



## **ET751 Mechanical Engineering Design Project, 4 Credits** **ET791 Electrical Engineering Design Project, 4 Credits**

**UNH Credit Hour Policy:** The University of New Hampshire is in compliance with the federal definition of the credit hour. For each credit hour, the university requires, at a minimum, the equivalent of three hours of student academic work each week assuming a 15-week semester (student workload for shorter length terms must be increased proportionally per week to maintain required approximately 45 hours of work per credit per term). Student work reflects intended learning outcomes and is verified through evidence of student achievement. For this 4-credit, 15-week course, students are expected to spend a minimum of 12 hours each week on their academic work.

**Course Format:** This course is an in-person, on-campus course. There is no remote attendance option. There is a regularly scheduled meeting time once a week and students are expected to attend. The project also requires on-campus attendance during team work sessions, robot practice sessions, and the final competition event. See course outline for topics/schedule and projected assignment due dates. Student participation is expected. All students will be assigned to a VEX Robot Team. All due dates apply to all students and will be strictly enforced.

**COURSE DESCRIPTION:** Students are required to find solutions to actual technological problems in design, fabrication, and testing similar to those posed in industry. Students define the problem, prepare a budget, prepare a schedule, and work to research, design, build, and test the software and hardware needed. Prerequisite: Senior standing in the ET program. This is a two-semester, year-long course: 4 credits per semester, a letter grade is issued at the end of each semester. Withdrawal from course results in loss of credit.

This course is a designated writing-intensive (WI) course which in part fulfills the university writing requirement (see <http://www.unh.edu/writing/uwr/>). WI courses meet three guidelines:

1. The writing is substantial and integral to the course, writing accounts for at least 50% of the grade acts as a means for learning course material.
2. The course employs feedback and process; writing is done in stages, allowing for meaningful feedback and revision.
3. The course employs both informal or low stakes and formal or high stakes writing assignments. Note the writing assignments listed in the course topics section per semester.



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**REQUIRED TEXT:** There is no course specific textbook.

**GENERAL COURSE INFORMATION:**

The two Engineering Technology senior project courses, ET751 Mechanical Engineering Technology and ET791 Electrical Engineering Technology are combined into a single course in Canvas. The two courses meet on the same day and same time.

The Engineering Technology Accreditation Commission of the Accreditation Board for Engineering and Technology (ETAC of ABET) requires that student outcomes, e.g., skills that students will have at the time of graduation, be specified and that data be collected annually per the ET program's Continuous Program Improvement Plan (CPIP) to verify outcomes are being met. The capstone senior project courses, ET751 and ET791, are a major source of data to verify that the outcomes are being met. For each program, Mechanical and Electrical, the necessary outcomes have been included in this syllabus. Student outcomes are measured and assessed through grading/evaluation by faculty and volunteer observers/reviewers/judges at the URC and VEX Competition.

A common UNHM sponsored project is used for all students in the combined capstone course. There is no independent or company sponsored project option. The common project is the VEX Robotics University Level Competition – called VEX U. Students will be randomly assigned to a 3-5 person team to design, fabricate, build, program, troubleshoot, test, and compete with VEX robots in a UNHM VEX U competition. The UNHM VEX U competition will be held on the UNHM campus toward the end of the spring term (late April). Each team is tasked to build two robots which perform various tasks in both a two-robot team vs. team competition style game and as individual team robot skills challenges (as required by VEX U). See the VEX U rules and current game documentation on the Vex Robotics web page.

In addition to the project responsibilities, weekly class meetings will consist of selected lecture materials and/or project work time. Attendance is required for specific dates and topics (see course outline) and will be part of the course grade. Attendance is expected during the scheduled class time and at specified robot events. The class is scheduled to meet once a week.



**CLASS MEETING INFORMATION: Attendance is expected on selected dates.**

Section	Day	Start Time	End Time	Room
Lecture	Monday	4:10 PM	5:30 PM	P149

Each VEX Team will require additional team meetings (I suggest weekly) to work on their robots. These meetings will be managed by each team. Access to workspace (machine shop lab, P116 and the playing field in P149) may be arranged working with faculty and staff. All team members are expected to equally participate on the project. Note the definition and expectation of a 4-credit course = minimum of 12 hours per week in addition to class time.

**GRADING AND ASSESSMENT:**

Both the fall and spring semesters have specific assignments and expectations with some differences which relate to how the project progresses over the academic year. Most graded assignments relate to the VEX U project which spans both semesters. Some graded assignments carry both a team (group) component and an individual contribution component. It is very likely that students working on the same team may receive different end of course grades. Grade breakdown by semester, and by precent weight are given in the tables below. Percentage refers to overall course grade. Due dates will be announced and posted on the Canvas course page.

A Writing Intensive (WI) course requires a significant amount of writing which amounts to 50% of the overall course grade. A cumulative final report is due at the end of each term. The Fall semester requires a Project Proposal, a written report (communication) of where the project is heading leading into the spring semester. The spring semester culminates in a Final Project Report, a written report (communication) of the concluded project detailing progress and final results. Each term has cumulative writing assignments assigned at strategic times which will ultimately build confidence and hone the student's writing skills toward the formulation of the end of term reports. Faculty will provide constructive feedback and allow revision of early writing assignments leading up to the final report submission deadline.

The course also requires verbal or oral communication of ideas, process, and design which are delivered through the Design Reviews Sessions (fall semester) and ultimately at the URC Presentation (spring semester). Each will require a presentation to an audience and the use of a PowerPoint presentation.

The following tables detail both fall and spring semester Grading distribution. The fall semester table will be used this semester. The spring semester table is given for completeness and to inform where the project will be heading.



<b>Fall Semester Grading Breakdown by Assignment</b>			
Assignment	Group	Individual	Overall percent
*Resume		x	10
*Literature search		x	8
Engineering Notebook entry (weekly)	x	x	10
Game Strategy (written – low stakes)	x		3
Initial Design Concept (written – low stakes)	x		3
*Design Reviews (3 oral group presentations)	x	x	20
Design Review Reflection (written – low stakes)	x		3
Challenges (written – low stakes)	x		3
Proposal Draft Report (written – high stakes)	x	x	8
*Robot Drivetrain Testing	x	x	10
Teamwork evaluation		x	10
Proposal Final Report (written – high stakes)	x	x	12
Total=			100

Notes: RED Highlights = Writing Intensive Requirements (50% total grade)

<b>Spring Semester Grading Breakdown by Assignment</b>			
Assignment	Group	Individual	Overall percent
Engineering Notebook entry (weekly)	x	x	10
Program Flow Outline (written – low stakes)	x		4
*Scrimmage Practice Sessions (2)	x	x	10
*Skills Practice Sessions (2)	x	x	10
Practice Results (written – low stakes)	x		4
Sensor Usage Proposal (written – low stakes)	x		4
Challenges (written – low stakes)	x		4
*URC Participation (oral group presentation) with PowerPoint (written work)	x	x	10
			4
*UNHM VEX U Competition	x	x	10
Proposal Draft Report (written – high stakes)	x	x	8
Teamwork evaluation		x	10
Proposal Final Report (written – high stakes)	x	x	12
Total=			100

Notes: RED Highlights = Writing Intensive Requirements (50% total grade)

**Important Note: Program required courses require students to achieve a minimum passing grade of C- in order to graduate from the program. A minimum GPA of 2.0 is also required in all program specific courses for graduation.**



**ATTENDANCE:** Class attendance is important for team active participation. You are responsible for all course assignments and meeting all deadlines unless exceptions are agreed upon with the instructors ahead of time. Attendance in this course is expected, if more than 3 absences occur a grade of AF may be issued at the discretion of the instructor. See the [Attendance and Class Requirements](#) policy in the undergraduate catalog and MANDATORY ATTENDANCE DATES listed on the course outline and described below.

In the event that a student needs accommodation for a religious or cultural holiday/observance, that student is encouraged to make that request as early in the semester as possible.

If you are dealing with an unexpected, extenuating circumstance that will keep you out of class or affect your performance for more than a day or two (e.g., test positive for Covid19), reach out to Lisa Enright, Assistant Dean of Student Success, at [lisa.enright@unh.edu](mailto:lisa.enright@unh.edu) to request a letter be sent to all your faculty.

If you are required to miss significant class time, you will be provided temporary academic supports so that you can continue to make satisfactory progress in this course. Please contact your course instructor to discuss the specific types of supports that will be implemented during your absence.

Note: Attendance is MANDATORY and recorded for specific sessions involving team performance: Fall semester (6 total) – Resume and Literature Search Workshops, (3) Design Review Sessions, Robot Field Testing event; Spring semester (7 total) – (3) Scrimmage and (2) Skills Practice Sessions, URC, UNHM VEX U competition. Excessive absences, (4 max) may result in a grade of AF (Administrative Fail) for the course. Excessive lateness or leaving session early (especially when affecting team performance) may be counted as an absence at the faculty member's discretion. Participation in the Undergraduate Research Conference (URC) and the UNHM VEX U Competition is MANDATORY. These are two events are scheduled near the end of the spring semester and occur typically on a Friday and a Saturday respectively, the actual dates will be announced as soon as the URC is scheduled.

**ACADEMIC HONESTY:** In the preparation and presentation of any assigned work – including examinations, tests, quizzes, term papers, reports, papers and other written or oral exercises – every student shall conform to a strict standard of academic honesty. Any attempt to deceive a faculty member or to help another student to do so will be considered a violation of this standard. In all assignments, students must acknowledge the words and/or ideas of others taken from print or electronic media, whether a direct quotation or a paraphrase; any omission of this is dishonest. Cheating on examinations or tests consists of knowingly giving, receiving, or using – or attempting to give, receive, or use – unauthorized assistance during an examination or test. A faculty member may record a grade of “zero” for any assignment on which a student has plagiarized or cheated. For repeat offenses within a single course, the faculty member may record a



grade of “F” for the course. Violations of this policy in multiple courses may result in dismissal from the college. See these various links to academic honesty, plagiarism tutorial, and academic integrity:

<https://catalog.unh.edu/srrr/academic-policies/academic-honesty/>

<https://cola.unh.edu/academics/plagiarism-tutorial>

<https://catalog.unh.edu/srrr/university-policies-regulations/academic-integrity/>

**PROFESSIONALISM:** Students are expected to show proper behavior and respect in the classroom and laboratory. Each student is expected to act as a professional as would be expected in industry. This includes the use of proper language and attitude toward the instructor and other students in the classroom and lab. Students should be on-time, not exit and re-enter class or lab excessively, and not leave early. Cell phones **should be turned off and put away** during lecture and laboratory sessions. Laptops are permitted for **note taking only**, NOT for accessing the internet or email services. Courtesy and respect is expected from all students. **All safety practices and policies must be adhered to at all times, especially in the lab.** Improper behavior or continued violations of any of the above rules will not be tolerated. Violation of the above rules, especially safety rules, will result in suspension from the lab and/or course with appropriate corresponding grade consequences.

**STUDENTS WITH DISABILITIES:** According to the Americans with Disabilities Act (as amended, 2008), each student with a disability has the right to request services from UNH to accommodate his/her/their disability. If you are a student with a documented disability or believe you may have a disability that requires accommodations, please contact Student Accessibility Services (SAS) located on the Manchester campus in the Student Services Suite (Office 405A).

Accommodation letters are created by SAS with the student. Please follow-up with your instructor as soon as possible to ensure timely implementation of the identified accommodations in the letter. Faculty have an obligation to respond once they receive official notice of accommodations from SAS but are under no obligation to provide retroactive accommodations.

For more information refer to [www.unh.edu/sas](http://www.unh.edu/sas) or contact SAS at 603.862.2607, 711 (Relay NH) or [sas.office@unh.edu](mailto:sas.office@unh.edu).

**Confidentiality and Mandatory Reporting of Sexual Violence or Harassment:**

The University of New Hampshire and its faculty are committed to assuring a safe and productive educational environment for all students and for the university as a whole. To this end, the university requires faculty members to report to the university's [Title IX Coordinator](#) (Bo Zaryckyj, [Bo.Zaryckyj@unh.edu](mailto:Bo.Zaryckyj@unh.edu), 603-862-2930/1527 TTY) or to the UNH Manchester/CPS Title IX Deputy Intake Coordinator (Lisa Enright, [lisa.enright@unh.edu](mailto:lisa.enright@unh.edu) 603-641-4336, Room 439) any incidents of sexual violence and harassment shared by students.



If you wish to speak to a confidential support service provider who does not have this reporting responsibility because their discussions with clients are subject to legal privilege, you can contact the [SHARPP Center for Interpersonal Violence Awareness, Prevention, and Advocacy](#) at (603) 862-7233/TTY (800) 735-2964. For more information about what happens when you report, how the university treats your information once a report is made to the Title IX Coordinator, your rights and reporting options at UNH (including anonymous reporting options) please visit [student reporting options](#). [The uSafeUS app](#) is also available for students to keep reporting options and resources easily accessible on their phones.

Help us improve our campus and community climate. If you have observed or experienced an incident of bias, discrimination or harassment, please report the incident by contacting the Civil Rights & Equity Office at [UNH.civilrights@unh.edu](mailto:UNH.civilrights@unh.edu) or TEL # (603) 862-2930 voice/ (603) 862-1527 TTY / 7-1-1 Relay NH, or [visit the CREO website](#). Anonymous reports may be submitted.

Confidential Support Resources for UNH Manchester:

- SHARPP Extended Services Coordinator for UNH Manchester- room 417. Available in person Mondays 9 am to 4-pm and by Zoom appointment year-round M-F.
- YWCA, NH – 603-668-2299(24hour), 72 Concord St. Manchester, NH
- The Mental Health Center of Greater Manchester: On campus mental health counselors are available by appointment during the academic year. Located in room 426.
- 24 Hour NH Sexual Violence Hotline: 1-800-277-5570
- 24 Hour NH Domestic Violence Hotline: 1-866-644-3574

**UNH Statement on emotional or mental health distress:** In partnership with The Mental Health Center of Greater Manchester, UNH Manchester offers consultation visits on a walk-in basis and through telehealth appointments. Services include:

- Free confidential screening & consultation with a licensed mental health therapist.
- Referrals to mental health or substance misuse treatment. And assistance in understanding how to afford additional treatment (with or without insurance!) or find free services.

You may email: [unhm.wellness@unh.edu](mailto:unhm.wellness@unh.edu) to make an appointment to meet with a counselor by clicking [here](#) or by using the QR codes below.

For in person appointments please scan this code



For remote appointments please scan this code



If you would like to connect to counseling services directly, you may do so by contacting The Greater Manchester Mental Health Center at (603) 668 - 4111.

The National Suicide Prevention Lifeline provides 24/7, free and confidential support via phone or chat for people in distress, resources for you or your loved ones, and best practices for professionals. Call (800) 273-TALK (8255).

### **Library Resources:**

The UNH Manchester librarians are available to assist you with the research process. Visit the library's website at <https://cps.unh.edu/library> to learn about library services and to search for reliable academic sources. You can contact the library at 603-641-4173 or at [unhm.library@unh.edu](mailto:unhm.library@unh.edu).

The links below guide you to useful online library resources:

- Make a **Research Appointment** with a librarian:  
<https://libraryguides.unh.edu/remoteaccess/researchhelp>
- Use the **Library Search Box** to find information:  
[https://libraryguides.unh.edu/librarysearchbox\\_unhmanchester](https://libraryguides.unh.edu/librarysearchbox_unhmanchester)
- Reserve a **Study Room**: <https://cps.unh.edu/library/support-services>
- Discover resources for **Citing Sources**:  
<https://libraryguides.unh.edu/unhm citingsources>
- Learn strategies for **Evaluating Sources**:  
<https://libraryguides.unh.edu/ENGL401UNHManchester/evaluatingsources>.

### **VEX-U Project Introduction:**

VEX Robotics and the REC Foundation sponsor robotic competitions each year at various levels. The following two websites contain much information about these competitions as well as providing educational and resource materials: <https://www.vexrobotics.com/> and <https://www.roboticseducation.org/>. There are several levels of competitions, most notably are the middle and high school levels using the VEX V5 platform (metal structural construction elements along with various sensors and a V5 Brain and Controller). VEX has a separate robotic platform for elementary school robotics platform called VEX IQ. VEX has a competition for college level students called VEX U. This competition uses the



VEX V5 platform. Other VEX components used for the middle/high schools plus additional machined/fabricated/printed parts are allowed at this level. The basic game (game changes each year) is used as well, but there are additional higher level challenges for college level students. See the current VEX Game Manual (Over Under) and the VEX U section <https://www.vexrobotics.com/v5/competition/vrc-current-game> Appendix C.

VEX U competitions consist of a college level student team using two robots working together in teams against another team to score points by performing various required tasks. Each robot has different size specification limitations. After successfully winning matches, teams can advance to the final championship round. In addition to building a successful team of two-robots which performs well in the team vs. team competition, there are “Robot Skills Challenges” (see Game manual Appendix B), and there are two prestigious championship level awards: the Excellence and Design Awards.

A short description (copied from the VEX website for these awards are listed below (taken from an earlier game manual appendix):

The **Excellence Award** is the highest award presented in the VEX U Robotics Competition. This award is presented to a team that exemplifies overall excellence in creating a high quality VEX U robotics program. This team is a strong contender in numerous award categories. Excellence winners must have an engineering notebook.

Key criteria include: Design Award ranking, Tournament Qualification Matches ranking, Robot Skills Challenge ranking, team interview skill, and a high quality VEX U robotics team

The **Design Award** is presented to a team that demonstrates an organized and professional approach to the design process, project and time management and team organization. Only teams that submit Engineering Notebooks are eligible for the Design Award.

Key criteria include: Engineering Notebook – a clear complete document of the team’s design process, Team ability to explain their design and strategy through the season, Team demonstrates personnel, time, and resource management, Teamwork, interview quality, and team professionalism

#### **Robot Skills Challenge:**

Teams individually compete with their robots on the game field to score points. There are two types of skills challenges required and both must be entered to score in the Robot Skill Challenge ranking. There is the Driving Skills Challenge which is entirely driver controlled and the Programming Skills Challenge which is entirely autonomous with no human interaction. Teams are ranked on the combined score of the two types of challenges.



For the purpose of the UNHM capstone course: Robot teams will be required to compete in a UNHM VEX U Competition to showcase design, functionality, performance, and programming of their robot projects. Teams are required to:

- Participate in the team vs. team competition matches, leading to a tournament championship.
- Participate in both Robot Skills Challenges
  - Driver Skills – Remote control
  - Programming Skills – 100% Autonomous
- Compete for the Design Award
- Compete for the Excellence Award
- Produce a well documented Engineering Notebook
- Demonstrate team management skills
- Demonstrate project management skills
- Each robot MUST include additional parts in their construction and function.
  - Machined parts
  - 3D printed parts
  - Multiple types of sensors

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The following section gives information about the program accreditation criteria and required program assessment. Excerpts are taken from the ABET/ETAC Accreditation Manual

**ABET/ETAC (Accreditation Board for Engineering and Technology/Engineering Technology Accreditation Commission)**

**I. General Criteria (2019)**

**Criterion 3. Student Outcomes**

The program must have documented student outcomes with a documented and effective process for the periodic review and revision of these student outcomes. For purposes of this section, well-defined activities or problems are practical, narrow in scope, use conventional processes and materials in traditional ways, and require knowledge of standard operating processes. Broadly-defined activities or problems are practical, broad in scope, relatively complex, and involve a variety of resources; use new processes, materials, or techniques in innovative ways; and may require extension of standard operating procedures.

**B. For baccalaureate degree programs, these student outcomes must include, but are not limited to, the following:**

- (1) an ability to apply knowledge, techniques, skills and modern tools of mathematics, science, engineering, and technology to solve broadly-defined engineering problems appropriate to the discipline;
- (2) an ability to design systems, components, or processes meeting specified needs



- for broadly-defined engineering problems appropriate to the discipline;
- (3) an ability to apply written, oral, and graphical communication in broadly-defined technical and non-technical environments; and an ability to identify and use appropriate technical literature;
  - (4) an ability to conduct standard tests, measurements, and experiments and to analyze and interpret the results to improve processes; and
  - (5) an ability to function effectively as a member as well as a leader on technical teams.

## **II. PROGRAM CRITERIA**

### **ELECTRICAL ENGINEERING TECHNOLOGY**

#### **PROGRAM CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS**

The curriculum must enable the program to prepare graduates with skills necessary to enter careers in the design, application, installation, manufacturing, operation and/or maintenance of electrical/electronic(s) systems. Graduates of baccalaureate degree programs are well prepared for development and implementation of electrical/electronic(s) systems. Given the breadth of technical expertise involved with electrical systems, and the unique objectives of individual programs, some baccalaureate programs may focus on preparing graduates with in-depth but narrow expertise, while other programs may choose to prepare graduates with expertise in a broad spectrum of the field. Therefore, the depth and breadth of expertise demonstrated by baccalaureate graduates must be appropriate to support the program educational objectives. The curriculum must enable the program to prepare graduates to have competence in the following curricular areas:

- a. the application of circuit analysis and design, computer programming, associated software, analog and digital electronics, and microcomputers, and engineering standards to the building, testing, operation, and maintenance of electrical and electronic(s) systems;
- b. the application of natural sciences and mathematics at or above the level of algebra and trigonometry to the building, testing, operation, and maintenance of electrical/electronic systems;
- c. the ability to analyze, design, and implement one or more of the following: control systems, instrumentation systems, communications systems, computer systems, or power systems;
- d. the ability to apply project management techniques to electrical/electronic(s) systems; and
- e. the ability to utilize differential and integral calculus, as a minimum, to characterize the performance of electrical/electronic systems.

### **MECHANICAL ENGINEERING TECHNOLOGY**

#### **PROGRAM CRITERIA FOR BACCALAUREATE LEVEL PROGRAMS**



The curriculum must prepare baccalaureate degree graduates with the knowledge, techniques, skills, and use of modern equipment in mechanical engineering technology. Baccalaureate degree graduates build on the strengths of associate degree programs by gaining proficiency in the analysis, applied design, development, implementation or oversight of more advanced mechanical components, systems or processes. Programs may focus on preparing graduates with in-depth but narrow expertise, while other programs may choose to prepare graduates with a broad spectrum of expertise. The depth and breadth of expertise demonstrated by baccalaureate graduates must support the program educational objectives. The following curricular topics are required (unless the program's faculty and primary constituents approve the substitution of other specific, mechanically-related technical subjects supporting attainment of program educational objectives):

- a. Application of principles of geometric dimensioning and tolerancing;
- b. Use of computer aided drafting and design software;
- c. Perform selection, set-up, and calibration of measurement tools/instrumentation;
- d. Elements of differential and integral calculus;
- e. Manufacturing processes;
- f. Material science and selection;
- g. Solid mechanics (such as statics, dynamics, strength of materials, etc.);
- h. Mechanical system design;
- i. Thermal sciences (such as thermodynamics, fluid mechanics, heat transfer, etc.);
- j. Electrical circuits (ac and dc) and electronic controls;
- k. Application of industry codes, specifications and standards; and
- l. Technical communications typically used in preparation of engineering proposals, reports, and specifications.

For both courses, ET751 and ET791, under the ABET General Criteria, Student Outcomes (1), (3), and (5) have targeted assignments which are assessed to evaluate the program's Continuous Improvement Plan. See table below.

Summary of Student Outcome vs. Assessed Assignments	
Outcome (1) Apply knowledge/skills	Written reports: Project Proposal Final Project Report
Outcome (3) Communication	Oral reports: Design Reviews URC Presentation Literature Search
Outcome (5) Teamwork	Teamwork evaluation: Contribution effort Performance