ARO4080 FINITE ELEMENT ANALYSIS *SYLLABUS*

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Class	Section	Number	Lecture	Location
ARO4080	1	73295	10:00 am – 11:15 am TuTh	Bldg 17, Room 1211

CLASS SCHEDULE

Week	Date	Lec	Day	Topics	LOGAN CHAPTERS	HW Due	PJ Due
1	23-Aug	1	Th	Intro to FEA & NASTRAN	1.1-1.7	-	-
	28-Aug	2	Tu	Spring Elements & The F.E. Method	2.1-2.5	1	1
2	30-Aug	3	Th	Truss Elements & Transformations	3.1-3.5	2	-
	4-Sep	4	Tu	Truss Elements in 2D	3.6	3	2
3	6-Sep	5	Th	NASTRAN Modelling of Bars, Beams & Springs	---	4	-
	11-Sep	6	Tu	Truss Elements in 3D	3.7	5	3
4	13-Sep	-	Th	**Test #1 (Lectures 1-5)**	---	-	-
	18-Sep	7	Tu	Symmetry & Inclined Supports	3.8-3.9, 3.14	6	4
5	20-Sep	8	Th	F.E. Idealization of Beams	---	7	-
	25-Sep	9	Tu	Beam Element under Transverse Loads	4.1-4.3	8	5
6	27-Sep	10	Th	NASTRAN Modelling of Shell Elements	---	9	-
	2-Oct	11	Tu	Beam Element under Distributed Loads	4.4	10	-
7	4-Oct	-	Th	**Test #2 (Lectures 1-10)**	---	-	-
	9-Oct	12	Tu	Beam Element w/ Nodal Hinge	4.6	11	6
8	11-Oct	13	Th	F.E. Modelling with FEMAP	---	12	-
	16-Oct	14	Tu	Hands-on FEMAP Practice Session	---	13	-
9	18-Oct	15	Th	2D Plane Frame Elements	5.1-5.2	14	-
	23-Oct	16	Tu	NASTRAN MSG Mesh & Buckling Analysis	---	15	7
10	25-Oct	-	Th	**Test #3 (Lectures 1-15)**	---	-	-
	30-Oct	17	Tu	Grid Frames: 2D Beams w/ Torsion	5.4	16	-
11	1-Nov	18	Th	Practical FE Modeling of Aero Structures	---	17	-
	6-Nov	19	Tu	Hands-on FEMAP Practice Session	---	18	8
12	8-Nov	20	Th	Frame Elements in 3D	5.5	19	-
	13-Nov	21	Tu	FEMAP Quiz & Hands-on Practice Session	---	20	-
13	15-Nov	-	Th	**Test #4 (Lectures 1-20)**	---	-	-
	20-Nov	22	Tu	Intro to NASTRAN Nonlinear	6.1-6.5	21	9
14	22-Nov	-	Th	**Holiday - Thanksgiving**	---	-	-
	27-Nov	23	Tu	NASTRAN: Thermal Analysis	6.6	22	10
15	29-Nov	24	Th	NASTRAN: Nonlinear Gap Analysis	---	23	-
	4-Dec	-	Tu	**Test #5 (Lectures 1-24)**	---	24	-
16	6-Dec	25	Th	Review of Topics	---	-	-
17	13-Dec	-	Th	**Final Exam (Lec 1-25) 9:10 AM - 11:10 AM**	**---**	-	-

Note: This syllabus plan is subject to change. Keep your eyes peeled for updates & have the latest on hand.

GRADING SCALE & WEIGHTS and TEXTS & TOOLS

Course Grading	
Homework	20%
Projects	20%
Quizzes	10%
Test #1	10%
Test #2	10%
Test #3	10%
Test #4	10%
Test #5	10%
Final Exam	+2%

Grading Scale

		A	100 % - 93 %	A-	92 % - 90 %
B+	89 % - 87%	B	86 % - 83%	B-	82 % - 80%
C+	79 % - 77%	C	76 % - 73%	C-	72 % - 70%
D+	69 % - 66%	D	65 % - 61%	D-	60 % - 56%
		F	55 % - 0%		

The final exam is optional & provides opportunity to better grade.

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COURSE DESCRIPTION & EXPECTATIONS

Prerequisites:

- C or better in ARO326 or ARO3271 for ARO Majors.

Course Description: Fundamentals of finite elements, including an introduction to the displacement method, development of simple computer codes to implement the method, analysis of simple one and two dimensional structural elements using hand solutions and using finite element software, and basics of structural idealization for finite element analysis in industry. Introduction to NASTRAN.

Required (Hardcopy) Text & Tools:

- Daryl Logan. A First Course in the Finite Element Method, 6th Edition. Cengage Learning, 2012.
- Engineering Calculator with Matrix Algebra & Simultaneous Equation Solving Capability.
- Pencil, Paper (Quad or Quint Pad Recommended).

Important Notes, Expectations & Comments:

- Attendance is required. Every class has deliverables which will result in loss of points if missed.
- Be on time to class. Late arrival will result in loss of homework, project & quiz points.
- Students who are late or who miss any class may be dropped from the class.
- Cell phones & laptops may not be used in class. Use will result in loss of class credit.
- Eating, drinking & sleeping are not allowed in the classroom.
- Cheating is unacceptable and will result in immediate failure of the class.
- Participation in class is desired, recommended, and rewarded.

Homework & Project Expectations & Guidelines:

- Homework will consist of hand-worked HW due each class & Bb HW due periodically.
- Homework & project due-dates are shown in the Syllabus.
- Homework & projects are due at the start of class. Credit will be lost if turned in after class starts.
- Homework & projects will not be accepted or scored after class ends on the day they are due.
- Collaboration on homework & projects is recommended. Copying is considered cheating.
- Homework & projects must be graded by student per grading procedure shown below prior to submittal.
- Ungraded & misgraded homework submittals will receive zero points. Plan accordingly.
- Each missing homework or project assignment will score -5 points (rather than zero).

Quiz & Test Expectations & Guidelines:

- Quizzes will be given nearly every class. Expect them & be prepared.
- Quizzes will usually be given at the start of class. Late arrival will likely miss the quiz.
- No make-up quizzes or exams will be administered.
- Most quizzes & exams will be open book (hardcopy only) & closed notes.
- No electronic devices (including electronic texts) except calculators will be allowed during exams or quizzes.
- During quizzes & tests, talking, communicating, sharing with other students, and getting out of seat without permission are not allowed and will be considered cheating. Raise your hand to be recognized if you need something during a quiz or test and do not get out of your seat without permission except to turn in your completed work.
- Bb & online quizzes may also be used, and must be taken within the allotted time.
- Bb & online quizzes must be taken individually without collaboration or help from others.
- Seating will be rearranged during quizzes & tests. Plan to sit alone & to do your own work.
- Each missing quiz (without prior authorization) will be scored -5 points (rather than zero).
- Each missing exam (without prior authorization) will be scored -50 points (rather than zero).

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HOMEWORK PREPARATION & GRADING EXPECTATIONS

This class is about finite element analysis. One aspect of the class investigates the mathematical basis of FEA thru hand analysis. This part is reinforced primarily thru the homework. The other aspect of this is learning to idealize and model structures in a way that a mathematical model is assembled and evaluated such that realistic & understandable results are obtained. This part is primarily reinforced in the projects, where structures will be idealized and evaluated using FE elements of increasing complexity.

Each student must grade their own homework & project prior to submittal using a colored pen or marker that stands out from your work. Any ungraded or unidentified work will not be scored, & will show a zero in my gradebook. Detailed grading procedure as follows.

Homework Grading Procedure:

- Score each problem as follows:
  - SETUP: Score 1 point if all the following is present in your solution:
    - Problem Number - Identified (1, 2, 3, etc) & circled
    - Given, Find, & Solution - Clearly marked & appropriate pertinent data recorded.
    - Sketch – Pertinent sketch of problem shown.
    - Neatness – Setup is legible & clear.
    - Note: Only claim this point if you also have a complete attempted solution for the problem.
  - WORK: Score 2 points if all the following is present in your solution:
    - Equations – All pertinent equations needed and/or used are shown
    - Sketches & FBDs – Includes sketch of problem or idealization & FBDs showing applied loads and reactions wherever possible.
    - Neatness – All work is legible and clear.
    - Complete - Problem is worked to completion & all answers are boxed.
  - ACCURACY: Score 0, 1, or 2 points, as follows.
    - If all answers of a problem are boxed & match the answer provided, score 2 points.
    - In only some of the answers provided match the solution, score 1 point.
    - If no answer is provided, score 2 points (as if you got it right).
- This means each problem score will range from 1 to 5 based on the above.
- Sum your scores to the top of the first page with the total points earned over the total possible (5 times the number of problems), and circle the total score conspicuously.
- If you want me to see or score something, write "See XYZ" & I will take a look & evaluate.
- I will make any modifications to the grades as needed, and may score punitive point reductions if I feel the scoring is intentionally misleading.
- Any ungraded homework or homework without a name will not be scored, and will show a zero in my gradebook.

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PROJECT PREPARATION & GRADING EXPECTATIONS

This class is about finite element analysis. One aspect of the class investigates the mathematical basis thru hand analysis. This part is reinforced primarily thru the homework. The other aspect of this is learning to idealize and model structures in a way that a mathematical model is assembled and evaluated such that realistic & understandable results are obtained. This part is primarily reinforced in the projects, where structures will be idealized and evaluated using FE elements of increasing complexity.

Project Identification & Submittal:

Name each finite element run using the following naming convention:

- ARO4080_PJii-jj-FirstLast, where ii is the project number, jj is the project subproblem number, & FirstLast is your first and last names, run together, but with capitals as needed.
- Also, use the same name, or similar, on the title statement in each FEM run.

Finite element codes generate a lot of pages of output, so, instead of students printing out countless sheets of data for submittal, projects will be submitted in two ways:

- A graded FEM Documentation Report will be submitted in class per syllabus due date.
- An electronic copy of the same report, along with additional FEM output, will be submitted electronically thru Blackboard.

Each project submittal will require the following submitted on or before the syllabus due date:

- FEM Documentation Report:
  - Download the template from the Resources content area of Bb.
  - Submit one graded (per grading procedure below) hardcopy in class.
  - Upload to Bb one electronic copy.
- Bulk Data File (BDF):
  - Upload to Bb each bdf text file from each FE run. It is a .nas or .bdf or similar file.
- OUTPUT (OUT):
  - Upload to Bb each output text file from each FE run, which is usually a .out or similar file.

This means each project submittal will involve one graded FEM documentation report submitted in class, and an electronic copy of the same along with one .bdf & .out file per FEM run uploaded to Bb before the syllabus due date.

Project Grading Procedure:

Grading will be identified clearly on the Title Page of the hardcopy of your FEM documentation report submitted in class. It will be scored as follows:

- FEM Documentation Report: (40 points)
  - Claim all 40 points if you provide everything in the report in a clear and quality manner, and submitted all .bdf & .out files to Bb prior to the due date.
  - Claim half credit if .bdf & .out files were not submitted.
- ACCURACY: (10 points max per problem)
  - If answers are provided, score an additional 10 points if all parts are correct.
  - Score only 5 additional points if some answers match and others do not match
  - Score zero additional if none match.
  - If no answers are provided or available, score all 10 points as if correct.
- This means each project score will range from 0 to 50 points, unless otherwise stated on project assignment.
- Mark your score clearly on the title page of the hardcopy of your FEM documentation report & circle the total score conspicuously.
- I will make any modifications to the grades as needed, & may score punitive point reductions if I feel the scoring is intentionally misleading.

If there are questions, see me.