

ME 27000 Basic Mechanics I
Spring 2019

Instructor: Prof. Kejie Zhao
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Lecture Time: MWF 1:30-2:20pm
Office Hours: MWF 12:30-1:30pm, Open door
Classroom: ME 1130
Blackboard: <https://mycourses.purdue.edu/>

Course Description

Vector operations, forces and couples. Free body diagrams, equilibrium of a particle and of rigid bodies. Distributed forces. Centers of gravity and centroids. Friction. Trusses, frames, and machines. Internal reactions resulting from axial, shear, torsional, and bending loading. Stress and strain analyses and elementary failure criteria.

Prerequisites/Concurrent Prerequisites

Prerequisites: MA 166 Analytical Geometry & Calculus II; PHYS 172 Modern Mechanics

Concurrent Prerequisites – ENGR 132 Transforming Ideas to Innovation II; MA 261 Multivariate Calculus

Course Outcomes

1. Develop an understanding of *static equilibrium* and *stresses in statically determinate structures* and how to apply them to engineering systems.
2. Learn a systematic approach to *problem solving*.
3. Foster effective mathematical and graphical *communication skills*.

Classroom Environment (Not Applicable to Distance Students)

I wish to encourage a professional classroom environment based on basic courtesy and mutual respect. To help achieve this environment, please arrive to class on time and come prepared to fully participate in class discussions. Please do not *sleep* in class, *text*, read the *Exponent*, work on *other assignments*, or *leave class early* without permission (unless you are feeling ill). Such behaviors are disrespectful to the instructor and fellow classmates, and can disrupt the learning process.

Homework

Homework (HW) must be submitted by 11:59pm (EST) on the due date (i.e., homework assigned in a particular class is due at 11:59pm on the day of the next class period, unless otherwise posted). Please post your HW on Gradescope on the appropriate HW link using a **single** PDF file (you will be asked to prescribe which page(s) each problem is on in Gradescope). Late HW will not be accepted without a personalized excuse (i.e., a generic PUSH note is not sufficient). Please review your homework submission **after** it has been uploaded onto Gradescope to ensure that all work has been properly submitted. If for some reason you have problems posting your HW on Gradescope, please email the grader the PDF of your HW before the 11:59pm deadline with an explanation. If you have a sudden problem converting your HW into a single PDF format, take a legible picture of your HW and email to the grader. Each of these accommodations should be rare occurrences. Students will be given two free HW scores in case they miss an assignment or suddenly become ill. Opportunities for additional HW extra credit may also be made available by your instructor. Homework solutions will be posted on the blog shortly after they are due. Graders will strive to have your assignments graded by the class period following submission. If you are unable to submit the work on-time due to circumstances outside of your control, you may submit your work to your instructor with written documentation of the circumstances for consideration.

Attendance Quizzes (Not Applicable to Distance Students)

A number of group attendance quizzes may be given throughout the semester to allow students to apply the basic principles learned that day. The purpose of the quizzes is to encourage attendance and participation, and help students identify “*gaps*” in their understanding of the basic mechanics principles. No make-up quizzes will be given. Quizzes will count 5% of your grade.

Exams

There will be 2 midterms and 1 final exam. There are no makeup exams. If you are unable to make it to an exam, you must have documentation (doctor's note, etc.). In the case of an excused absence on an exam, your final exam will count as your score for the exam you missed. Instructors will strive to have exams graded and returned within one week of the exam date.

Grades (In-Class Students)

Homework	10%
Quizzes	5%
Exam 1 and 2	25% or 60%
Final Exam	60% or 25%

If you score better on the average of Exams 1 and 2 than you do on the Final, the average of these Hour Exams will count as 60% and the Final will count as 25% of your final grade.

Distance Students

Homework	15%
Exam 1 and 2	25% or 60%
Final Exam	60% or 25%

If you score better on the Final Exam than on the average of Exams 1 and 2, the final will count as 60% and the average of the Hour Exams will count as 25% of your final grade.

Grades will be assigned on an absolute scale as follows: $A+ \geq 97$; $97 > A \geq 93$; $93 > A- \geq 90$, $90 > B+ \geq 87$; $87 > B \geq 83$; $83 > B- \geq 80$; $80 > C+ \geq 77$; $77 > C \geq 73$; $73 > C- \geq 70$; $70 > D+ \geq 67$; $67 > D \geq 63$; $63 > D- \geq 60$, $F < 60$. **No sweeping exam or final curves will be administered.** Students are strongly encouraged to attend all classes and complete all assignments to the best of their ability.

Deadline to Collect Graded Work

It is the policy of the School of Mechanical Engineering to retain any hardcopy graded work (homework, quizzes, projects, labs, hourly exams, etc.) for only one week after it is released to students. After one week, any uncollected work may be appropriately discarded. Electronically stored assignments, such as those uploaded to Blackboard or Gradescope will be retained until the end of the semester, after which they may be deleted. Final exams will be held until 30 days into the next regular semester to give students a reasonable period to collect their final exams. After 30 days into the next regular semester, any remaining final exams may be discarded appropriately. Students are strongly encouraged to collect their graded work in a timely fashion to have it available for future use. Details are available at: <https://engineering.purdue.edu/ME/Academics/Undergraduate/recordRetentionPolicy>

Tutorial Room (Not Applicable to Off-Campus Students)

Assistance with any questions will be available daily in the ME 270 Tutorial Room. The schedule is as follows:

	A	B	C	D	E	F
1	M	T	W	Th	F	
2	10:30-11:30					
3	11:30-12:30					
4	12:30-13:30					
5	13:30-14:30					
6	14:30-15:30					
7	15:30-16:30					
8	16:30-17:30					

The ME 270 Tutorial Room is located in ME 2138 (labeled Tutorial Room 2) in the new ME Wing (almost directly above the classroom). The Tutorial Room will have TAs available during the hours of operation to answer any questions you may have concerning homework problems, old exam problems, or other conceptual questions you may have as well as ample table space to sit down and work on homework with your peers. We strongly encourage you to take advantage of this valuable resource.

Course Blog

In addition to the Tutorial Room, a course blog (which will be available 24/7) is a place where you can seek assistance from fellow students in all sections of ME 270 as well as assist other students with their

questions. In essence, the Course Blog is a natural extension of our Tutorial Room, like a 24/7 Discussion Forum for the course. Most of the posts will be from fellow students. However, our faculty and TAs will also periodically monitor the discussion in case an erroneous discussion thread breaks out. There are two rules that have to be followed in the Course Blog. First, please don't post any inappropriate comments (e.g., negative comments about instructors, TAs, peers, etc.). Second, you are not allowed to post your final numerical solution on the blog, although it is fine to guide others on the process you followed to arrive at your solution. Access to the blog can be found at the following website: <https://www.purdue.edu/freeform/statics/>.

Class Text

ME 270 does utilize a workbook style textbook. The textbook (entitled "Statics: A Lecturebook" by Profs. Krousgrill and Rhoads) is a brand new book (Edition 1, Fall 2018) available through the University Bookstore. The textbook includes all of the necessary reading materials and a variety of example problems, many of which you will work out in class.

Academic Honesty

Faculty and students working together can promote a fair and positive academic environment. All students are expected to conduct themselves in an ethical manner. Students are permitted to discuss homework assignments together, but should do their own work when preparing a problem solution (i.e., copying of a solution manual, an on-line resource such as Chegg, or another student's work is explicitly prohibited). Exams are to be completed without unauthorized assistance. Any student caught cheating on an assignment or exam will receive disciplinary action, up to and including receiving a grade of "F" for the course. In addition, documentation of the infraction will be forwarded to the Office of the Dean of Students (ODOS), which may result in additional disciplinary sanctions, up to and including expulsion from the University. All of us are equally responsible for ensuring a fair and positive environment. If you become aware of any dishonest activities, please report the infractions to me (anonymously if you prefer) and I will investigate the concerns. If there is sufficient evidence of academic dishonesty, I will take disciplinary action. Finally, remember if you are complicit in assisting a peer to cheat, you are equally guilty. Please take to heart Purdue's Honor Pledge:



"As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together - we are Purdue."

Academic Integrity Statement: http://www.purdue.edu/purdue/about/integrity_statement.html
Code of Student Conduct: http://www.purdue.edu/studentregulations/student_conduct/regulations.html
Reports of cheating can be submitted through the ODOS website (purdue.edu/odos), by phone at 765-494-8778 or by email at integrity@purdue.edu.

Class Attendance (Not applicable to Distance Students)

Students are expected to attend every class period for which they are enrolled. If a student misses class due to illness, additional time for assignments can be permitted only if the student has a personalized note from a physician on or immediately prior to the date of the absence (i.e., a generic PUSH note is not sufficient). When an absence can be anticipated (interviews, scheduled doctor's appointment, etc.), students are responsible for notifying instructors well in advance of the absence. In such cases, students are expected to work ahead and submit their homework prior to the scheduled absence. Occasionally, other emergency absences (e.g., family emergency, bereavement, etc.) may be necessary. Students need to submit the proper documentation as soon as possible to be eligible to request accommodation for missed work. The link below is the official University policy on class attendance. http://www.purdue.edu/studentregulations/regulations_procedures/classes.html

ME Exam Calculator Policy

The **only** exam calculators that are permitted to be used during exams are the **TI-30XIIS** and the **TI-30Xa**. Students retain the freedom to use their calculator of choice for on homework, labs, and projects, but are encouraged to practice using their exam calculator to make sure they fully understand its functionality. The use of any unauthorized calculators during an exam will be deemed an academic dishonesty infraction. Students who violate this policy are subject to sanctions from the instructor, up to and including a failing grade in the course, as well as be reported to the Office of the Dean of Students for University-level sanctions, which could include probation, suspension, or even expulsion from the University. Any questions about this policy should be addressed to your instructor.

Copyrighted Materials

Please note that the ME 270 Lecturebook, assignments, exams, quizzes, etc. are copyrighted materials and should not be sold, bartered to others, or posted on-line without the expressed written consent of the authors. Similarly, notes taken in class are considered to be “derivative works” of the instructor’s presentations and materials and likewise should not be sold or bartered or posted on the internet without consent. Students are permitted to use their notes, assignments, exams and quizzes etc. for individual and/or group study or other non-commercial purposes reasonably rising up from enrollment in the course or the University generally.

Course Evaluations

During the last week of the semester, you will be provided an opportunity to evaluate this course and your instructor. You will receive an official email from evaluation administrators with a link to the online evaluation site. You will have about a week to complete this evaluation. Your participation in this evaluation is an integral part of this course. Your feedback is vital to improving education at Purdue University. We strongly urge you to participate in the evaluation system. Most instructors will provide some modest incentive (extra credit) for your participation, but may require you to provide documentation that you have completed the survey (e.g., a screen shot showing completion).

Grief Absence

Occasionally, students experience a death in their family and are entitled to a time of bereavement according to University regulations. In such cases, students are strongly encouraged to contact the Office of the Dean of Students for assistance in documenting the incident and contacting all of their instructors. The official regulations regarding the University Grief Policy can be found at the following link. <https://www.purdue.edu/odos/sac/grief-absence-policy-for-students/>

Campus Emergencies

In the event of a major campus emergency (e.g., severe weather, active shooter, etc.), course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. The School of Mechanical Engineering will provide details regarding access to information online and any additional procedures that may be needed as soon as they are available or can be obtained by contacting the instructors or TAs via mail or phone. You are expected to read your @purdue.edu email on a frequent basis.

Violent Behavior Policy

Purdue University is committed to providing a safe and secure campus environment for members of the university community. Purdue strives to create an educational environment for students and a work environment for employees that promote educational and career goals. Violent Behavior impedes such goals. Therefore, Violent Behavior is prohibited in or on any University Facility or while participating in any university activity. For details of Purdue’s policy go to the following link. <http://www.purdue.edu/policies/facilities-safety/iva3.html>

Students with Disabilities

If you have a disability that requires special academic accommodation, please make an appointment to speak with your instructor within the first week of the semester in order to discuss any adjustments and bring your accommodation letter from the Disability Resource Center. It is important that we are informed about this at the beginning of the semester. It is the student's responsibility to notify the

Disability Resource Center (<http://www.purdue.edu/drc>) of an impairment/condition that may require accommodations and/or classroom modifications. If a student does not notify their instructor well in advance about the need for accommodations, there may not be time to arrange some accommodations.

Nondiscrimination Policy

Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. For details, see the link below: <http://www.purdue.edu/dfa/consumerinfo/nondiscrimination.php>

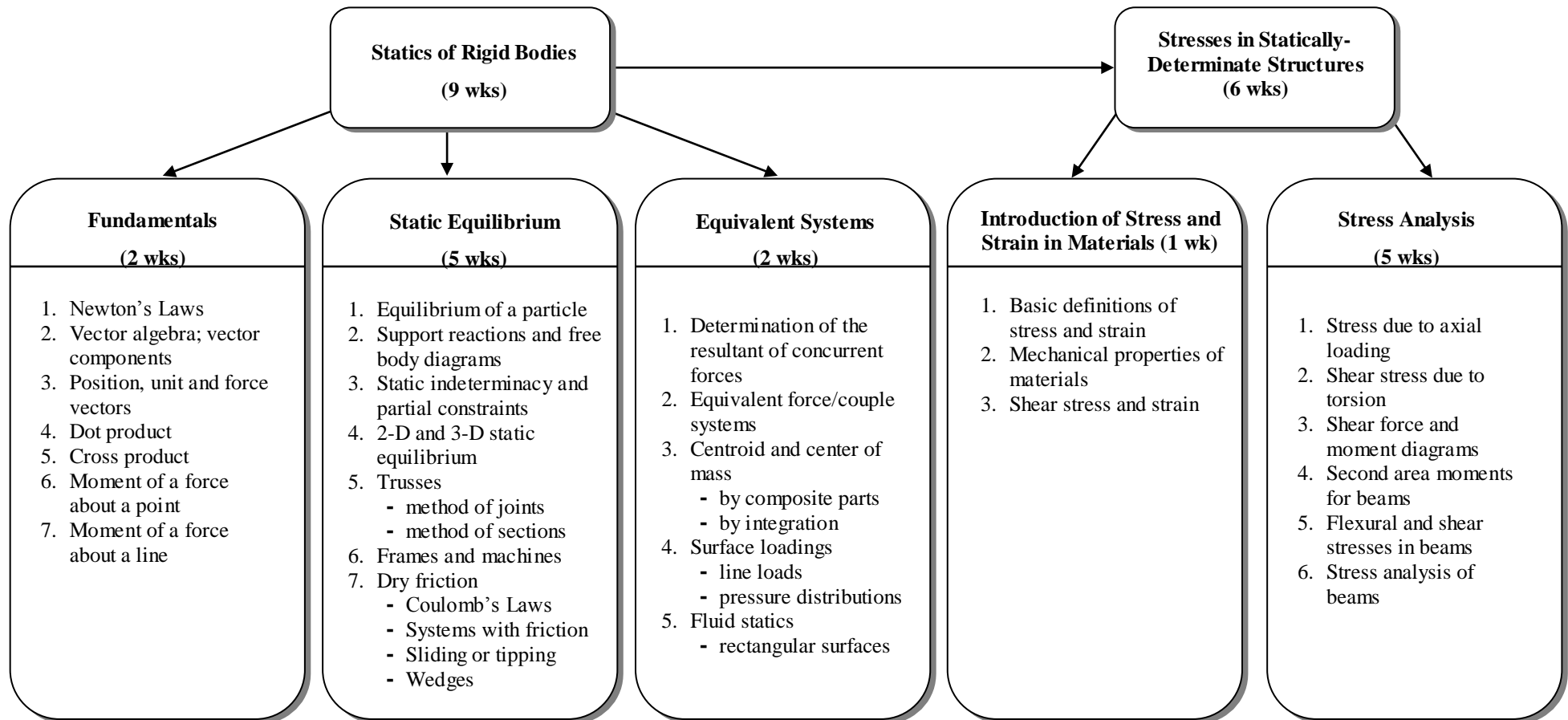
Counseling and Psychological Services (CAPS) Information

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765) 494-6995 and <http://www.purdue.edu/caps/> during and after hours, on weekends and holidays, or through its counselors physically located in the Purdue University Student Health Center (PUSH) during business hours.

ME 27000
BASIC MECHANICS I

Course Outcomes [Related ME Program Outcomes in brackets]

1. Develop an understanding of *static equilibrium* and *stresses in statically determinate structures* and how to apply them to engineering systems. [A1, A2]
2. Learn a systematic approach to *problem solving*. [A2]
3. Foster effective mathematical and graphical *communication skills*. [B1]



ME 270 – Basic Mechanics I

Spring 2019

Period	Date	Topic	Reading	Homework
STATICS				
1	M	Jan. 7	Introduction, Unit Conversions	1.A-F
2	W	Jan. 9	Position, Unit, and Force Vectors	H1.A, H1.B
3	F	Jan. 11	Dot Product	2.A-B
4	M	Jan. 14	Particle Equilibrium (2-D)	2.C
5	W	Jan. 16	Particle Equilibrium (3-D)	H3.A, H3.B
6	F	Jan. 18	Moment About a Point	3.A-E
B	M	Jan. 21	Martin Luther King Day	4.A-B
7	W	Jan. 23	Force Couples, Equivalent Systems	H4.A, H4.B
8	F	Jan. 25	Free Body Diagrams; Equilibrium of Rigid Bodies (2-D)	5.A-B
9	M	Jan. 28	Equilibrium of Rigid Bodies (2-D)	4.C-D
10	W	Jan. 30	Equilibrium of Rigid Bodies (3-D)	H7.A, H7.B
11	F	Feb. 1	Equilibrium of Rigid Bodies (3-D)	H8.A, H8.B
12	M	Feb. 4	Distributed Loading	4.E-F
13	W	Feb. 6	Centers of Mass of Centroids: By Composite Parts	H9.A, H9.B
14	F	Feb. 8	Centers of Mass of Centroids: By Integration	H10.A, H10.B
15	M	Feb. 11	Fluid Statics: Buoyancy	4.E-F
R	W	Feb. 13	Review for Exam 1	H11.A, H11.B
E	Th	Feb. 14	EXAM 1 (6:30 – 7:30 PM); (Covers Lectures 1-14)	5.D
B	F	Feb. 15	NO LECTURE	5.C
16	M	Feb. 18	Fluid Statics: Hydrostatic Loads	H12.A, H12.B
17	W	Feb. 20	Friction: General	H13.A, H13.B
18	F	Feb. 22	Friction: Slipping-Tipping	H14.A, H14.B
19	M	Feb. 25	Friction: Flat Belts	5.E-F
20	W	Feb. 27	Friction: Wedges	Ch. 1-5
21	F	Mar. 1	Trusses: Method of Joints	H15.A, H15.B
22	M	Mar. 4	Trusses: Method of Sections	Location
23	W	Mar. 6	Trusses: Zero-Force Members	None assigned
24	F	Mar. 8	Frames and Machines: Simple Systems	WTHR 200

Period	Date	Topic	Reading	Homework
B	M	Mar. 11	SPRING BREAK	
B	W	Mar. 13	SPRING BREAK	
B	F	Mar. 15	SPRING BREAK	
25	M	Mar. 18	Frames and Machines: Simple Systems	8.A-D
26	W	Mar. 20	Internal Force/Couple Analysis	9.A
27	F	Mar. 22	Shear Force and Bending Moment Diagrams (Pt. Loads)	9.B
R	M	Mar. 25	Review for Exam 2	Ch. 6-8
E	M	Mar. 25	EXAM 2 (6:30 – 7:30 PM); (Covers Lectures 15-26)	Location
B	W	Mar. 27	NO LECTURE	WTHR 200
28	F	Mar. 29	Shear Force and Bending Moment Diagrams (Dist. Loads)	9.B
29	M	Apr. 1	Shear Force and Bending Moment Diagrams (Graph. Meth.)	9.B-D
30	W	Apr. 3	Stress-Strain Curves; Axial Stress and Strain	10.A-D
31	F	Apr. 5	Axial Stress and Strain; Factor of Safety	10.D-E
32	M	Apr. 8	Shear Stress and Strain	11.A-D
33	W	Apr. 10	Shear Stress Due to Torsion in Circular and Tubular Shafts	11.E
34	F	Apr. 12	Bending Stresses in Beams	12.A
35	M	Apr. 15	Bending Stresses in Beams	12.A
36	W	Apr. 17	Second Moments of Area: By Composite Parts	12.B
37	F	Apr. 19	Second Moments of Area: By Integration	12.B
R	M	Apr. 22	Review for Final Exam	Ch. 1-12
R	W	Apr. 24	Review for Final Exam	Ch. 1-12
R	F	Apr. 26	Review for Final Exam	Ch. 1-12
E		FINAL EXAM (details to be announced); (Covers Lectures 1-37)		

Coding: Integer = Lecture number; B = Break; E = Exam; R = Review lecture.

Homework numbers correspond to lecture numbers. Review lectures do not increase counter. Homework is due the class period after it is assigned.

TEXTS

ME 270 textbook ("Statics: A Lecturebook") available only through the University Bookstore.

ME 270 BLOG

You will automatically be added to the Blog once you have registered for ME 270 and will be invited to join. Once you have access to the Blog, you can adjust your email settings to receive all, some or none of the posting, as per your preference.

Your Name (Last, First, Middle) Problem Number

Date

Given: concise statement (in your own words) of the information given.

Find: concise statement (in your own words) of the information sought.

Solution:

- Draw a schematic (where appropriate, a free body diagram) of the system and label appropriate coordinate axes. Use a straight edge whenever possible.
- State mathematical formulation of basic laws or definitions to be used.
- State your initial assumptions.
- Beginning with the basic equations, carry through the analysis, simplifying as far as possible before substituting in numbers.
- Substitute in numerical values (using a consistent set of units) to obtain numerical answers.
- Check your answers to be sure that they are reasonable.
- Label your answers and include appropriate units with the answers.
- Use "over bar" notation for all vectors appearing in your solution; e.g., \bar{F} .

NOTE:

[1] Work problems directly on the sheet to be turned in. Give all the details of calculations.

[2] Neat work will help in avoiding careless errors (Mars Climate Orbitor).

[3] Use Engineering Grid Paper for all homework problems.

[4] One problem per page working on just the light side of the paper.

[5] Make sure your name, problem number, date, etc. appears on all pages.

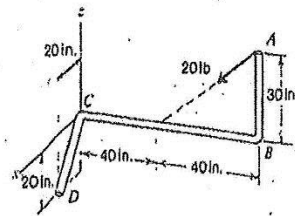
Full Name

Problem 3.36

Date

Given: A 20 lb force applied at point A of bent bar

Find: Moment of this force about line CD



Solution:

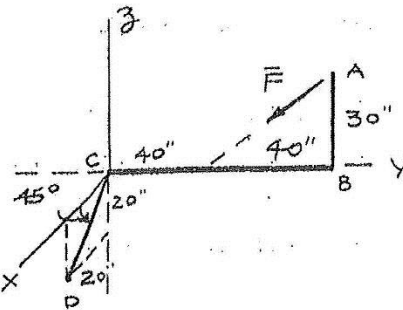
$$\vec{F} = 20(-0.8\vec{j} - 0.6\vec{k}) \text{ lb}$$

$$\vec{r}_{A/C} = (80\vec{j} + 30\vec{k}) \text{ in}$$

$$\vec{M}_C = \vec{r}_{A/C} \times \vec{F}$$

$$= (80\vec{j} + 30\vec{k}) \times (-16\vec{j} - 12\vec{k}) \text{ lb-in}$$

$$= -480\vec{i} \text{ lb-in}$$



$$\vec{e}_{D/C} = \cos 45^\circ \vec{i} - \sin 45^\circ \vec{k}$$

$$M_{CD} = \vec{M}_C \cdot \vec{e}_{D/C} = (-480\vec{i}) \cdot (\cos 45^\circ \vec{i} - \sin 45^\circ \vec{k})$$

$$= -339.4 \text{ lb-in}$$

$$\vec{M}_{CD} = M_{CD} \vec{e}_{D/C} = 240(-\vec{i} + \vec{k}) \text{ lb-in}$$

STUDENT INFORMATION SHEET

Name: _____ Name You Go By: _____ M F

Phonetic Spelling: _____ (if unusual)

School: _____ Academic Level: _____ PUID: _____

E-Mail Address: _____

Hometown: _____

Birthday: _____

Interests, hobbies, etc.: _____

List something “unforgettable” about yourself: _____

Work Experience (Coop, Summer Intern, etc.): _____

Computer Skills (Word, Excel, etc.): _____

Shop Skills (Lathe, Drill Press, etc.): _____

Distance Students Only

Exam Format (Check One)

- ☐ **On-Campus** (or in Close Proximity) - Will Take Exams with Class On-Campus
- ☐ **Off-Campus** – Will Identify a Suitable Proctor and Take Exams Off-Campus

If Off-Campus, please provide the following additional information

- Location _____
- Time Zone _____
- Number of Hours Ahead or Behind Eastern Time Zone (+/- # hrs) _____

(Distance Students: Please complete the above form and return to Prof. Jones on the 1st day of class.)