THE UNIVERSITY OF ARIZONA
COLLEGE OF ENGINEERING
Civil & Architectural Engineering & Mechanics

CE214 – STATICS (CE 214 SP19 002)
POLICY & SYLLABUS
Spring 2019

Statics: A branch of engineering mechanics that deals with bodies at rest and forces in equilibrium**.**

Catalog Description: (3 units) Equilibrium of a particle, equivalent and resultant force systems, equilibrium, geometric properties of areas and solids, trusses, frames and machines, shear force and bending moments, friction.

Prerequisites: Math 129 (Math 223 recommended) and Phys 141.

Learning outcomes:
Students should be able to:
1. Draw Free Body Diagrams.
2. Calculate forces on rigid bodies by using fundamental laws (such as Newton's laws) and concepts.
3. Demonstrate an understanding of the principles of mechanics by defining terms, identifying assumptions, and applying to problem solving.
4. Apply engineering principles to analyze physical systems.
5. Demonstrate problem-solving skills by defining problems, applying concepts and equations, and checking answers, including presentation of solutions.

Learning outcomes support ABET program outcomes:

Primary
1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
Secondary
3. an ability to communicate effectively with a range of audiences
5. an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Instructor:	George N. Frantziskonis, Room 206A, Civil Engineering Building
Phone:	520-621-4347
Email:	frantzis@email.arizona.edu, http://civil.arizona.edu/george-frantziskonis
Lecture:	TuTh 9:30-10:45 Haury Anthropology building, Room 129
Office hours:	M 1:00 – 2:00pm, W 1:00-2:30pm. See TA office hours for recitations and homework.

Teaching Assistant:	Haohua (Howard) Chen, Room TBA, Civil Engineering Building
Email	howardchen@email.arizona.edu
Office hours	Monday 2:00pm - 4:00pm, Wednesday 2:00pm - 3:00pm, In Civil Engr. Bldg., room 207A
Recitations	Listed in course schedule

Textbook: Engineering Mechanics - Statics, by R.C. Hibbeler, 14th Edition, Pearson Publications (ISBN 978-0-13-391892-2).

- Hard-bound, loose-leaf, or digital copies are acceptable.

- You do not need to obtain the online MasteringEngineering supplement from the publisher.
- This text is a classic that is up-to-date with photos of statics in the real world, clear explanations of concepts, and many example problems. Make this text your constant companion this semester – it won't let you down!
- Other materials will be supplied through the course D2L website.

Weights for course grade:
10 points – homework,
50 points – 3 tests @ 16.67 points each,
24 points – final exam,
8 points – attendance (main lecture and recitations),
8 points – quizzes

Scale for final grade:		
A	Outstanding	90 - 100
B	Above Average	80 < 90
C	Average	70 < 80
D	Below Average	60 < 70
E	Failure	< 60

The cutoffs for grades may be lower, but will not be higher (I will not raise the standards mid-semester). The course grades are not curved. I feel very strongly that learning should be measured with a standard (maybe a high standard, but a standard none the less) and that you should not be directly competing with anyone other than yourself. I fully expect everyone in the course to be successful and if you are having problems, then you must initiate a process for improvement.

LEARNING GOALS

In this course, we will use fundamental laws (such as Newton's laws) and concepts to determine the actions of forces on rigid bodies. The important goals to be achieved are:

1. An understanding of the principles of mechanics
2. Application of these principles to analyze physical systems
3. Develop problem-solving skills

COURSE CONTENT

Day 1 (1/10/2019): Read sections 2.1 to 2.8 (from the text book), Vectors
Day 2 (1/15/2019): Read sections 2.1 to 2.8 and 2.9 (from the text book), Vectors, Dot Product. Take quiz for day 2 before class time on Day 2.
Day 3 (1/17/2019): Work on problems F2-4, F2-22, 2-89. Read sections 4.1-4.4, Moment, Cross Product. Take quiz for day 3 before class time on Day 3.
Day 4 (1/22/2019): Read sections 4.1-4.4, 4.5, Moment, Moment about Axis. Work on problems F4-4, F4-11, 4-6. Take quiz for day 4 before class time on Day 4.
Day 5 (1/24/2019): Read section 4.6, Moment of a Couple. Work on problems F4-19, F4-24. Take quiz for day 5 before class time on Day 5.
Day 6 (1/29/2019): Read section 4.7 (and 4.8), Simplification - Force and Couple system. Work on problems F4-25, F4-29, F4-31, F4-35. Take quiz for day 6 before class time on Day 6.
Day 7 (1/31/2019): Read sections 5.1-5.3, Free Body Diagrams, Equilibrium in 2D. Work on problems 5.1, F5-1, F5-2. Take quiz for day 7 before class time on Day 7.
Day 8 (2/5/2019): Read sections 5.1-5.4, Free Body Diagrams, Equilibrium in 2D, two- and three-force members. Work on problem 5-16. Take quiz for day 8 before class time on Day 8.
Day 9 (2/7/2019): Read sections 5.5-5.6 (and a bit of 5.7), Free Body Diagrams, Equilibrium in 3D. Work on problems F5-10, F5-12. Take quiz for day 9 before class time on Day 9.
Day 10 (2/12/2019): Review of all material covered so far. Work on practice exams. Take quiz for day 10 before class time on Day 10.
Exam 1, 2/14/2019

Day 11 (2/19/2019): Read sections 6.1-6.2 (and a bit of 6.3), Trusses and method of joints. Work on problem F6-4. Take quiz for day 11 before class time on Day 11.
Day 12 (2/21/2019): Read sections 6.1-6.3, Trusses and method of joints and zero force members. Work on problem F6-1 and understand why the force in member DB is zero. Take quiz for day 12 before class time on Day 12.
Day 13 (2/26/2019): Read section 6.4, Trusses and method of sections. Work on problem F6-7. Take quiz for day 13 before class time on Day 13.
Day 14 (2/28/2019): Read section 6.6, Frames and machines. Work on problems F6-14, F6-16. Take quiz for day 14 before class time on Day 14.
Day 15 (3/12/2019): Read section 6.6, Frames and machines. Work on problems F6-14, F6-16. Take quiz for day 15 before class time on Day 14/15.
Day 16 (3/14/2019): Read section 6.6, Frames and machines. Work on problem F6-22. Take quiz for day 16 before class time on Day 16.
Day 17 (3/19/2019): Read section 9.1, Center of Gravity, Center of Mass, and the Centroid of a Body. Work on problems F9-1, 9-6. Take quiz for day 17 before class time on Day 17.
Days 18-19 (3/21/2019, 3/26/2019): Read sections 9.2-9.4, Composite Bodies, Surfaces and Solids of Revolution (Theorem of Pappus), Resultant of a Distributed Load. Work on problems F9-7, F9-8, F-9-15. Take quiz for day 18 before class time on Day 18 and quiz for day 19 before class time on Day 19.
Exam 2, 3/28/2019
Day 20 (4/2/2019): Read sections 7.1-7-2 and a bit of 7-3, Internal Loads and Shear and Moment Diagrams. Work on problems F7-1, F7-4, F7-7. Take quiz for day 20 before class time on Day 20.
Day 21 (4/4/2019): Read sections 7.2-7-3, Internal Loads and Shear and Moment Diagrams. Work on problem F7-8. Take quiz for day 21 before class time on Day 21.
Days 22-23 (4/9/2019, 4/11/2019): Read sections 7.2-7-3, Internal Loads and Shear and Moment Diagrams. Take quiz for day 22 before class time on Day 22, and quiz for day 23 before class time on Day 23.
Exam 3, 4/16/2019
Days 24-25 (4/18/2019, 4/23/2019): Read sections 8.1-8.3, Dry Friction, Wedges. Take quiz for day 23 before class time on Day 23, and quiz for day 24 before class time on Day 24.
Day 26 (4/25/2019): Course Review. Take quiz for day 26 before class time on Day 26, if applicable.
Final Exam, 5/7/2019, 8:00am - 10:00am

HOMEWORK

Homework problems will be submitted in D2L as assignments. Due dates will be posted in D2L and will be communicated via email. The homework solution should be converted to a single PDF file and uploaded in D2L as an assignment. The submitted homework will be graded and grades will be posted in D2L. Homework should be done in a neat, orderly fashion. Late homework is not accepted and receives a grade of zero.

Failure to comply with the policy on homework may result in downgrading and/or refusal to accept the work.

EXAMINATIONS

You must take three examinations during the semester and a final examination. All examinations will be held during the regular class session in the lecture room assigned to this course. All exams are closed book and calculators are permitted. However, only calculators approved by the Civil Engineering department are allowed. A list of approved calculators will be emailed to all students shortly. The list can also be found in:
http://ncees.org/exams/calculator/

No credit is given for correct answers obtained by incorrect reasoning and/or compensating errors. Partial credit will be given for work that pertains to the correct solution. The final exam is mandatory and there will be no change in time as this would be a violation of University policy. A similar policy holds in this class for the tests, yet under exceptional circumstances other arrangements may be made, on a case-by-case basis. There will be no make up for missed examinations. The final examination score will be adjusted for, at most, one acceptable excused missed examination. An unexcused missed examination or a second missed examination is scored as zero.

Examinations are regarded as engineering reports. Procedures and presentation of solutions should be precise and legible. Penalties are assessed for:

(I) algebra and arithmetic errors;
(II) answers presented without proper units, sign or direction;
(III) incomplete free body diagram; and
(IV) messy or illegible presentation.

A summary of your grades will be posted regularly in D2L. You must check that your grades are correct. You must notify the instructor of any omission or error within 10 days after grades are posted. Changes may not be accepted after that.

ACADEMIC INTEGRITY

One sanction for dishonest academic work permitted under the University CODE OF ACADEMIC INTEGRITY is a failing grade in the course. The grade of E will be assigned for dishonest academic work.

ATTENDANCE POLICY

Participating in the course and attending lectures and other course events are vital to the learning process. As such, attendance is required at all lectures and discussion section meetings. Absences may affect a student's final course grade. For those courses in which enrollment is limited, missing the first class session may be interpreted as excessive absence. If this action is filed in the Registrar's Office by the end of the fourth week of classes, it will result in cancellation of registration in the course. If the student is administratively dropped after the end of the fourth week of classes, it will result in a failing grade being awarded in that course.

Policy of this class:

- If you need to be absent from the class for justifiable reasons (sickness, family obligations, etc.), you must inform the instructor in advance or immediately after the day of absence.
- It is required that you attend all classes and recitations. The instructor may report to the Registrar's Office if absence is excessive, which may result in administrative drop from the class. Attendance accounts for 8% of the course grade.

Auditors are also expected to attend the classes.

Students are expected to check their official UA email daily.

***THIS POLICY WILL BE STRICTLY ENFORCED*.**

WHY MECHANICS?

Mechanics was the first branch of analytical science and is the foundation of all branches of engineering. It comprises of two parts, Statics and Dynamics. An understanding of Mechanics is essential for all engineers, since it is fundamental to the design and construction of a wide variety of every day structures, such as buildings, bridges, electric power transmission towers, cables, machines, airplanes, ships, trains, chains, pencil sharpeners, doors, windows, etc. It also has extensive applications in the

oil, gas, nuclear, and chemical industries, including offshore oil platforms, pressure vessels, storage tanks and pipelines. New applications emerge each year; for example, rapid advances are being made in the following fields: "smart" structures, which can sense and respond automatically to damage, temperature changes, etc.; large deployable structures for use in outer space; biomechanics; environmental systems.

Engineering and Mechanics; the inseparable partnership.

Engineers need to be familiar with all phases of a project including:

- ☑ specification of the purpose of a new structure
- ☑ determination of the applied loads (e.g., from design codes, or tests on models or prototypes)
- ☑ identification of a number of possible solutions (creativity and experience help)
- ☑ materials selection
- ☑ Modeling and analysis of possible solutions
- ☑ comparison of solutions on technical, economic, environmental and aesthetic grounds
- ☑ optimization of the chosen solution (computers widely used)
- ☑ construction, testing and commissioning
- ☑ service and maintenance
- ☑ decommission (and feedback to help future designers)

Engineers need to be aware of possible failure mechanisms, including:

- ☑ failure of ductile materials, in tension, shear or compression
- ☑ brittle failure
- ☑ fatigue (caused by repeated applied loading, or vibration)
- ☑ buckling
- ☑ failures caused by dynamic loads, such as blast or impact
- ☑ deterioration due to wear or corrosion
- ☑ excessive deflection
- ☑ unacceptable effects on the environment
- ☑ aesthetic failures

It is surprisingly easy to overlook a possible loading, or possible failure mechanism, without considerable experience. Unfortunately, many spectacular failures have occurred, and continue to occur where engineers overlook a simple factor.

There are many uncertainties in the field of design. The nature and magnitude of loadings applied to a structure cannot always be predicted with great accuracy (e.g., wind loads on a bridge), nor too can the support conditions. Material properties are variable (e.g., concrete) and structural geometry is not known precisely. Engineers must appreciate these uncertainties when selecting appropriate safety factors in design.

WHY STATICS?

Statics is the study of forces and their effects on systems in equilibrium (without producing motion of the system). Statics includes systems of forces, which are equivalent to one another. Engineers need to *understand* the way in which loaded structures behave, i.e., the way structures *carry* loads. This, in turn, requires understanding of:

- ☑ application of the principles of *equilibrium*, to determine the internal forces caused by applied loads
- ☑ *material properties* of the structure, to determine strains and deformation of each component or member of the structure

- ☑ the geometric and kinematic relationships between the various components or members, which will determine the overall deflections of the structure, from considerations of *"compatibility"*.