	Scientific Calculator (TI-36X or equivalent)
1	Spiral Notebook Paper (Class Room use only)
1	Spiral Notebook Clean Room
1	15Cm Steel Scale Metric
2	Pen Clean Room

2	Pens Blue
1	Safety Glasses (Industrial grade, clear lenses side shields)
3	Latex/Nitral Gloves Box = 200

**TSTC Grading Policy:**

(Grades for all Major courses must be C or better)

Grade	Percent	Description	Grade Points
A	90-100	Excellent/Superior Performance Level	4
B	80-89	Above Required Performance Level	3
C	70-79	Minimum Required Performance Level	2
D	60-69	Below Required Performance Level	1
F	Below 60	Failure to meet Performance Requirements	0
IP	--	In Progress	
W	--	Withdrawal	0
CR	--	Credit	0
AUD	--	Audit of Course	0
See College Catalog for complete descriptions.			

**Department's Participation Policy:**

A student absent for more than 15% of the lecture periods or 15% of the lab periods, regardless of grades earned on assignments, will have to repeat the course.

**Course Schedule:**

As a projects-based course, the student will first present project proposal(s) for one or more of the Learning Activities listed below. Once the proposal has been approved, the student will produce and defend a final report on the selected Learning Activity. The proposal(s) and final report will be submitted in written format and presented orally using presentation software.	
Learning Activities	Student Objectives
1 Carbon Nanotube Materials, Dry Forms	Develop carbon nanotube processing and describe the difficulty getting the carbon nanotubes into solution. Characterize the process of functionalizing nanotubes.
2 Making Buckypaper	Characterize the process of making buckypaper.
3 Making a Simple Nano-Composite	Characterize the process of making a simple nano-composite material.
4 Making a Reinforced Carbon Nanotube / Epoxy Composite	Characterize the process of making a simple reinforced epoxy composite.
5 Measuring CNT / Epoxy Composite Electrical Properties	Characterize the process of measuring the electrical properties of various composite materials.
6 Measuring CNT / Epoxy Composite Mechanical Properties	Characterize mechanical properties of the nanocomposite materials.

**Lecture Periods:**

Lecture periods will provide students with a mechanism to consult with the instructor and other students on the various elements of the proposals and final report. Consultation with the instructor outside of scheduled lecture periods can be accommodated through appointments.

Student must inform the instructor of presentation requirements (computer, projector, etc.) one week before presentation date.

**Laboratory Periods:**

Laboratory periods will provide students with an opportunity to explore the specifics of their selected Learning Activity. On a weekly basis, students will schedule the necessary nano lab and equipment for their Learning Activity through the Lab Manager. Students will be responsible for maintaining a project database.

**Course Assessment:**

- Written Assessments
  1. Project Proposal
  2. At the beginning of each lab period, the student will submit a “state of the project” report. The report should be three typed paragraphs that states the material requirements to complete the project, completed proposal items and uncompleted proposal items.
  3. Final Project Report and Presentation
  4. Peer Review

**Grading Scheme:**

- Students must average a 70% for the proposal and final report/presentation to successfully pass the course. A final grade of “C” or above is required for course completion. The course must be retaken if a grade lower than a “C” has been earned.

<i>Activity</i>		<i>Total Points</i>
Proposal	100 (must pass with at least a 70)	100
14 State of the Project Reports	100 points per report	1400
15 Peer Reviews	100 points per review	1500
Final Report & Presentation	100 points (must pass with at least a 70)	100
<b><i>Total Possible Points for Course</i></b>		<b><i>3100</i></b>

A = 2790 min      B = 2480 min      C = 2170 min      D = 1860 min

**Course Policies:**

- **Safety Procedures:**

Required attire for labs: Shirt (no tank tops), full-length pants, rubber-sole shoes (no sandals or flops), and **safety glasses**. Remove all jewelry before entering labs.

Lab behaviors:

  - No eating, smoking or drinking in labs.
  - No horseplay at any time in this building.
  - You are responsible for your safety as well as the others in the lab. Use safety glasses.
  - Make sure you stand on a clean rubber mats when using any electronic device.
  - Pick up/remove anything unsafe.
  - Never probe voltages over 80V.

**I am a safety nut. Think first, move second. Don't break the safety rules.**

- *Lab Procedures:*

Bring your tool box and safety glasses to each lab. If you don't have them, you will not be permitted in the lab – you will go home and get them or be counted absent.

Leave your lab clean and orderly. A lab attitude grade will be given at the end of each lab. This grade will be based on how you work, what type of work you do, how safely you work, and how clean and orderly you leave the lab.

If you get equipment out, put it back in the correct place. If the equipment uses batteries, make sure to turn off the device.

**Turn off all gasses at the end of the lab!**

- *Late Work:* No late work will be accepted. All work, including labs, must be completed on time. If you have an excused absence (see Excused Absences below), then the work missed during the absence must be completed and submitted within one week of the return from the excused absence.
- *Excused Absences:* For Lectures – only the Lecture Instructor can give an excused absence for lectures. Only the Lab Instructor can give an excused absence for labs. To qualify for an excused absence, you must call (254)867-4857 leave a message as to why you will miss class, examples: Jury duty, military recall/duty, sick but not hung over, court summons etc.

Proposal and Report Criteria: Adapted from: Springfield Township High School Library

Value	Thesis	Information Seeking/Selecting and Evaluating	Analysis	Synthesis	Documentation	Product/Process
	Proposal	Final Report				
A	Student(s) posed a thoughtful, creative question that engaged them in challenging or provocative research. The question breaks new ground or contributes to knowledge in a focused, specific area.	Student(s) gathered information from a variety of quality electronic and print sources, including appropriate licensed databases. Sources are relevant, balanced and include critical readings relating to the thesis or problem. Primary sources were included (if appropriate).	Student(s) carefully analyzed the information collected and drew appropriate and inventive conclusions supported by evidence. Voice of the student writer is evident.	Student(s) developed appropriate structure for communicating product, incorporating variety of quality sources. Information is logically and creatively organized with smooth transitions.	Student(s) documented all sources, including visuals, sounds, and animations. Sources are properly cited, both in-text/in-product and on Works-Cited/Works-Consulted pages/slides. Documentation is error-free.	Student(s) effectively and creatively used appropriate communication tools to convey their conclusions and demonstrated thorough, effective research techniques. Product displays creativity and originality.
B	Student(s) posed a focused question involving them in challenging research.	Student(s) gathered information from a variety of relevant sources- -print and electronic	Student (s) product shows good effort was made in analyzing the evidence collected	Student(s) logically organized the product and made good connections among ideas	Student(s) documented sources with some care, Sources are cited, both in-text/in-product and on Works-Cited/Works-Consulted pages/slides. Few errors noted.	Student(s) effectively communicated the results of research to the audience.
C	Student(s) constructed a question that lends itself to readily available answers	Student(s) gathered information from a limited range of sources and displayed minimal effort in selecting quality resources	Student(s) conclusions could be supported by stronger evidence. Level of analysis could have been deeper.	Student(s) could have put greater effort into organizing the product	Student(s) need to use greater care in documenting sources. Documentation was poorly constructed or absent.	Student(s) need to work on communicating more effectively
D	Student(s) relied on teacher-generated questions or developed a question requiring little creative thought.	Student(s) gathered information that lacked relevance, quality, depth and balance.	Student(s) conclusions simply involved restating information. Conclusions were not supported by evidence.	Student(s) work is not logically or effectively structured.	Student(s) clearly plagiarized materials.	Student(s) showed little evidence of thoughtful research. Product does not effectively communicate research findings.

Presentation Criteria:

Value	Organization	Subject Knowledge	Graphics	Mechanics	Eye Contact	Elocution
A	Student presented information in logical, interesting sequence which the audience could follow.	Student demonstrated full knowledge (more than required) by answering all class questions with explanations and elaboration.	Graphics explained and reinforced screen text and presentation.	Presentation had no misspelled word or grammatical errors.	Student maintained eye contact with audience, seldom returned to notes.	Student used a clear voice and correct, precise pronunciation of terms so that all audience members could hear the presentation.
B	Student presented information in logical sequence which the audience could follow.	Student was at ease with expected answers to all questions, but failed to elaborate.	Graphics related to text and presentation.	Presentation had no more than two misspelled words and/or grammatical errors.	Student maintained eye contact most of the time but frequently referred to notes.	Student's voice was clear. Student pronounced most words correctly. Most audience members could hear the presentation.
C	Audience had difficulty following presentation because student jumped around.	Student was uncomfortable with information and was able to answer only rudimentary questions.	Occasional use of graphics that rarely supported text and presentation.	Presentation had three misspellings and/or grammatical errors.	Student occasionally made eye contact, but still read most of the report.	Student's voice was low. Student incorrectly pronounced terms. Audience members had difficulty hearing presentation.
D	Audience could not understand presentation because the information was not presented in a logical sequence.	Student did not have a grasp of the information; student could not answer questions about subject.	Graphics were superfluous or presentation contained no graphics.	Presentation had four or more spelling errors and/or grammatical errors.	Student read all of the report and made no eye contact.	Student mumbled, incorrectly pronounced terms and spoke too quietly for students in back of class to hear.

Adapted from: Information Technology Education Services, NC Department of Public Information.