East Tennessee State University Engineering Technology, Surveying, & Digital Media

ENTC 3600 - Manufacturing Technology - Fall 2022

Instructor	Mr. Bill Hemphill			
E-mail	hemphill@etsu.edu & etsuhemp@gmail.com			
Room	109C Wilson-Wallis Hall			
Phone	(423) 767-5254 Cell (primary voice contact)			
	(423) 439-7822 ETSU Voice (Dept. office)			
	(423) 439-7750 ETSU Fax			
Office Hours	Monday & Wednesday 8:30 – 9:10 a.m.			
	Tuesday & Thursday 8:35 – 9:30 a.m.			
	or by appointment (please contact by E-mail—see above)			
Web Site	https://elearn.etsu.edu/ (search for 'ENTC-3600-001' or '82901.202280')			
Course GAs	Holger Olesen			

Covid-19/SARS-CoV-2/Coronavirus Response

The pandemic is not 'over.' Please get fully vaccinated and boosted; please feel free to wear a mask or other appropriate face covering to class especially if you have been exposed (even if you are not experiencing symptoms). Getting vaccinated **and** wearing a mask that covers your nose and mouth communicates the care and respect you have for yourself, the care and respect you have for those you live with, and the care and respect you have for other members of this classroom community. The best evidence we have, from public health professionals, is that getting vaccinated provides protection from hospitalizations. Wearing masks is one of the best ways to protect against the spread of COVID-19 and its variants and other airborne illnesses. For the safety of your classmates, your instructor(s) and staff; if/when reported cases spike locally and you choose not to wear a mask, you may not be able to participate fully in team-based lab activities face-to-face. If you forget your mask the department will have a few available each day to distribute. Students with medical conditions that inhibit their ability to wear masks should register through disability services. Additional information including the revised Academic Calendar for the Fall 2022 semester is available at https://www.etsu.edu/coronavirus/.

I Course Description:

Manufacturing Technology (3 hours)—This course has as its primary emphasis the study of the management and production aspects of manufacturing. Students will have the opportunity to learn mass-production principles and methods, including the use of computers and robotics. Laboratory experiences will revolve around the design, planning, and mass production of an item. (Fall)

Prerequisite: ENTC 2200 (Machine Tool Technology).

Overview: This "milestone" type course integrates technologies, techniques and processes involved in the present-day manufacture of products extending from conceptual design through production to end-of-product-life methods. The course is designed as a design/prototype/build-type of High Impact Practices (HIP) experience integrating designing, planning, fabricating & managing engineering data configuration activities with an emphasis on safety. Students will have the opportunity to take one or more products from "art to part" incorporating 2D & 3D CADD modeling, manual woodworking, & CNC operations. Laboratory experiences will typically revolve around designing, prototyping, and building at least one musical instrument. As such, this course provides both theoretical and hands-on instruction and guidance in designing and fabricating a product of their choice—typically a solid body or semi-hollow body electric

Fall 2022

guitar or similar musical instrument. During the course, students will learn techniques and strategies for reverse engineering, designing, prototyping, and building playable musical instruments as well as the safe use of wood, polymer, and metalworking tools as well as safe shop practices and process planning. Because of the iterative processes involved in designing, prototyping & building a product, the student will develop engineering data configuration management practices including developing and following standards and documenting designs, processes & procedures.

Recommended Prerequisites: ENTC 2170 (CADD), ENTC 2310 (Electrical Principles), & ENTC 3710 (CNC Programming).

II Course Objectives

ETSU

As an outcome of the successful completion of the course, each student will have developed and demonstrated:

- Describing and following the safety precautions necessary in modern machine and woodworking shops.
- Setting up and safely operating common metalworking and woodworking machines and tools (e.g., powered, handheld, and computer-controlled).
- Developing and documenting a logical sequence of operations for designing, prototyping, fabricating, assembling, and finishing a product.
- Developing CADD drawings with product edge and exportable centerline toolpath data and efficiently importing and configuring 2D &/or 3D DXF files for CNC operations incorporating standardized file and CADD layer naming conventions.
- Reading electrical schematics, soldering components, and troubleshooting circuits.
- Working in teams to design, prototype, fabricate, assemble, and finish at least one "spec" product (e.g., guitar or musical instrument) for an outside client.
- **Note:** Course outcomes are in alignment with the following ABET Criterion 3.B.1. (1-3) and 3.B.2. (6a-e):
 - 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;
 - 6. Graduates must demonstrate the ability to apply the following to the solution of manufacturing problems to achieve manufacturing competitiveness:
 - a. materials and manufacturing processes;
 - b. product design process, tooling, and assembly;
 - c. manufacturing systems, automation, and operations; and
 - d. statistics, quality and continuous improvement, and industrial organization and management.
 - e. Graduates of baccalaureate degree programs must have a capstone or integrating experience that develops and illustrates student competencies in applying both technical and non-technical skills in successfully solving manufacturing problems.

III Required Texts and Materials

Required Texts:

Aikens, M. & Singer, T. (2010). Guitar primer. Dayton, OH: National Center for Manufacturing Education. Available URL: <u>http://www.collabnfab.org/resources/guitar_primer_v2.pdf</u>

- Aikens, M. & Singer, T. (2010). Exploring innovative STEM education through guitar design and manufacture workbook (Ver. 1006.1). Dayton, OH: National Center for Manufacturing Education. Available URL: <u>http://www.collabnfab.org/resources/final_workbook.pdf</u>
- French, M. & Harriger, B. (2010). Assembling an electric guitar, Ver. 1.0. West Lafayette: Purdue University. Available URL: <u>http://www.collabnfab.org/resources/assembling an electric guitar.pdf</u>
- **NOTE:** The above and other recommended instructional materials are available for free download through the Guitarbuilding.org's curriculum website at the following URL: <u>http://www.guitarbuilding.org/#!curriculum</u>.
- Stanton, George C. Numerical control programming. (Chapters 1 5). Johnson City: East Tennessee State Univ. Available URL: <u>http://faculty.etsu.edu/hemphill/entc3710/nc-prog/index.htm</u>
- Hemphill, W.K. & Stanton G.C (1997). Language Skills Handbook, (On-line Ed.), Johnson City, TN: East Tennessee State University. Available URL: <u>http://faculty.etsu.edu/hemphill/langskil</u>

Required Materials:

Eye Protection: A pair of safety goggles or safety glasses with side shields.

- Foot Ware: Close toe shoes only. Sandals, flipflops, "barefoot" running shoes are NOT appropriate; wearers will not be able to work or watch demonstrations in the lab.
- **Body Blank:** Students will be responsible for procuring/gluing up the wooden blank for their body design. Body blank typically run about 5.5 board feet of nominal dimensions 15½" W x 22" L x 2" THK. ETSU maintains a small supply of 8/4 (i.e., nominal 2") thick domestic hardwoods for those students who do not wish to purchase exotic or domestic hardwoods.
- Guitar Hardware & Electronics: Students will be responsible for specifying and purchasing hardware (e.g., hardtail bridge, tuning machines, knobs, string trees, etc.) and electronics (e.g., pickup(s), potentiometers, 3- switches, jacks, etc.). Ordering items in conjunction with other students and the instructor can result in significant savings as the ETSU Guitar Building project is often accorded significant discounted pricing (up to 50% off). Please work closely with your instructor regarding hardware and electronics.

Small Tools (available at local hardware/industrial supply stores or online):

Steel rule: full flexible, satin chrome finish, 6-inch, 5R graduation (10ths & 100ths one side, 32nds & 64ths other side).

Hex/Allen Wrenches: A set of standard (inch) hex keys (Allen wrenches) such as Eklin #91 may be purchased at local hardware stores. Purchase quality tools.

Notes:

As part of your departmental fees, standard "Strat-style," 6 in-line, pre-fretted necks (maple with rosewood fingerboards) from the STEM Guitar Project Storefront may be incorporated into your design; those necks will be provided upon request (L/H models are available).

"3 & 3" (Gibson) style necks are typically not available for the standard 25½" string length. Your instructor will assist you in adapting the standard 25½" string length CADD data to a shorter pre-fretted neck (typically moving the bridge and bridge pickup) and fitting the neck heel to the body's neck pocket. **Students are responsible for the costs incurred in using any neck other that those purchased from the Storefront.** Certain consumables (e.g., 2" foam blanks, standard router bits, sandpaper, finishing supplies, etc.) will be provided.

While normal wear & tear of tooling is expected & accommodated, damage to tools, tooling, and/or equipment caused by carelessness or neglect will be the responsibility of the appropriate students. If you screw something up, you are responsible for purchasing or building another. Best advice: Prototype early & often with forgivable materials.

Recommended Materials and/or Texts:

Covid-19 PPE: Appropriate PPE (e.g., a face mask or covering) may be worn when oncampus, especially indoors or in crowded areas. (See note above)

Caliper: A six inch (6") or eight inch (8") digital or dial caliper.

Micrometer: A zero-to-one inch (0 - 1") micrometer or digital micrometer.

- Coleman, E. & Erlewine, D. (2010). Fret Work Step-By-Step, 2/E. Athens, OH: Stewart-MacDonald. (Available URL: <u>http://www.stewmac.com/shop/Books, plans/Building and repair: Fretting/Fret W</u> <u>ork_Step-By-Step.html</u>)
- French, R.M. (2009). Engineering the guitar: Theory and practice. New York: Springer. ISBN 978-0-387-74368-4 (hardcover), ISBN: 978-0-387-74369-1 (E-book), or ISBN: 978-1-4419-4496-2 (softcover)

Valentino, J.V. & Goldenberg, J. (2008). Introduction to computer numerical control (4th Ed.). Upper Saddle River, NJ: Prentice Hall. ISBN-13: 9780132436908. [**Note**: A used 3rd Edition (ISBN-13: 9780130944245) of this text is also OK]

IV Attendance Policy

Attendance, as noted below, is counted for grading purposes. Accommodations will be made regarding campus access due to any/all Coronavirus/Covid-19 concerns. Students are expected to attend each offered class session in person/on campus &/or when offered on-line (AKA "Zoom class"). Attendance will be taken at some time during each class meeting. Absence at roll call is considered as absence for the entire period. Students are responsible for missed lectures. If you know you are going to be absent from class for an authorized University activity, please let the instructor know beforehand. When unexpected problems arise, contact the instructor by E-mail or phone as soon as possible.

Students are responsible for the material covered in all class sessions as well as all assignments. Exams and assignments may include any material covered in the lectures, assigned readings, classroom demonstrations or homework exercises. Demonstrations will not be repeated.

A test, exercise, or paper may be given (or submitted) early for a university-sponsored absence; please provide suitable notice, if possible. Make-up tests &/or assignments will be given at the discretion of the instructor; the student must present suitable documentation (evidence) explaining the emergency absence to the instructor.

Weather: Classes are seldom canceled; cancellation announcements will be made using text alerts & broadcast media. The University radio station is WETS, 89.5 FM.

Project success will depend upon individuals and team members showing up and actively participating in class during normally scheduled course meeting times. Students are expected to be "on station" before the class begins (i.e., in the classroom or already working in the lab(s)).

Parking on Campus

On-campus parking may be problematic throughout the semester. Some say "hellish" may be more apropos. Plan accordingly. When the campus is closed, parking is less problematic.

V Honor Code, Academic and Classroom Misconduct:

2018-19 ETSU Undergraduate Catalog, Student Conduct and Rights, Honor Code: "East Tennessee State University is committed to developing the intellect and ethical behavior of its students. Students found to be in violation of policies on plagiarism, cheating, and/or fabrication will be held accountable for their actions. Any knowledge of academic misconduct should be reported. Students are expected to act with honesty, integrity, and civility in all matters."

From the <u>ETSU Undergraduate Catalog</u>'s section on <u>Student Conduct and Rights, Student</u> <u>Disciplinary Policies</u>, Academic and Classroom <u>Misconduct</u>:

"(B) Plagiarism, cheating, and other forms of academic dishonesty are prohibited. Students guilty of academic misconduct, either directly or indirectly, through participation or assistance, are immediately responsible to the instructor of the class. In addition to other possible disciplinary sanctions which may be imposed through the university's academic misconduct policy because of academic misconduct, the instructor has the authority to assign an "F" or a zero ("0") for the exercise or examination, or to assign an "F" in the course."

For additional information, please see the ETSU Plagiarism Policy.

Use of Guitar Project CADD/CAM/CNC Data Files

Integral to the concept of the ENTC 3600 Manufacturing Technologies course is the use and incorporation of pre-existing design data elements, specifically the use of instructorprovided CADD data of various components and features, sample centerline tool paths, etc. As such, incorporating available data—provided with permission—does not constitute plagiarism **provided** that, if the data has information regarding licensing information, attribution requirements, and/or subsequent sharing information, the user will appropriately include such data in his/her data set(s) and will honor the spirit and intent of the information.

Copying &/or appropriating—without permission of the original file creator—another student's work and calling it your own is plagiarism. ETSU does not and will not tolerate this serious type of cheating. Sharing files with other students—outside the limitations set above—is itself an act of academic misconduct. Everyone caught sharing, copying &/or turning in nominally identical files as his or her own work effort will receive zero (0) points for that assignment. A second instance of cheating will result in failure of the class (F) for any/all students. All instances of plagiarism/academic misconduct will be documented and reported per university policies and procedures.

In situations involving allegations of plagiarism, inappropriate file sharing, or wholesale use of existing work effort without individualism or customization; the instructor reserves the right to require any student(s) to resubmit one or more similar assignment(s)—with

ETSU

appropriate modifications—to demonstrate proficiency, understanding and competence.

VI Evaluation and Grading

It is expected that the **student** will accept the primary responsibility for achieving the course objectives and will **through self-initiative** complete **all** assignments. This includes demonstrating that an acceptable level of data customization has been completed.

Description	Points	Percentage
Laboratory work—Individual Guitar(s)/Project(s)	150 points	75%
Attendance & Participation	25 points	12.5%
On-time Assignments, Quizzes, Reports, etc. (weighted)	25 points	12.5%
Total:	200 points	100%
a) Incomplete project (significant effort demonstrated)	(80 points)	(37.5%)
b) Project is not submitted or no demonstrated effort	(0 points)	(0%)

Minimum Percentage Score for Grades:

		А	93%	A-	90%
B+	87%	В	83%	B-	80%
C+	77%	С	73%	C-	70%
D+	67%	D	63%	D-	Below 60%

A test, exercise, or paper may be given (or submitted) early for a University sponsored absence (please provide suitable notice, if possible). Make-up tests may be given at the discretion of the instructor and only if a student presents suitable documentation (evidence) explaining the (emergency) absence to the instructor.

Quizzes and exams may include any material covered in the lectures, assigned readings, videos, classroom discussions or exercises.

Students with documented needs for note taking, test taking, or other classroom accommodations should make arrangements with the instructor early in the term. Contact the ETSU Disability Services Voice: (423) 439-8346; Fax: (423) 439-8489; TDD: (423) 439-8370 URL: https://www.etsu.edu/students/ds

VII. University and Departmental Facilities

Students may work in labs only in the presence and under the supervision of a state employee (faculty member or graduate assistant). Students may never work alone. The dates and times of additional laboratory access will be posted during the term. The University's Syllabus Attachment page is available on-line at the following URL:

https://www.etsu.edu/curriculum-innovation/syllabusattachment.php.

To log onto any University PC or the "ETSU" network, you must know & use your ETSU user/E-mail name and password. If you need assistance, please contact the ETSU Office of Information Technology Services' <u>ITS Help Desk</u>, call at (423) 439-4648 or E-mail them at <u>itshelp@etsu.edu</u>. As access to the department's PC labs may be limited, it is suggested that, for computer work other than CADD, you consider using PC labs on the main campus. For information on location and operating hours of other University computer labs, visit the ITS Help Desk web site at <u>https://www.etsu.edu/helpdesk/default.php</u>.

Public Safety & Emergency Preparedness

Information regarding public safety and emergency preparedness at ETSU is available at the following URL: <u>http://www.etsu.edu/safety/</u>. Students should become familiar with ETSU's general emergency procedures (URL: <u>https://www.etsu.edu/safety/emergency_preparedness/</u>) and install the ETSU Safe Mobile App (URL: <u>https://www.etsu.edu/safety/etsu_safe.php</u>).

With recent changes in Tennessee law, a small, limited population of faculty and/or staff is authorized to carry **concealed** firearms for individual self-defense in certain parts of campus. An authorized weapon must remain appropriately concealed and in control (i.e., on the body or a carried item such as a purse) of the individual always.

You are encouraged to report any weapon &/or suspicious activity as soon as possible to ETSU Public Safety at (423) 439-4480 or using the confidential, on-line Bucs Report It/Silent Witness Form at https://www.etsu.edu/dps/bucsreportit.php. The general rule holds: **If you see something, say something!**

VIII. Food, Drinks, and Tobacco Products

Food, drinks, and the use of tobacco products (of any type) are never permitted in any of the University labs. Heavily caffeinated beverages may be consumed during the really boring lectures; please be careful and clean up after yourself.

Tobacco products of all types are no longer permitted on campus*. Tobacco is bad for you; any/all types can and will eventually kill you. You have been warned; don't play cute. Resistance is futile. (*except, of course, in your own vehicle in a designated parking area)

IX. Guitar Materials & Components: Kits vs. "Roll your own"

The ETSU Guitar Project has partnered with the National STEM Guitar Project (URL: <u>http://www.guitarbuilding.org/</u>) of the National Center for Manufacturing Education (NCME). Complete or partial kits (e.g., electronics and hardware only) are available for reduced pricing (versus commercially available guitar kits) through their storefront (URL: <u>http://guitarbuilding.org/store/</u>). As noted earlier, **NCME's "full guitar" kits are configured differently than ETSU's current guitar body/neck designs, specifically in regards to the style of truss rod and geometry of the neck heel/neck pocket**.

ETSU has a mechanism for ordering these kits via the local student SME chapter. Early in the semester, your instructor will be coordinating the purchase of numerous components and/or kits via the Society of Manufacturing Engineers (SME). Purchasing guitar components with your own credit card through your instructor may save you significant money. Of course, you are liberty to purchase some or all of your materials directly through the NCME &/or local or Internet-based vendors (e.g., wood for bodies, fretboards &/or necks; pickups, tuning machines, etc.) and/or via the instructor and materials on hand at the University.

Other students desire to order their own components through local and/or on-line vendors. Students ordering through ETSU—with their own credit cards—can get a 50% discount from All Parts and sometimes or discounts from periodic sales or educational discounts.

Students are encouraged to

- limit their customization efforts to choices of wood, body type and style, electronics placement and pocket design, and headstock shape;
- stick to the standard NCME design: six string solid or semi-hollow body, nontremolo style bridge, dual humbuckers, and headstock with either 6 in-line or 3+3 headstock;
- embellish via laser engraving &/or dyed pourable polyesters; and
- keep it simple.

If you choose hardware and/or components outside the limited types and styles of hardware and/or electronic components used in "standard" guitars, please note that you are responsible for ensuring the playability and functionality of the guitar.

The goal of this class is to design, prototype and fabricate playable guitars as a mechanism for learning about the processes involved in product design and manufacturing and staying on top of evolutionary changes in the engineering documentation.

If you want to own and play a Les Paul, Strat, Tele, or whatever please, buy a **real** Les Paul, Strat, Tele, or whatever.

Machine Tool & Wood Technologies Laboratories Procedures and Rules:

All students are expected to exercise caution with respect to the health and safety of themselves and others. When in class or in the lab for an activity or demonstration, the following procedures and regulations are to be observed at all times:

- If you are not certain that what you are doing is a safe procedure, then **DON'T DO IT**! Ask an instructor—that's what they are here for!
- Safety goggles or safety glasses with side shields must be worn whenever you are in the laboratory. This is a state law as well as a part of the federal Occupational Safety and Health Act (OSHA) wherein **EMPLOYEES** as well as employers can be heavily fined for unsafe practices.

Students without eye protection will not be permitted in the laboratory until eye protection is secured.

- **NEVER WORK ALONE.** Always ensure that someone is available and aware that you are working in the lab.
- A state employee (e.g., faculty member, knowledgeable Graduate Assistant, full time departmental staff member, etc.) **MUST** be present for you to operate any powered machine tool(s) in the laboratory.
- Report all injuries (no matter how minor) to your instructor—to protect yourself.
- Scuffling, "horse-play," and "practical" jokes are considered to be the acts of idiots and are not tolerated in the laboratory.
- Excessively long hair can be hazardous around machinery and must be restrained.
- Be certain all safety devices and guards are in place and operational. **Do not operate** unguarded machines.
- Never blow compressed air towards another person.
- Only one person should be operating a machine at any one time.
- Be certain the work piece and cutter are securely and safely mounted in your machine. If you are not certain, ask your instructor to check your setup.
- Keep your fingers away from revolving cutters and work.
- **NEVER** operate a machine while wearing gloves. The glove could become caught in the machine and pull your hand or arm into the machine.
- **NEVER** leave a running machine unattended.
- Always stop a machine when needing to make adjustments, take measurements, remove chips, or lubricate; keep loose tools from accumulating on the machine.
- Use a brush (or pliers) to remove chips (never your hands).
- Roll up your sleeves and remove all rings, watches, bracelets, necklaces, neckties, or anything else that might conceivably become caught in a machine.
- Do not leave chuck keys in a chuck (lathe or drill press), even for an instant.
- **NEVER** operate or be in the vicinity of rotating equipment if you are under the influence of any prescription medications or recreational pharmaceutical substances that alter your mood &/or affect your judgment, balance, wakefulness, etc. If you are in a compromised state, inform your instructor that you are unable to participate in the class or lab activity. Likewise, if you are suspected of being under the influence, you will be asked to leave the lab area for your safety and the safety of your fellow classmates.
- Lift heavy objects safely, preferably using mechanical devices. If you MUST be a hero and lift manually, at least do it correctly. Lift with the legs, keeping the spine vertical. Remember, spinal injuries are permanent—they never completely heal.

Rules & Guidelines for Departmental Rooms & Computer Labs:

- Food or drinks are not to be consumed in the classroom or the lab areas. (Note: Bottled water may be brought into room; keep a lid on it.) The classroom, lab, & break areas must be kept clean at all times; please clean messes when you leave.
- No tobacco products—of any type—may be consumed; ETSU is a tobacco-free campus.
- Computer Files: Save and save often. Save on at least two different physical media: i.e., one hard drive (typically, on the STUDENT drive or folder) & at least one removal media (e.g., USB drive, E-mail attachment, CD-R, etc.). Hard drives may be purged or reformatted anytime.
- No unauthorized personnel (e.g., girl or boyfriends, significant others, children, roommates, etc.) are allowed in the computer, machine tool or other labs.
- Do not give the door combination, usernames, &/or passwords to anyone.
- Be respectable of others when using the external speakers. It is strongly recommended that you bring your own headphones or ear buds.
- Follow all directions when submitting assignment files electronically.
- Store your files on the lab machines at your own risk. All temporary files are typically deleted on log-out. All data files are subject to erasure after the last semester final is given.
- Students may never install any software on any lab machine.
- Do not change desktop settings or screen savers. Store any desktop icons and shortcuts in your user-account directory.
- Do not remove or install equipment (e.g., personal laptops) to the network. Use the campus-wide wireless connectivity provided through ITS.
- Do not illegally copy software.
- No viewing or downloading pornographic materials in the lab; ETSU's Acceptable Use Policy is applicable for all usage of PCs and University-related E-mail account(s).
- Do not lock the computers for more than 15 minutes (i.e., bathroom breaks are acceptable but don't go to lunch and expect to return to the same computer.
- Do not turn the machines off. Log out and power down the monitor when finished.
- Promptly report any problem(s) to your instructor, to Ms. Loretta Fritz (<u>mbradley@etsu.edu</u>) or the technical support workers. When reporting difficulties, please note the machine name, the nature of the problem, and any out of the ordinary events, error messages, etc. Use the "Fault Report" logs when available.
- It is a **REALLY GOOD IDEA** to place a "Contact_Info.txt" file containing your name, E-mail(s) and cell &/or home phone numbers in the root directory of each of your USBs.
 A. Really. Good. Idea.
- Remember that project data is a shared resource; please don't be stupid and inconsiderate. For instance, when using the "AXYZ computer," use the appropriate class folder on the C: drive to store class files. Files stored on the desktop are subject to random erasure. Also, if you chose to work from a USB drive, not only are you are flirting with disaster but, in the advent of your absence, team members cannot access your latest work file(s).

ETSU