Course Information

ECE 51018- Hybrid Electric Vehicles
CRN 21283 (WNG), 21287 (EPE), 23335 (OXE), 28273 (OL1), 32674 (MXE), 31675 (CXE)
Credits: 3

Meeting Days and Time
MWF 10:30-11:20, Wang 2579

Prerequisites by Topic
Collegiate-level physics and math. Basic programming skills (Matlab).

Instructor Contact Information

	Instructor	Teaching Assistant
Name	Oleg Wasynczuk	Shubham Agnihotri
Office	Do not use	Do not use
Phone	Do not use	Do not use
Email	wasynczu@ecn.purdue.edu	sagnihot@purdue.edu
Office Hours	Weekdays 2:00-3:00 pm (or by appointment) https://purdue.webex.com/meet/wasynczu	By appointment https://purdue-student.webex.com/meet/sagnihot

Office hours will be via Webex.
Face-to-face meeting by request.
The preferred method of communication is by Purdue email.
Please use your Purdue email account or Brightspace (not gmail or other non-Purdue account)
Be sure to include "ECE 51018" in the subject line of any email (automatically done in Brightspace).

Course Description

The primary objective of the course is to introduce architectures and technologies associated with electric, hybrid electric, and plug-in hybrid vehicles including their constituent components. Specific topics include electric and hybrid electric drive trains, energy storage (batteries and/or ultra-capacitors), electromechanical energy conversion (permanent-magnet, induction, and switched-reluctance machines), power electronics, vehicle-level modeling and control, and optimization.

Learning Resources, Technology & Texts

Text
C. Mi, A. Masrur, and D. W. Gao, Hybrid Electric Vehicles with Practical Perspectives, IEEE/Wiley, 2018 (Second Edition). You may download pdf copy through Purdue Libraries website.

Hardware Requirements
Laptop or desktop computer (Windows, Mac, Linux) with webcam and strong internet connection. Ready access to reliable printer.

Software Requirements

Word Processor: A standard word processing application such as MS Word, Pages, or LaTeX will be needed to generate project reports.

Respondus Lockdown Browser: You will need to download and install Respondus Lockdown Browser for taking exams. Instructions for doing this will be provided later.

Matlab/Simulink: Matlab/Simulink will be needed to perform projects. You may use "Citrix" for remote access to Purdue's MATLAB license. See the following link for more information: Purdue Software Remote System. Alternatively, you can purchase a student version for $99 USD using the following link: MATLAB and Simulink Student Suite. However, Purdue students and faculty can now download and install MATLAB/Simulink on their personally owned computers for free by using the following link: https://www.mathworks.com/academia/tah-portal/purdue-university-31484706.html

Individuals should review the page, scroll down, and click on the *Sign in to get started* button. Most users will need to create a MathWorks account using their Purdue e-mail address by clicking on the *Create Account* link just under the sign-in boxes. If the individual already has a MathWorks account using their Purdue e-mail, they can sign in. If they have created an account using another e-mail, they will need to establish a new MathWorks account with the Purdue e-mail to take advantage of this offer.

Course Schedule

Topic	Approx. Lectures	Assignments
Powertrain fundamentals	6	
Vehicle architectures (series, parallel, split torque)	7	Project 1
Exam 1	1	
Review of basic physics (electromechanics)	2	
Permanent-magnet ac machine and control	4	Project 2
Induction machine and control	5	
Switched reluctance machine and control	3	
Exam 2	1	
Battery characteristics, limitations, and management	6	Project 3
Vehicular-level power electronics	2	
Power/energy management strategies	4	
Review	2	
Exam 3 (Final Exam Period)		

Key Dates and Academic Calendar

- Jan. 4 – Academic Year Faculty/Staff First Day
- Jan. 19 – Classes Begin
- Feb. 17 – Reading Day
- Feb. 22 – Exam 1
- March 18 – Reading Day
- March 29 – Exam 2
- April 13 – Reading Day
- May 1 – Classes End
- May 3-8 – Final Exams (Exam 3)
- May 8 – Semester Ends
- May 11 – Grades Due

Link to Purdue [Academic Calendar](#)

Learning Outcomes

A student who successfully fulfills the course requirements will have demonstrated:
  (i)   An understanding of the principal architectures of electric and hybrid electric vehicles
  (ii)   Ability to analyze performance characteristics and understand limitations of each architecture
  (iii) An understanding of the principal components of an HEV including the power/energy storage, conversion, transmission, and control subsystems
  (iv)   Ability to integrate disparate subsystem models to form end-to-end vehicle model

Procedures During Covid19 Pandemic

1. Lectures will be live during scheduled class time. Lectures will be recorded and uploaded to Brightspace.
2. Physical attendance in classroom (studio) is encouraged but NOT required. You will be able to view recorded lectures via Brightspace. If you suspect exposure to COVID, please follow procedures described later. Those who attend must obey all "[Protect Purdue](#)" regulations and guidelines.
3. Procedures may change depending on circumstances of semester. The goal will always be to provide a safe and meaningful learning experience for everyone.

Assignments

Projects:
Three Matlab/Simulink projects (Analysis of a Parallel Hybrid Electric Vehicle, Analysis of a Permanent-Magnet ac Motor Drive, and Analysis of Battery Round-Trip Efficiency) will be assigned. Working together is allowed. However, reports must represent your own work. Copying all or part of another student's report is plagiarism and will result in failure of course (plagiarism checkers will be used) and referral to the Dean of Students.

Exams:
There will be three exams (one at end of each module). A 50-minute time limit on all exams will be strictly enforced. The dates are as follows,
    Exam 1, Monday February 22, 2021
    Exam 2, Monday, March 29, 2021
    Exam 3, Final Exam period, TBD

Course Grading

Exams (40%): Exams contribute to 40% of the final grade.

Projects (60%): There will be three projects. Information on the projects and instructions on how to submit them will be posted later. Projects contribute to 60% of the final grade. Typed reports will be graded on basis of correctness of results, supporting analysis, documentation of computer models, and discussion of results.

The final grade will be based on the weighted sum of exams and projects converted to a percentage. The course cutoffs are as follows:

40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100
D-	D	D+	C-	C	C+	B-	B	B+	A-	A	A+

Academic Integrity

All project reports and exams are to be an individual's own work. You may discuss project results with one another; however, the final results and typewritten report must be your own work. Sharing or comparing answers on an exam or plagiarizing another student's report (or other source) will result in a failing grade for the course and referral to the Dean of Students. I will use plagiarism checking tools. Unless prior approval is requested and granted, late projects will result in a loss of points for that project.

Classroom Guidance Regarding Protect Purdue

The Protect Purdue Plan, which includes the Protect Purdue Pledge, is campus policy and as such all members of the Purdue community must comply with the required health and safety guidelines. Required behaviors in this class include: staying home and contacting the Protect Purdue Health Center (496-INFO) if you feel ill or know you have been exposed to the virus, wearing a mask in classrooms and campus building, at all times (e.g., no eating/drinking in the classroom), disinfecting desk/workspace prior to and after use, maintaining proper social distancing with peers and instructors (including when entering/exiting classrooms), refraining from moving furniture, avoiding shared use of personal items, maintaining robust hygiene (e.g., handwashing, disposal of tissues) prior to, during and after class, and following all safety directions from the instructor.

Students who are not engaging in these behaviors (e.g., wearing a mask) will be offered the opportunity to comply. If non-compliance continues, possible results include instructors asking the student to leave class and instructors dismissing the whole class. Students who do not comply with the required health behaviors are violating the University Code of Conduct and will be reported to the Dean of Students Office with sanctions ranging from educational requirements to dismissal from the university.

Any student who has substantial reason to believe that another person in a campus room (e.g., classroom) is threatening the safety of others by not complying (e.g., not wearing a mask) may leave the room without consequence. The student is encouraged to report the behavior to and discuss next steps with their instructor. Students also have the option of reporting the behavior to the Office of the Student Rights and Responsibilities. See also Purdue University Bill of Student Rights.

Related Considerations:
1. A listing of recommended safe practices for the specific class or laboratory setting (other PPE or safety behavior) can be found at the links below.
   ● Overarching SOP for Classrooms, Instructional Laboratories, and Experiential Courses
2. References Supporting Protect Purdue Compliance:
   ● Office of the Dean of Students Protect Purdue Compliance Plan: Ask, Offer, Leave, Report
   ● Office of the Dean of Students Managing Classroom Behavior and Expectations

Academic Guidance in the Event a Student is Quarantined/Isolated

If you become quarantined or isolated at any point in time during the semester, in addition to support from the Protect Purdue Health Center, you will also have access to an Academic Case Manager who can provide you academic support during this time. Your Academic Case Manager can be reached at acmq@purdue.edu and will provide you with general guidelines/resources around communicating with your instructors, be available for academic support, and offer suggestions for how to be successful when learning remotely. Importantly, if you find yourself too sick to progress in the course, notify your academic case manager and notify me via email or Brightspace. We will make arrangements based on your particular situation. The Office of the Dean of Students (odos@purdue.edu) is also available to support you should this situation occur.

Nondiscrimination Statement

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. More details are available on our course Brightspace table of contents, under University Policies. A link to Purdue's full nondiscrimination policy can also be found here.

Accessibility

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247. More details are available on our course Brightspace under Accessibility Information.

Mental Health Statement

If you find yourself beginning to feel some stress, anxiety and/or feeling slightly overwhelmed, try WellTrack. Sign in and find information and tools at your fingertips, available to you at any time.

If you need support and information about options and resources, please contact or see the Office of the Dean of Students. Call 765-494-1747. Hours of operation are M-F, 8 am- 5 pm.

If you find yourself struggling to find a healthy balance between academics, social life, stress, etc. sign up for free one-on-one virtual or in-person sessions with a Purdue Wellness Coach at RecWell. Student coaches can help you navigate through barriers and challenges toward your goals throughout the semester. Sign up is completely free and can be done on BoilerConnect. If you have any questions, please contact Purdue Wellness at evans240@purdue.edu.

If you're struggling and need mental health services: 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 mental health support, services are available. For help, such individuals

should contact [Counseling and Psychological Services (CAPS)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

TaskHuman offers 1-on-1 live video calls with coaches who help you focus on wellness topics such as anxiety, mindfulness, reducing stress, clean eating, time management, in-home workouts, relationship tensions, and nearly a thousand more topics. You can log on at any time to access experiences as diverse as working through heightened anxiety to a personalized yoga session with carefully vetted providers. Purdue ECE has an exclusive agreement with TaskHuman which gives you unlimited access to these resources (and some Purdue-specific bonuses). Using this link gets you access to all the perks: https://taskhuman.com/referral/purdue. Learn more here:
https://engineering.purdue.edu/ECE/TaskHuman.

Attendance Policy during COVID-19

You should stay home and contact the Protect Purdue Health Center (496-INFO) if you feel ill, have any symptoms associated with COVID-19, or suspect you have been exposed to the virus. In the current context of COVID-19, in-person attendance will not be a factor in the final grades, you still needs to inform me of any conflict that can be anticipated and will affect the submission of an assignment. When conflicts can be anticipated, such as for many University-sponsored activities and religious observations, you should inform me of the situation as far in advance as possible. For unanticipated or emergency conflict, when advance notification to an instructor is not possible, you should contact me by email as soon as possible. In cases of bereavement, quarantine, or isolation, you or your representative should contact the Office of the Dean of Students via [email](#) or phone at 765-494-1747. Our course Brightspace includes a link on Attendance and Grief Absence policies under the University Policies menu.

Emergency Preparation

1. If you experience any symptoms of COVID-19 or suspect you may have been exposed to someone with COVID-19 stay home and call the Protect Purdue Health Center at 765-496-INFO.
2. Keep your cell phone on to receive a Purdue ALERT text message.
3. Log into a Purdue computer connected to the network to receive any Desktop Popup Alerts.

Disclaimer

1. In the event of a major campus emergency or disruption of normal activities, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond my control. Relevant changes to this course will be posted on Brightspace with a notice sent by email. You are expected to read your @purdue.edu email on a frequent basis. The goal will always be to provide a safe and meaningful learning experience for everyone.

Have a great semester and, above all, stay healthy!
Oleg Wasynczuk