Power and Machines for Biological Systems

ABE 4171 Section 04HC; Number 10060
Class Periods: TU & TH, 2nd and 3rd period, 8:30 to 10:25AM
Location: 211 Rogers Hall
Academic Term: Fall 2025

Instructor:
Tom Burks
Email Address: tburks@ufl.edu
Office Phone Number: 352-294-6728
Office Hours: TU or TH, 10:30AM till 11:00AM, 225 Rogers Hall

Teaching Assistant/Peer Mentor/Supervised Teaching Student:
Please contact through the Canvas website

- TA:

Course Description**:** *3 credits.* Design and specification of power and machine elements applied to agricultural, biological, land and water resources, or food engineering; power units, machine elements, rigid transmission, fluid power transmission, electrical systems, electronics in off-road vehicles. *Offered each fall*

Course Pre-Requisites / Co-Requisites: EGM 3520 Mechanics of Materials, and EML 3007 Thermodynamics and Heat Transfer, EGM 3400 Elements of Dynamics. It is strongly recommended that students be familiar with SolidWorks and MATLAB.

Course Objectives

- Gain ability to design, test, and analyze power and machinery systems, which can be applied to a broad range of engineering applications including, but not limited to, field production, food processing, irrigation systems, and biological systems.
- Learn theoretical concepts associated with power and machinery design. Theory will be reinforced through team design projects.
- Learn how to evaluate mechanically oriented design problems, formulate a solution, design and specify components, develop a formal report and present concepts to class. Students will develop team skills and communicate ideas in written and oral format. Project will reinforce need for ethical design practices.

Materials and Supply Fees
Each student group will need to provide their own Arduino Uno kit

Professional Component (ABET):
This course contributes 3 credit hours toward meeting the minimum 48 credit hours of Engineering Topics in the basic-level curriculum for the Bachelor of Science Degree in Biological Engineering.

Relation to Program Outcomes (ABET):

Outcome	Coverage*
1. An ability to identify, formulate, and solve engineering problems by applying principles of engineering, science, and mathematics.	High
2. An ability to apply both analysis and synthesis in the engineering design process, resulting in designs that meet desired needs.	Medium

3. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.	
4. An ability to communicate effectively with a range of audiences	
5. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.	Low
6. An ability to recognize the ongoing need for additional knowledge and locate, evaluate, integrate, and apply this knowledge appropriately.	
7. An ability to function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty	Medium

*Coverage is given as high, medium, or low. An empty box indicates that this outcome is not covered or assessed in the course.

Required Textbooks and Software

- *Machine Elements in Mechanical Design, 6th ed.*
- Robert L. Mott,
- Pearson Education Inc., Upper Saddle River, New Jersey
- ISBN: 978-0134441184

Required Textbooks and Software

- *Off-Road Vehicle Engineering Principles*
- Carroll E. Goering
- ASABE 2950 Niles Road, St Joseph MI.
- ISBN: 1-892769-26-3
- (Required chapters available in PDF)

Required Materials

- *Kinematics and Dynamics of Mechanical Systems, 2nd ed.*
- Kevin Russel
- CRC Press, Taylor & Francis Group, Boca Raton, FL.
- ISBN: 13: 978-1-4987-2493-7 (Amazon: ebook $24.23 rent, or $54.95 purchase)

Recommended Materials

- *Matlab tutorials*
- https://www.tutorialspoint.com/matlab/index.htm
- https://www.mathworks.com/help/matlab/getting-started-with-matlab.html

Course Schedule

Lecture Schedule (Refer to Canvas for more details and assignments)

Week	Lect #	Main Lecture Topics starting TU 2nd , and TH 2nd period	Text	Ch.	Supplement topics
1 (8/19)		No Class			
1	1	Mobile Elect. Systems	Georing	10	*Intro Materials (Mott Ch 2)*
2 (8/26)	2	Stress and Deformation	Mott	3	*Electrical Power (Gust Ch 4)*
2	3	Electrical Power Distribution	Gustafson	5	*Intro BoeBot and Brain (1)*
3 (9/2)	4	Combined Stress & Mohr's Circle	Mott	4	**Term Design Meeting**
3	5	Introduction to Kinematics	Russel	1, 3	*BoeBot Shield (2)*
4 (9/9)	6	Design for Different Loading	Mott	5	
4	7	Math in Kinematics	Russel	2	*BoeBot Assembly (3)*
5 (9/16)	8	Electric Motors	Mott	21	
5	9	Kinematic Analysis	Russel	4	*BoeBot Navigation (4:1-3)*
6 (9/23)	10	Column and Beam	Mott	6	**Term Design Meeting**
6		**Exam 1 (9/27/25 Due)**			*BoeBot Navigation (4:4-6)*
7 (9/30)	11	Belt and Chain	Mott	7	
7	12	Dimensional Synth.	Russel	5	*BoeBot Whiskers (5:1-3)*
8 (10/7)	13	Kinematics of Gears	Mott	8	
8	14	Static Force Anal.	Russel	6	*BoeBot Whiskers (5:4-6)*
9 (10/14)	15	Keys and Couplings	Mott	11	
9	16	Dynamic Force	Russel	7	*BoeBot Light Sensor (6:1-3)*
10 (10/21)	17	Shaft Design 1	Mott	12	
10	18	Shaft Design 2	Mott	12	*BoeBot Light Sensor (6:4-6)*
11 (10/28)	19	Tolerances	Mott	13	**Term Design Meeting**
11		**Exam 2 (11/1/25 Due)**			
12 (11/4)	20	Roller Contact Bearings	Mott	14	
12	21	Combustion Engines 1	Georing	1,2,3	
13 (11/11)	22	Springs	Mott	18	**Term Design Meeting**
13	23	Combustion Engines 2	Georing	4,5	
14 (11/18)	24	Fasteners	Mott	19	**Term Design Meeting**
14	25	Welded and Bolted Frame	Mott	20	
15 (11/25)		Thanksgiving Week			
15		Thanksgiving Week			
16		Team Projects & BoeBot Challenge			BoeBot Final Race
Finals		**Exam 3 (Finals Week Schedule)**			

Student Individual Class Activities and Expectations

a) There will be approximately one homework assignment per week from the Mott textbook, which is associated with prior week's lecture material. There will be a few independent assignments associated with special topics covered. You may discuss homework, but you may not copy verbatim from another student. A scanned PDF copy of homework should be turned in online in canvas in advance of class. Solutions must be executed in units given/requested. **Solutions for homework will be posted to Canvas later the week of assignment due day, so no late homework accepted beyond Friday of assignment week. A ten percent late penalty after due date, zero credit after Friday of due week.** Homework review before exams.

b) There will be a quiz associated with each lecture, open on Canvas during the day of lecture assignment, which will cover content from that lecture, examples, and/or demonstration.

c) Three equally weighted non-comprehensive exams will be given. Exams will be open book and notes with a three hour duration. The time limit is fixed, so you must work effectively to complete all questions which will be multiple choice, design, short answer, and T/F type questions.

e) There will be a five page term paper with double spaced lines and 12 point font required that will cover contemporary issues in engineering design of automated systems according to student interest area. The paper

will focus on the multi-disciplinary nature of automated machines, their evolution, as well as the impact that automation is having on the economy and global society.

Student Group activities

f) The design project will more fully expose the students to the material being covered in the class. The project will require the student teams to write up a project report describing the work they have done and documenting all design calculations. The topics will be selected by the student teams from their domain of interest in Precision Ag and Robotics, Biological systems, Bio-Energy and water resources.

g) Students will work in teams to complete exercises using the BoeBot Arduino robot platform. Each team will keep a PDF folder of exercises completed that will be turned in at the end of the semester. Students will then compete in a BoeBot challenge where speed, navigation accuracy will be tested in competition with other student teams.

Attendance Policy, Accommodations, and Make-Up Policy

a) Students who have special learning needs should notify the instructor as soon as possible to make accommodations.
b) No make-up exams will be given except for valid medical reasons or unless prior arrangements are made.
c) Laptops and cellphones may be used to review lecture slides, video and take quizzes. Please no texting or email during class or exam times.
d) Lecture based quizzes will be given that can be taken out of class, if necessary, but may be at a disadvantage due to material covered in class. Material will be available in lecture notes if you decide to take quizzes out of class.
e) Students may drop one homework and one quiz from their lowest score.
f) Excused absences must be consistent with university policies in the undergraduate catalog (https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx) and require appropriate documentation.

Evaluation of Grades

Assignment	Qty	Percentage of Final Grade
Homework Sets	15 to 20	10% (drop lowest)
Lecture Quizzes	15 to 20	5% (drop lowest)
Midterm Exams	3	20% Each
Team Design Project	1	10%
BoeBot Folder	1	10%
Review Paper	1	5%
Total		100%

Grading Policy

The following cutoff will be used.

Percent	Grade	Grade Points
95 - 100	A	4.00
90 – 94.9	A-	3.67
87 - 89.9	B+	3.33
84 - 86.9	B	3.00
80.0 - 83.9	B-	2.67
77 - 79.9	C+	2.33
74 - 76.9	C	2.00
70.0 - 73.9	C-	1.67
67 - 69.9	D+	1.33
64 – 66.9	D	1.00
60.0 - 63.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Students Requiring Accommodations
Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting https://disability.ufl.edu/students/get-started/. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation
Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

In-Class Recording
Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy
UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The Honor Code (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:
• Your academic advisor or Graduate Program Coordinator
• Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
• Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
• Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

Software Use
All faculty, staff, and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy
There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: https://registrar.ufl.edu/ferpa.html

Campus Resources:

Health and Wellness

U Matter, We Care:
Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: https://counseling.ufl.edu, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence
If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)
Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or http://www.police.ufl.edu/.

Academic Resources

E-learning technical suppor*t*, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu. https://lss.at.ufl.edu/help.shtml.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; https://career.ufl.edu.

Library Support, http://cms.uflib.ufl.edu/ask. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring. https://teachingcenter.ufl.edu/.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers. https://writing.ufl.edu/writing-studio/.

Student Complaints Campus*:* https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/;https://care.dso.ufl.edu.

On-Line Students Complaints*: https://distance.ufl.edu/state-authorization-status/#student-complaint*.