

# ECE 8580 –Power Electronics

## Class Meetings

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Section DL01: Thursday, 4:10-7:10pm, Online

## Instructor

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Dr. Jonathan Berardino

[jonathan.berardino@villanova.edu](mailto:jonathan.berardino@villanova.edu)

## Office Hours

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TBD based on Week 1 feedback

By appointment otherwise

## Course Objectives

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1. To develop an understanding of semiconductor devices and circuit topologies used for performing power conversion at the  $\leq 500$  kW power level.
2. To examine and analyze input/output conditions of advanced power circuits with regard to power, efficiency, waveshape, and harmonic distortion.
3. To develop an understanding of the limitations of power electronic components and learn to design for these limitations.
4. To become familiar with techniques for performing computer simulation of power electronic circuits.

## Course Materials

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### Primary Textbook:

Mohan, Undeland and Robbins, *"Power Electronics: Converters, Applications, and Design"*, 3<sup>rd</sup> edn., John Wiley & Sons, 2003

### Additional References:

1. Hart, *"Power Electronics"*, 1<sup>st</sup> edn., McGraw Hill, 2011
2. Baliga, *"Fundamentals of Power Semiconductor Devices"*, 2<sup>nd</sup> edn., 2019

## Grading Policy

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Final grades will be determined from the following:

Homework	20%
Midterm	20 %
Final Exam	30%
<u>Course Project</u>	<u>30%</u>
Total	100%

The scale used to assign letter grades is:

Letter Grade	Numerical Grade	Letter Grade	Numerical Grade
A	94 to 100	C	73 to 76
A-	90 to 93	C-	70 to 72
B+	87 to 89	D+	67 to 69
B	83 to 86	D	63 to 66
B-	80 to 82	D-	60 to 62
C+	77 to 79	F	Less than 60

This is the proposed grading scale and may be adjusted to reflect overall class performance.

## Tentative Schedule

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<u>Date</u>	<u>Topic</u>	<u>Reading Assignment</u>
JAN 28	Overview of PE systems; Semiconductor Physics Review	Chap. 1, 19
FEB 4	Power Diodes; Power Thyristors	Chap. 20, 23
FEB 11	Power MOSFETS; Power IGBTs	Chap. 22, 25
FEB 18	<b>*WORKING BREAK*</b> WBG Power Devices; Review	Chap. 26
FEB 25	Diode Bridge Rectifiers; Phase Controlled Rectifiers	Chap. 5.3-5.9, 6
MAR 4	DC/DC conversion: Modeling and Control Topics	Outside reading
MAR 11	<b>Midterm Exam</b> ; DC/AC inversion: Modeling and Control Topics	Outside reading
MAR 18	Resonant Converters	Chap. 9
MAR 25	Bidirectional Convertors; Matrix Converters	Outside reading
APR 1	Magnetic Design	Chap. 30
APR 8	Applications: UPS, Utility Interfaces	Chap. 11, 18
APR 15	Applications: Motor Drives	Chap. 12-15
APR 22	Applications: Motor Drives (cont.)	Chap. 12-15
APR 29	<b>Course Project Due; Project Presentations</b>	N/A
MAY 6	<b>Final Exam</b>	N/A

\* A working break is a period of time during which no assignments, exams, or papers are due. Classes may be held as normal or modified at the discretion of the instructor (for example, by making class meetings during the working break asynchronous). No examinations may be administered, and no take-home exams may be due, during the working break. No paper or other assignments may be due on the days of the working break.

## Homework

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- Homework assignments will be given on a regular basis.
- Collaboration with other students is both acceptable and encouraged but I expect each assignment to be submitted individually.
- Homework should show evidence of work and provide full details of the analysis in a logical manner; providing only final answers will not be accepted.
- Calculations and figures should be labeled and/or captioned to allow the reader to go through the calculations without difficulty.
- Clearly indicate your final answers.
- Students having difficulty with the homework or course materials are strongly encouraged to seek help from the instructor.

## Exams

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- All exams will be open notes and open book but all submissions must be completed individually. No amount of collaboration between students is acceptable.
- All exams will be due 72 hours after the exam has been posted.
- No late exam submissions will be accepted. Please inform the instructor ASAP if any conflicts will impact this schedule.
- Any questions regarding exams should be address with the instructor within 24 hours of the exam being posted to ensure prompt resolution

## Course Project

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- Details on the course project will be released **Week 4**
- Project may be done individually or in teams of up to two (2) students.
- Final project report and presentation due in class per the schedule.
- No late project submissions will be accepted. Please inform the instructor ASAP if any conflicts will impact this schedule.

## Late Assignment Submission Policy

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- Homework submitted up to one (1) week late will receive a penalty of 25%.
- Homework greater than one (1) week late will receive no credit.
- As stated above, no late exam submission will be accepted.
- Work/life conflicts that may result in a late submission must be cleared with the instructor in advance.

## Inclusive Classroom

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We consider this classroom to be a place where you will be treated with respect; and, we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment for every other member of the class.

## Attendance

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Attendance is not mandatory for this course. As this class is entirely held online, the lectures will be recorded and available for viewing outside of class on the students' schedule. Students are **strongly encouraged** to attend lectures via the live stream in order to interact with both the professor and other students.

Where possible, students should inform their instructors if they plan to be late or absent from class or otherwise unable to view the recorded lectures. In all cases, students should be prepared to provide documentation to petition for *excused* absences to the Associate Dean for Student and Strategic Programs. Students should use the [form for requesting an excused absence](#). Excused absences do not count toward a failure in the course for first year students. Absence from class does not release the student from work assigned. Students who miss an in-class obligation (exam, presentation, etc.) due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement. In the case of illness or injury, the form must be submitted within 24 hours of missing class.

The University's list of excused absences for all students includes the following:

- participation in NCAA athletic competitions
- participation in special academic events (e.g., conferences, field trips, project competitions)
- participation in official university business (e.g., student representatives attending meetings related to university governance)
- attendance at significant events involving the immediate family (e.g., funerals, weddings)
- religious holidays - see the University's policy on Religious Holidays
- college-approved participation in placement activities (e.g., job interviews, graduate school interviews, attending job fairs)
- legally required absence (jury duty, court appearance, short-term military service)
- documented serious illness, such as COVID, or disability

## Academic Integrity

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The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs.

Students are encouraged to read the [University's academic integrity policy](#).

The College of Engineering has adopted the following exam guidelines:

- Students must arrive before the start of the exam. Under exceptional circumstances a student may need to arrive late, but he/she can enter the exam no later than 5 minutes after the start of the exam.

- All cell phones must be turned off and stored away until the student exits the exam room.
- The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an exam.
- Each student must write and sign the following statement, *"I have neither given nor received any unauthorized assistance in the completion of this exam."* If taking an exam remotely, students still need to copy and sign this statement (even if signed for electronically).
- In the case of virtual exams, the instructor may implement video proctoring or other measures to ensure academic integrity. For consent purposes, the instructor will announce ahead of time to students if they plan to use any form of video proctoring during an assessment and whether a recording will take place.
- For this class, **all exams will be take home exams**. The exams are open book but must be completed individually. Any evidence of plagiarism will be addressed in accordance with the University academic integrity policy.

## Adherence to the Student Code of Conduct and the CARITAS Commitment

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Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to University regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

To foster a professional environment, please wear appropriate clothes, mute if you are not talking to cut down on background noise, refrain from eating, and select an appropriate setting when we are meeting online.

Students, faculty, and staff are expected to comply with the [CARITAS Commitment](#). Students should wear masks, practice social distancing and good hygiene, wipe down their work area upon arrival and departure, and request an excused absence if they are not feeling well.

## Students with Disabilities

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It is the policy of Villanova to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability please contact me after class or during office hours to make arrangements.

If you have a non-physical disability you need to register with the Learning Support Office by contacting 610-519-5176 or at [learning.support.services@villanova.edu](mailto:learning.support.services@villanova.edu) as soon as possible. Registration is needed to receive accommodations.

The Office of Disability Services collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical disabilities the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact and register with Gregory Hannah, advisor to students with disabilities @ 610-519-3209 or visit the office on the second floor of the Connelly Center.

## Electronics Policy

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Students are prohibited from making any audio or visual recordings (including taking photographs) of lectures, discussions, or other classroom activities, unless a student (1) has written permission in advance from the instructor, or (2) is permitted to record under terms and conditions as approved by the University's Office of Disability Services or Learning Support Services. Students who have received approval to record classes as an academic accommodation must provide supporting documentation from the Office of Disability Services or Learning Support Services in advance of any recording. Students may use authorized recordings only for the purposes of individual study in the course and may not disseminate or share them with a wider audience without explicit permission.

## Copyright Policy

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The materials used in Villanova University courses ("Course Materials") generally represent the intellectual property of course instructors, third parties and/or the University which may not be disseminated or reproduced in any form for public distribution (e.g., sale, exchange, etc.) without the written permission of the course instructor. Course Materials include all written or electronic documents and materials, including syllabi, current and past examination questions/answers, and presentations such as lectures, videos, PowerPoints, etc., provided by a course instructor. Course Materials may only be used by students enrolled in the course for academic (course-related) purposes.

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